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July 29, 2014

Ms. Jessica Wooley, Interim Director
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 S. Beretania Street, Room 702
Honolulu, Hawai'i 96813

'14 JUL 29 P4:10

Dear Ms. Wooley:

SUBJECT: Draft Environmental Assessment for Kamehameha Schools Kahalu'u Ma Kai Project
TMK: (3) 7-8-013:002, 013, 042 & 043; Kahalu'u, North Kona, Hawai'i

With this letter, the County of Hawai'i Planning Department hereby transmits the draft environmental assessment and anticipated finding of no significant impact (DEA-AFONSI) for the proposed Kamehameha Schools Kahalu'u Ma Kai Project situated at TMK:(3) 7-8-013:002, 013, 042 & 043 and located in the North Kona District on the Island of Hawai'i for publication in the next available edition of the Environmental Notice.

Transmitted via separate cover is the completed OEQC Publication Form, two copies of the DEA-AFONSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word.

Please call Daryn Arai of the Hawai'i County Planning Department at (808) 961-8142 or Ronald Sato of HHF Planners at (808) 457-3172 should there be any questions.

Sincerely,

DUANE KANUHA
Planning Director

DSA:klt
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cc: Mr. Ronald Sato, AICP, HHF Planners, 733 Bishop Street, Honolulu 96813
Planning Department, West Hawai'i Division

APPLICANT ACTIONS
SECTION 343-5(C), HRS
PUBLICATION FORM (JANUARY 2013 REVISION)

Project Name: Kamehameha Schools Kahalu'u Ma Kai Project
Island: Hawai'i
District: Kahalu'u, North Kona
TMK: (3)7-08-013: 002, 013, 042, and 043
Permits: USACE Nationwide Permit, State DOH 401 WQC, DOH NPDES, Construction Noise, DLNR Special Permit, CZM Consistency Determination, County SMA Permit, Plan Approval, Construction (Grubbing/Grading & Building)

Approving Agency: Planning Department
County of Hawai'i
101 Pauahi Street, Suite 3
Hilo, Hawai'i 96720
Mr. Daryn Arai
(808) 961-8288

Applicant: Kamehameha Schools
Land Assets Divison – West Hawai'i
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Mr. Allen Salavea, Land Planning & Entitlements Manager
(808) 322-5321

Consultant: HHF Planners
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Mr. Ronald Sato, AICP, Associate
(808) 457-3172

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'14 JUL 29 P3:20
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

Status (check one only):

_X_DEA-AFNSI — Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of DEA, a completed OEQC publication form, along with an electronic word processing summary and a PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov; a 30-day comment period ensues upon publication in the periodic bulletin.

__FEA-FONSI — Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and a PDF copy (send both summary and PDF to oeqchawaii@doh.hawaii.gov; no comment period ensues upon publication in the periodic bulletin.

__FEA-EISPN — Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov; a 30-day consultation period ensues upon publication in the periodic bulletin.

__Act 172-12 EISPN — Submit the approving agency notice of determination on agency letterhead, an OEQC publication form, and an electronic word processing summary (you may send the summary to oeqchawaii@doh.hawaii.gov. NO environmental assessment is required and a 30-day consultation period upon publication in the periodic bulletin.

__DEIS — The applicant simultaneously transmits to both the OEQC and the approving agency, a hard copy of the DEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the DEIS (you may send both the summary and PDF to oeqc@doh.hawaii.gov); a 45-day comment period ensues upon publication in the periodic bulletin.

__FEIS — The applicant simultaneously transmits to both the OEQC and the approving agency, a hard copy of the FEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the FEIS (you may send both the summary and PDF to oeqc@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.

__ Section 11-200-23 Determination — The approving agency simultaneous transmits its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS to both OEQC and the applicant. No comment period ensues upon publication in the periodic bulletin.

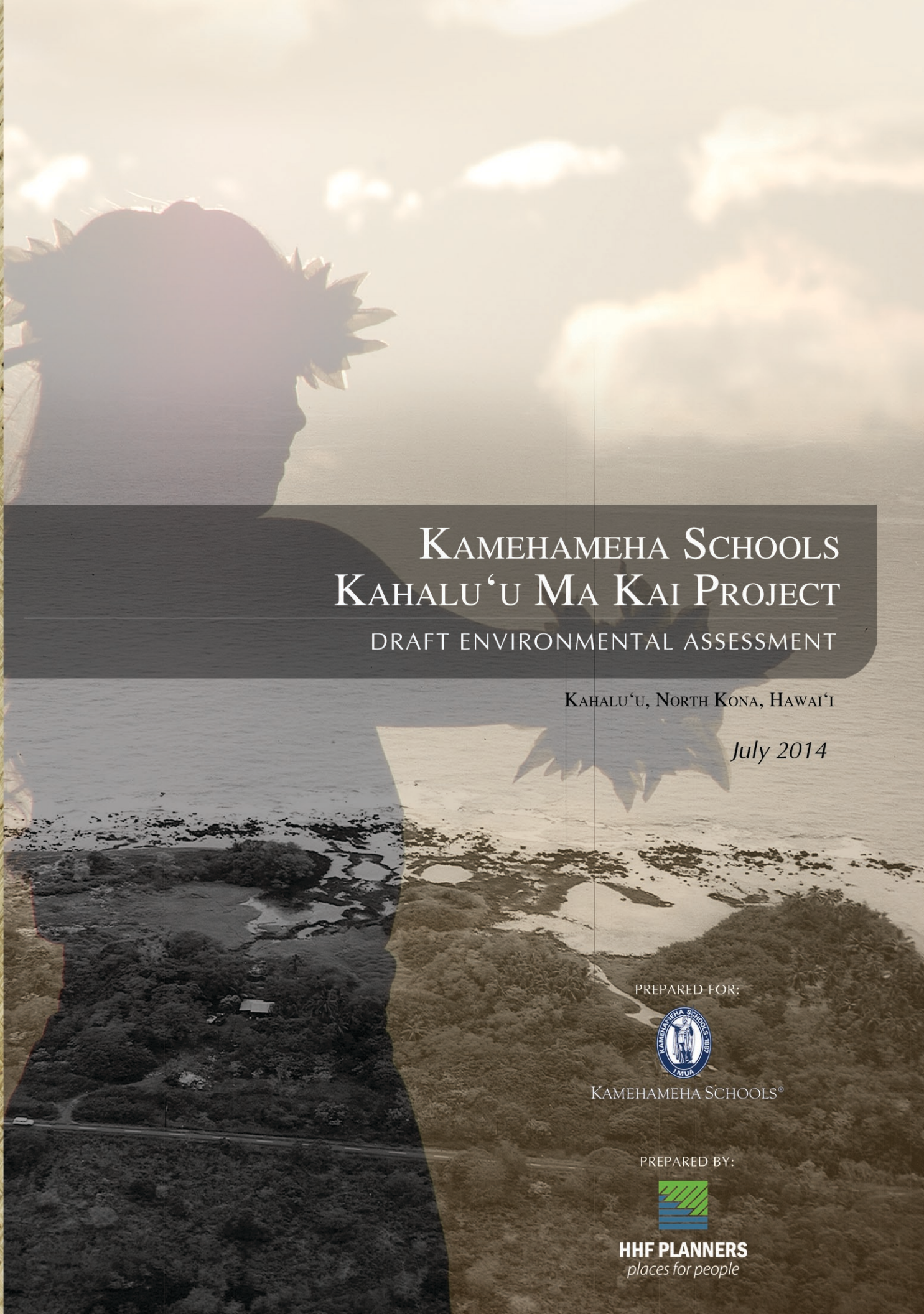
__Statutory hammer

Acceptance	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it failed to timely make a determination on the acceptance or nonacceptance of the applicant's FEIS under Section 343-5(c), HRS, and that the applicant's FEIS is deemed accepted as a matter of law.
__Section 11-200-27 Determination	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is not required. No EA is required and no comment period ensues upon publication in the periodic bulletin.
__Withdrawal (explain)	

Summary (Provide proposed action and purpose/need in less than 200 words. Please keep the summary brief and on this one page)**:**

Kamehameha Schools (KS) is proposing the Kahalu‘u Ma Kai Project to establish an educational complex on its property located in the Kahalu‘u Ahupua‘a on the Island of Hawai‘i. Establishment of this educational complex would require: 1) the demolition of the former Keauhou Beach Resort hotel and remnant Kona Lagoon Hotel facilities; 2) construction of several new structures on the property; and 3) continued restoration and preservation of historic sites. The project site consists of 22.73 acres of a shoreline property located at the southern end of Kahalu‘u Bay.

The purpose of this project is to facilitate KS's mission by restoring a historically and culturally significant property, and in the process support ‘āina-based educational and the culture-based instructional approach in West Hawai‘i. The cultural education vision for this property is to provide a place for the teaching and learning of applied Hawaiian knowledge that supports the development of 21st century skills. The proposed change in land use reflects a much lower intensity of development, and changes activities occurring on the site from being visitor-oriented to primarily educational-oriented.



Kamehameha Schools Kahalu'u Ma Kai Project

DRAFT ENVIRONMENTAL ASSESSMENT

Kahalu'u, North Kona, Hawai'i

July 2014

PREPARED FOR:

Kamehameha Schools®

PREPARED BY:

HHF PLANNERS
places for people

Kamehameha Schools Kahalu'u Ma Kai Project

DRAFT ENVIRONMENTAL ASSESSMENT

Kahalu'u, North Kona, Hawai'i

July 2014

PREPARED FOR:

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APPENDICES

Appendix

APPENDIX A.....Pre-Assessment Consultation

Pre-Assessment Consultation Comments and Responses

APPENDIX B ..... Botanical Survey

Botanical Survey of Kahalu‘u Ma Kai Project Area; Island of Hawai‘i (March 2014)
Prepared by: Geometrician Associates, LLC.

APPENDIX C ..... Avian and Terrestrial Mammals Survey

Avian and Terrestrial Mammalian Species Surveys Conducted for the Kahalu‘u Ma Kai Project, North Kona District, Island of Hawai‘i (October 2013)
Prepared by: Rana Biological Consulting, Inc.

APPENDIX D ..... Air Quality Study

Air Quality Study for the Proposed Kahalu‘u Ma Kai Project (March 2014)
Prepared by: B.D. Neal and Associates

APPENDIX E .....Noise Study

Environmental Noise Assessment Report; Keauhou Beach Resort Demolition and Kahalu‘u Ma Kai Development (March 2014)
Prepared by: D.L. Adams Associates

APPENDIX F.....Marine and Water Quality Study

Assessment of the Marine Water Chemistry and Biotic Community Structure; Kamehameha Schools Kahalu‘u Ma Kai Project (April 2014)
Prepared by: Marine Research Consultants, Inc.

APPENDIX G .....Archaeological Inventory Survey

Draft Archaeological Inventory Survey for the Kahalu‘u Ma Kai Project, Kahalu‘u Ahupua‘a, North Kona District, Island of Hawai‘i; Volumes 1 and 2 (May 2014)
Prepared by: Cultural Surveys Hawai‘i, Inc.

APPENDIX H.....Cultural Impact Assessment

Final Cultural Impact Assessment for the Kahalu‘u Ma Kai Project, Kahalu‘u Ahupua‘a, North Kona District, Island of Hawai‘i (May 2014)
Prepared by: Cultural Surveys Hawai‘i, Inc.

Appendix

APPENDIX I ..... Preliminary Engineering Report

Kahalu‘u Ma Kai Preliminary Engineering Report (January 2014)
Prepared by: Belt Collins Hawaii, LLC.

APPENDIX J ..... Traffic Impact Analysis Study

Traffic Impact Analysis Report; Kahalu‘u Ma Kai Redevelopment (March 2014)
Prepared by: Austin, Tsutsumi and Associates, Inc.

CHAPTER 1
INTRODUCTION AND BACKGROUND

Kamehameha Schools (KS) is proposing to establish an educational complex on its property located in the Kahaluʻu Ahupuaʻa on the Island of Hawaiʻi. Establishment of this educational complex would require: 1) the demolition of the former Keauhou Beach Resort hotel and remnant Kona Lagoon Hotel facilities; 2) construction of several new structures on the property; and 3) continued restoration and preservation of historic sites. This project is referred to as "Kahaluʻu Ma Kai," and this Environmental Assessment is being prepared to support land use entitlements for its implementation.

The project site consists of 22.73 acres of a shoreline property located at the southern end of Kahaluʻu Bay and bordered by Aliʻi Drive on the inland (mauka) side. This property was formerly the site of the Kona Lagoon Hotel (KLH) before it was demolished in 2004, and the Keauhou Beach Resort (KBR) that closed in October 2012. Table 1.1 provides a summary of pertinent project information.

1.1 PURPOSE FOR ENVIRONMENTAL ASSESSMENT

This project triggers the State of Hawaiʻi's (State) environmental review process under Chapter 343 (Environmental Impact Statements), Hawaiʻi Revised Statutes (HRS), as amended, because the project involves:

1. Use within a historic district. The entire project site is within the Kahaluʻu Historic District (SIHP No. 50-10-37-4150) that is listed in the National Register of Historic Places (National Register); and
2. Demolition activities within a state-owned property extending makai (seaward) of the shoreline that is also within a historic site (Kahaluʻu Historic District) listed on the National Register.

The project area is also situated within the County's Special Management Area (SMA), and re-development of the site requires a SMA Use Permit from the County Planning Commission. Under the County's Rule 9 (Special Management Area), and after consultations with the County Planning Department, compliance with the State's environmental review process is also required.

Applicant and Approving Agency

HHF Planners (HHF) is serving as the "Authorized Agent" on behalf of KS (Applicant) in the preparation of this Draft Environmental Assessment (Draft EA). The project is an "Applicant Action" under the State's environmental review regulations because KS is the proposing entity. The County Planning Department will serve as the "Approving Agency" processing the environmental assessment document.

Table 1.1
Summary of Project Information

Project Name:	Kamehameha Schools Kahaluʻu Ma Kai Project
Accepting Authority: State Chapter 343, HRS	Planning Department County of Hawaiʻi 101 Pauahi Street, Suite 3 Hilo, Hawaiʻi 96720 Telephone: (808) 961-8288 Contact: Mr. Daryn Arai, Planning Program Manager
Preparers of Environmental Assessment:	HHF Planners 733 Bishop Street, Suite 2590 Honolulu, Hawaiʻi 96813 Telephone: (808) 457-3172 Contact: Mr. Ronald A. Sato, AICP, Associate
Project Location:	The project is located on the west side of the Island of Hawaiʻi along the Keauhou-Kahaluʻu coastline next to (south of) Kahaluʻu Bay. The site is the former location of the Kona Lagoon Hotel (previously demolished) and the recently closed Keauhou Beach Resort.
Tax Map Key Parcels:	(3) 7-08-013: 002, 013, and 043; (3) 7-08-013: 042 (State Property).
Project Area:	22.73 acres
Existing Use:	The southern half of the project site (former Kona Lagoons Hotel) is presently used by KS for educational and cultural programs. The northern half of the property is currently unused and consists of the hotel and associated amenities of the KBR which closed in October 2012.
State Land Use District:	Urban District
County General Plan (LUPAG)	Resort Node and Open Area
Communities Plan Land Use Designation:	Kona Community Development Plan: Project site is located within Kona Urban Area.
Special Management Area:	Project site is within the County's SMA boundary.
County of Hawaiʻi Zoning District:	V-.75, Resort-Hotel District (750 sf area / unit)
Flood Zone Designation:	Zone VE – Coastal flood zone with velocity hazard (wave action); Zone AE – 100-year flood zone (base flood elevation determined); Zone X – Areas outside the 500-year flood.

This Draft Environmental Assessment (Draft EA) was prepared pursuant to Chapter 343, Environmental Impact Statements, Hawaii Revised Statutes (HRS), as amended (State of Hawai‘i, 2007) and Title 11, Chapter 200 (Environmental Impact Statement Rules) of the State Department of Health's Hawaii Administrative Rules (HAR), as amended (State of Hawai‘i, 1996). A Finding of No Significant Impact (FONSI) is anticipated for this project.

Pre-assessment consultation was conducted with various agencies and community organizations under the environmental review process, which are discussed in more detail in Chapter 6. Copies of comment letters received from consulted parties and responses to them are included in Appendix A.

1.2 APPLICANT BACKGROUND

Kamehameha Schools

Kamehameha Schools (KS) is a private charitable educational trust endowed by the will of Princess Bernice Pauahi Bishop to support an educational system serving more than 47,000 learners in Hawai‘i and across the nation. KS's mission is to fulfill Princess Pauahi's desire to create educational opportunities in perpetuity to improve the capability and well-being of children of Hawaiian ancestry. KS operates an educational system serving over 6,900 students of Hawaiian ancestry at Kindergarten through 12th grade campuses on O‘ahu, Maui and Hawai‘i island, and at 30 preschool sites statewide. KS also extends its educational reach into the community to serve more than 40,000 additional learners through a range of programs and community collaborations such as public charter school support and literacy enhancement programs for public school children.

KS Educational Groups

KS has an ´Āina-Based Education Division that develops and implements strategic community partnerships to deliver ´āina-based learning experiences to students and families on KS-owned lands, statewide. The Keauhou-Kahalu‘u Education Group (KKEG) is part of that division, and provides ‘āina-based education and culture-based instruction specifically at the project site.

KKEG works to provide learning opportunities to students, teachers, community members, and visitors through a series of interactive programs and lectures. Educational partners include the State of Hawai‘i Department of Education, University of Hawai‘i, KS campus and enrichment programs, a variety of private education organizations, and non-profit organizations within the Keauhou and Kahalu‘u communities.

The Keauhou and Kahalu‘u ahupua‘a both possess unique natural and cultural resources that have exceptional educational value. Therefore, the Kahalu‘u Ma Kai Project would provide the opportunity to integrate education, land-stewardship, culture, and community-building. This would be achieved by facilitating access to these resources *in situ*, rather than relying on traditional in-classroom teaching methods. The KKEG, along with other KS educational and cultural partners, would thus benefit from this project.

1.3 PROJECT LOCATION

The Kahalu‘u Ma Kai project is located on the west side of the Island of Hawai‘i along the Keauhou-Kahalu‘u coastline next to (south of) Kahalu‘u Bay. This property is located within the Kahalu‘u ahupua’a of the Island of Hawai‘i. Figure 1.1 is a location map showing the project site.

1.3.1 Project Vicinity and Surrounding Uses

The project site is situated within the Keauhou Resort area, which is a 2,400-acre fully integrated destination resort community that is located about five miles south of Kailua-Kona, and extends into the ahupua‘a of both Kahalu‘u and Keauhou. This resort area includes the Sheraton Kona Resort and Spa at Keauhou Bay, the Keauhou Shopping Center, the Kona Country Club (two golf courses), and various timeshare, residential and resort condominiums, and single-family residences. These lands also hold some of Hawaii’s most culturally significant sites such as the Kahalu‘u Ma Kai property that has five heiau present on that property alone.

Vehicular access to this project area is by Kuakini Highway and Ali‘i Drive which generally run in a north-south direction in the region. Kuakini Highway is a State highway that is part of the Hawai‘i Belt Road (SR-11) situated about one mile inland from the coastline, and serves as the main vehicular access through this area. Ali‘i Drive is a County collector roadway generally routed along the coastline from Kailua-Kona to about one mile south of the project site. Within the project area, Kamehameha III Road is a County road connecting Kuakini Highway with Ali‘i Drive providing mauka to makai access.

The vicinity of the project site can be generally characterized as being more rural having lower density single-family residences developed on the slopes above (mauka) Kuakini Highway. Developed areas below (makai) this highway down to the shoreline are predominantly visitor-oriented uses as shown on Figure 1.1. The area immediately mauka (east) and north of the project site up to Kuakini Highway is largely undeveloped. A large residential subdivision, consisting of Ali‘i Heights, Ali‘i Heights Mauka, and Keauhou View Estates, is located further north of the project area.

The County’s Kahalu‘u Beach Park at Kahalu‘u Bay is located immediately north of the project site. The Keauhou-Kona Surf and Racquet Club is a visitor-oriented residential community located immediately south of the project site. Figure 1.2 is a vicinity map showing major roadways along with existing surrounding uses. Ali‘i Drive borders the eastern (mauka) end of the shoreline portion of the project site.

Source: State of Hawai'i GIS Data and Google Earth Pro - 3/3/2014

KAHALU'U MA KAI

Figure 1.1 - Project Location Map

Kahalu'u, Hawai'i

0 1,150 2,300 FEET

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Source: State of Hawai'i GIS Data and Google Earth Pro - 3/3/2014

Kahalu'u Ma Kai

Figure 1.2 - Project Vicinity Map

Kahalu'u, Hawai'i

0 175 350 FEET

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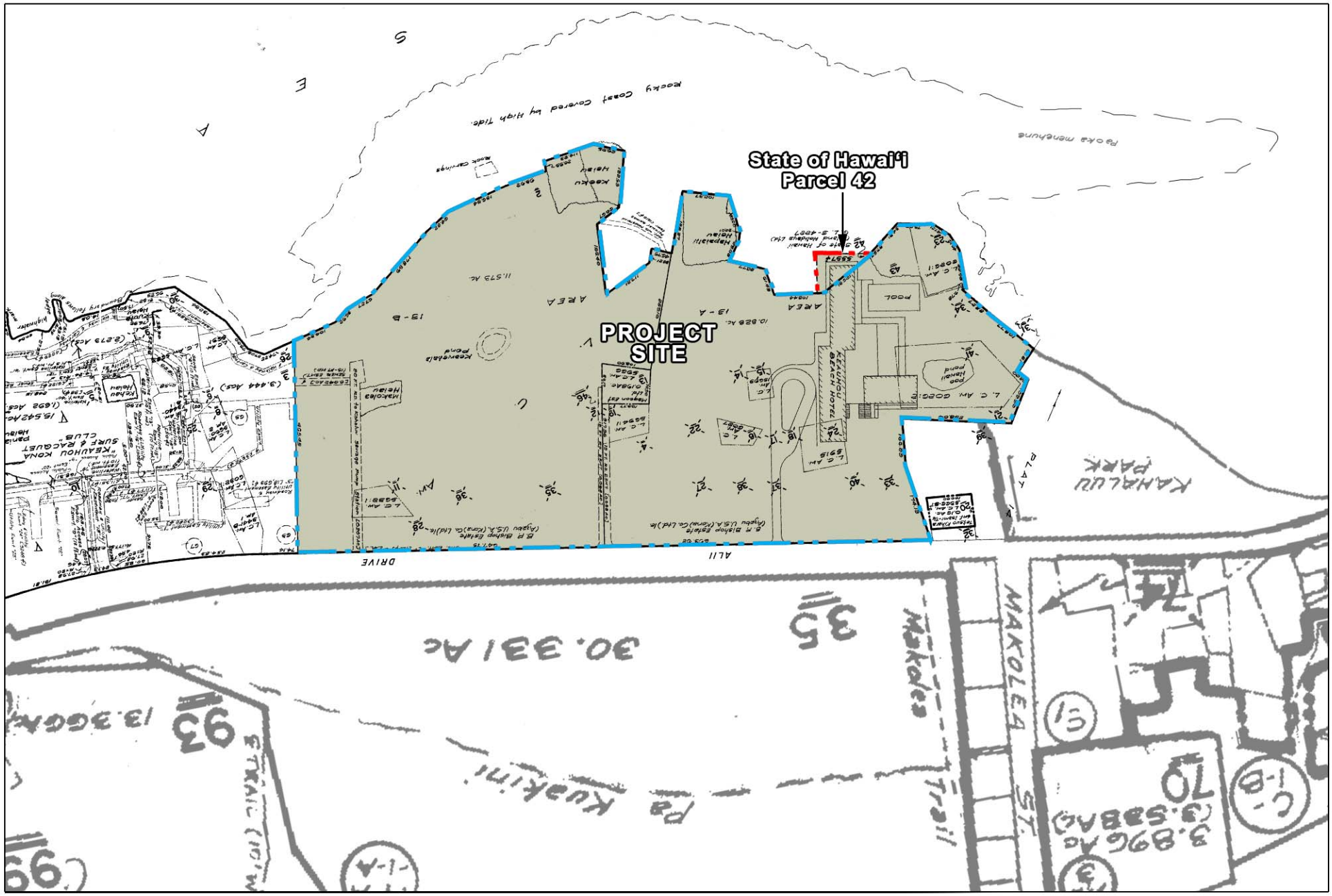
An existing parking lot with a building used by the Royal Order of Kamehameha is located along Ali‘i Drive across the project site. This parking lot and associated property mauka of Ali´i Drive is owned by KS. Makolea Street forms an unsignalized intersection with Ali‘i Drive at the northern end of the project site. Condominium developments (The Beach Villas at Kahalu‘u and The Makolea) are located at this intersection adjacent to the parking lot.

1.3.2 Property Information

The project site is comprised of three parcels that are owned by KS, and one additional parcel that is owned by the State of Hawai‘i. The Tax Map Key (TMK) for the three parcels (22.60 acres) owned by KS are: (3) 7-08-013: 002, 013, and 043. TMK (3) 7-08-013: 042 (referred to as Parcel 42) is a small parcel of about 0.13 acres (5,557 square feet) owned by the State of Hawai‘i. Figure 1.3 shows the Tax Map for these parcels.

Parcel 42 is a non-exclusive term building easement (GLS 5963) first granted in 1969 to KS by the State, and is under the jurisdiction of the State Department of Land and Natural Resources (DLNR). This easement includes the portion of the existing KBR hotel structure that extends beyond (makai) the shoreline and into the tide pools. After demolition of the hotel, the easement for Parcel 42 will be terminated because it will no longer be required. Existing structures within Parcel 42 will be removed and restored as close as possible to the original condition based upon consultation with the State DLNR, Land Division. Therefore, after demolition of the KBR hotel, the resulting net project area would ultimately be 22.60 acres. A summary of these parcels in relation to the ultimately completed project site is provided.

Tax Map Key Parcels	Parcel Acreage	Project Area (Completed)
Kamehameha Schools		
(3) 7-08-013: 002	11.573 acres	11.573 acres
(3) 7-08-013: 013	0.198 acres	0.198 acres
(3) 7-08-013: 043	10.828 acres	10.828 acres
State of Hawai‘i		
(3) 7-08-013: 042	0.128 acres	0.000 acres (Terminated)
Total	22.727 acres	22.599 acres



Kahalu'u Ma Kai

Figure 1.3 - Tax Map Key

Kahalu'u, Hawai'i

0 175 350 FEET

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1.3.3 General Site Conditions

The project site is somewhat rectangular in shape as it extends makai from Ali‘i Drive down toward the shoreline. Elevations at the site vary from about 25 feet above mean sea level at Ali´i Drive gently sloping down to sea level along the shoreline. A large complex of tide pool exists fronting the property. The project site was extensively altered by the construction of the KBR and the former KLH. The KLH was demolished in 2004, and the KBR closed in October 2012. Over the last seven years, KS has been actively restoring historic sites and re-establishing the cultural landscape that previously existed. Exhibit 1.1 shows an oblique aerial photo of this area.

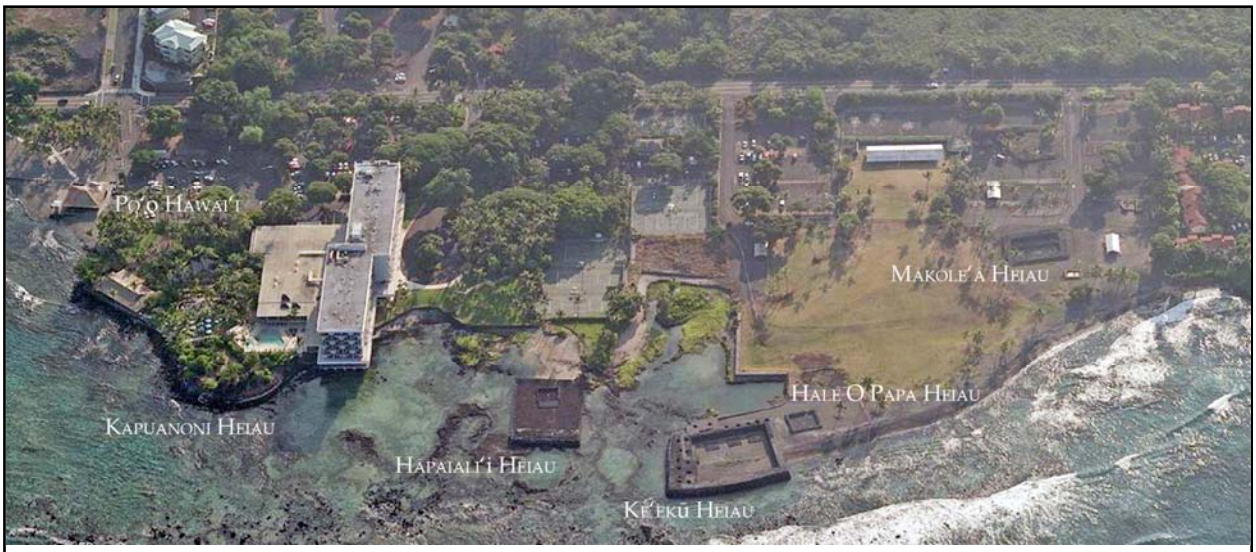


Exhibit 1.1. Oblique Aerial View of the Kahalu‘u Ma Kai Project Site

The area of the former KLH on the southern half of the property is now characterized by a large lawn and temporary tent structures used to support existing ‘āina-based educational and cultural programs conducted at the site. Large paved parking areas are still present, along with the Mākole‘ā Heiau, and a sewer pump station on the southern end. A small strip of sandy beach about 600 feet in length (Mākole‘ā Cove) is also present along the southern shoreline of this property. Exhibit 1.2 shows an oblique aerial photo of this particular area.

The northern portion of this area consists of the now closed KBR and associated facilities. Resort structures still present on site include the main KBR hotel, an underground parking structure, a former snack bar and restaurant known as Kalani Kai (former Restaurant Kai) in the northern corner, a modern era replica of the Kalākaua Cottage, and the tennis courts complex. Exhibit 1.3 includes an oblique aerial view of this northern area. Historic sites present within this northern half of the property include Hale O Papa Heiau, Ke‘ekū Heiau, Hāpaiali‘i Heiau, Po‘o Hawai‘i pond, and the remnants of the Kapuanoni Heiau makai (seaward) of the hotel’s swimming pool (see Exhibits 1.1 and 1.2). The Kalākaua Cottage (Exhibit 1.4) is not considered a historic property because it is a replica of the original structure and is less than 50 years old.

Exhibit 1.2. Oblique Aerial View of Southern Half of Site

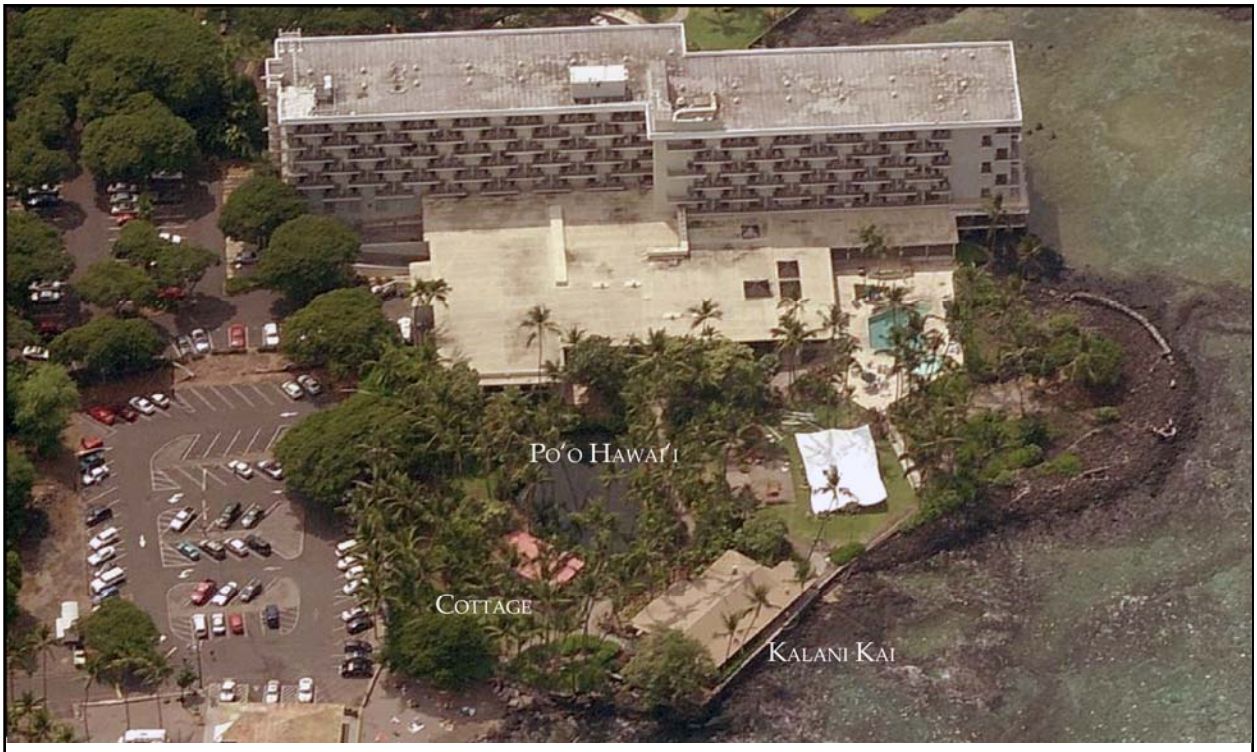


Exhibit 1.3 South Oblique Aerial View of Northern Portion of Project Site

A large, walled anchialine water pond (Po‘o Hawai‘i) is located just north of the hotel structure (Exhibit 1.3) between the KBR hotel and Kalani Kai structure. This pond's shape is generally rectangular, approximately 110 feet by 70 feet, and about 7,700 square feet in size. A small spring is also located just north of the tennis complex.

Exhibit 1.4 Photo of Kalākaua Cottage Replica

1.4 EXISTING ACTIVITIES

1.4.1 Existing Educational Programs

Educational programming is currently occurring on the southern half of the project site using a temporary tent structure with portable restrooms. KKEG operates five programs: 1) Hui Kaha Pōhaku; 2) Kia‘i ‘Āina Kualoloa; 3) Puana Ka ‘Ike; 4) Huaka‘i Kahalu‘u; and 5) Kilo.

Hui Kaha Pōhaku. This program has been functioning for seven years. It is a hands-on, practical approach to mapping the cultural and historical sites that are located in the Kahalu‘u and Keauhou ahupua‘a. Students are introduced to the sites with cultural protocols that are specific to the geographical location. Both Hawaiian and Western math and engineering skills are taught, and students learn how to apply both traditional Hawaiian and classroom skills by utilizing tools to create accurate maps of the various ancient historical sites. Learners produce quality maps that are then utilized to either preserve or restore the sites for educational purposes. This program reaches learners from:

- Hawai‘i Academy of Arts & Sciences (grades 7th – 12th);
- Kealakehe High School; and
- Ke Kama Pono, a State sanctioned alternative youth program providing focused learning on social and work skills.

Kia‘i ‘Āina Kualoloa. This program has also been in operation for seven years. It is a year-long program that meets two to three times a month on Saturdays. Curriculum originally focused on historical, cultural and current environmental information specific to Kahalu‘u and Keauhou, but has since expanded to the greater Kona region. Students learn about the traditional Hawaiian mo‘okūauhau (genealogy) and Papakū Makawalu methodologies of weather, ahupua‘a, animals, fish, plants, sites, ali‘i, and people and eventually internalize the process and focus on their own mo‘okū‘auhau. Chants, Hawaiian protocol, environmental kinship and resource management practices from both the Hawaiian and western points of view are the placed-based outcomes of the learning. Originally, students ranged from grades 1 to 12, but the program has since evolved to include family members so that the family as a whole learns these methods together.

Families began in the Kahaluʻu and Keauhou ahupuaʻa, and have since visited and worked with other communities from Kaloko, Keolonahihi, Keʻei, Miloliʻi and recently Kūkiʻi. This program reaches learners from:

- Elementary schools;
- Konawaena Middle School;
- Ke Kama Pono; and
- Parents and family members of those listed above.

Puana Ka ʻIke. This is a monthly lecture series that features up and coming Hawaiian scholars and their work with environmental kinship. Presenters provide the Kona community with information regarding the integration of traditional Hawaiian practices with western sciences in a professional capacity. KKEG also uses these presentations as a way to inform the Kona communities about the latest events, activities and other KS plans. This program is implemented in partnership with the University of Hawaiʻi, Hilo Campus and the Kōhala Center. This program reaches learners from:

- Keauhou Surf & Racquet Club (residents/guests);
- Various resort guests; and
- Various Kona communities such as:
  - Hawaiian families from Keauhou and Kahaluʻu
  - Hawaiian families from the greater Kona community
  - Amy Greenwell volunteers
  - Keauhou Cultural Advisory Groups
  - Kahaluʻu Cultural Advisory Groups
  - Daughters of Hawaiʻi
  - Royal Order of Kamehameha
  - Queen Liliʻuokalani Trust
  - Laiʻopua LLC
  - U.H. West Hawaii/Hawaiʻi Community College
  - Nā Kālai Waʻa
  - Pūnana Leo o Kona.

Huakaʻi Kahaluʻu. This annual program reaches out to Hawaiian families to come together and learn Hawaiian practices of moʻokūʻauhau, storytelling, family history recordation, photography and kīhei printing. The purpose of this program is to bring several different Hawaiian families together to assist everyone with recording family stories, moʻokūʻauhau and traditions in both traditional and modern means. Families explore the enviornment and make connections with one another, the Kahaluʻu and Keauhou lands, and family histories. Families create and leave with books of the photos that they took over the four-day program, and with the family stories they will share. This program is a unique way to introduce families to KS lands, KS programs, and placed-based curriculum in a holistic way.

Kilo. This is a new program that emerged with elements from the four previously mentioned programs. It is a placed-based program with goals to teach communities how to recognize natural environmental indicators that inform the residents about daily, weekly, monthly, and annual climate

activities. Kilo gives the learners opportunities to observe and record the activities of the animals, fish, plants, birds, insects, weather, ocean in comparison to the seasons and other natural environmental occurrences. This program utilizes a blend of Hawaiian methodologies, scientific inquiry, and contemporary technology to eventually notice natural algorithms, which will in turn inform about what to look for in the environment that indicates change or seasonal consistencies specific to our lands in Kona. This program reaches learners from:

- Hawai‘i Academy of Arts & Sciences (grades 7th – 12th);
- Kealakehe High School;
- Ke Kama Pono;
- Elementary schools;
- Konawaena Middle School;
- Ke Kama Pono;
- Parents and family members;
- U.H. West Hawai‘i / I Ola Hāloa;
- Hawai‘i Community College; and
- U.H.-Hilo, Anthropology Department.

Collaborators and Partnerships

Nā Kālai Wa‘a. Currently, KKEG has two collaborators that have gone through the KS collaboration process. The first is Nā Kālai Wa‘a, which is the organization that cares for and provides programs through their wa‘a kaulua voyaging society. The second is Kūikawa‘a which is a masters and apprenticeship program that works to increase the number of knowledgeable navigators who will teach learners the practices of open ocean voyaging with non-instruments, and introduce the use of contemporary instruments. KKEG also houses the canoe Mauloa, which is a four-seat wa‘a that was carved out of a single koa tree utilizing traditional tools. Mauloa also has traditional parts that are made out of natural materials such as cocoanut fiber ropes, hau tree trunks, lauhala sails, and strong koa tree masts. Through the apprenticeship and partnership programs, learners have the opportunity to engage experts on the canoe practices of the past and future.

University of Hawai‘i-Hilo (UHH), M.A. Heritage Program. This is an approved collaboration that is still in its infancy stages as KKEG works with the Anthropology Department to develop a masters of arts program for Hawaiian students in the field of resource management. Currently, this program is working through the UHH process of approval from the Board of Regents. The goal is to increase the number of Hawaiians with postgraduate degrees in anthropology, archaeology and resource management. These students will be working in the Keauhou and Kahalu‘u lands, accessing the cultural and historical sites to provide information about the historical uses and activities of the Hawaiian ancestors of Pauahi‘s Kona lands.

UH West HI – Hawai‘i Lifestyles Lawai‘a and Plant Culture Programs. This is a new partnership between the community college and KKEG that focuses on the Kona field system in Maluaka and the coastal lands within the Kahalu‘u and Keauhou ahupua‘a. Currently, students have been learning the Kilo Program methodologies by recording observations made in various parcels. Historical and

cultural stories are being collected and analyzed by the students to provide insightful information about the previous practices and activities of the historical past. KKEG plans to integrate stories found in the Hawaiian language newspapers, historical Hawaiian literature and land tenure documents with social-economics and scientific data to provide genuinely holistic placed based curriculum for the 'Āina o Pauahi.

Cultural Activities

KKEG hosts several cultural activities on the project site and mauka Maluaka parcels. The following is a list of the current activities.

- Annual Makahiki celebration
- Solstice & Equinox sunset ceremonies on Hāpaiali'i Heiau
  - Ala Polohiwa a Kāne (June 19th-22nd)
  - Piko o Wākea (September 19th-23rd)
  - Ala Polohiwa a Kanaloa (December 19th-22nd)
  - Piko o Wākea (March 19th-23rd)
- Papahulilani classes – Celestial observations
- Māmoe Ceremony – Sunset ceremony marking graduation and semester completion of learners from the community college.
- Kia'i 'Āina Kualolo – Various heiau, tidal pool, coastal work, lawai'a and mahi'ai practices.
- Kilo – Incorporates various cultural practices with scientific inquiry & empirical data collection

1.4.2 Existing Managed Public Access

KS has been managing public access to the project site since the closing of the KBR in October 2012. Visitors to the property generally consist of persons: 1) wanting to access the beach at Mākole'ā Cove; 2) wanting to visit the cultural sites; and 3) making general inquiries of interest in the property. Since 2013, KS security has been taking informal counts of visitors to the site and categorizing them to estimate the level of activity. A summary of this informal data of visitation activity is provided.

Category Description	Monthly		Daily	
Vehicle/Pedestrian Entry (Main Gate) *(Combines both cars and pedestrians)*	1,230		40	
Visiting Cultural Sites	220	persons	7	persons
Beach Access	550	persons	18	persons
General Inquiry of Site	900	persons	30	persons

Based upon this information, the site receives about 40 "visitations" a day. This total includes a combination of either cars entering the site or pedestrians walking in. On average, about seven people visit the site on a daily basis specifically to view the heiau. The majority of visitors (about

85%) conduct this activity during the day (between 7:00 a.m. and 3:00 p.m.). On average, about 18 persons visit the site on a daily basis to access the beach to walk, sun bathe, or conduct other recreational activities. Many of these visitors arrive early in the morning to walk along the beach for exercise. The majority of visitors (about 75%) conduct these activities during the day (between 7:00 a.m. and 3:00 p.m.). The property also receives several visitors (about 30 persons) a day who have a general inquiry or interest of the site. This includes visitors inquiring about the site, whether there are recreational activities allowed (e.g. snorkeling), etc.

Beach access is currently granted through entrance from the main gate, and visitors are instructed to follow a designated pathway that is marked by white arrows to the beach. Beach access is granted from sunrise to sunset.

Visitor access to view the heiau (cultural sites) is also granted through the main gate. Visitors receive an informational brochure from security that explains that KS is in the midst of redeveloping the site to serve their ‘āina-based educational programs. Thus, limited access is currently available for the public to view the heiau. The brochure includes a map showing the designated pathway leading to established viewing areas of the heiau, along with information on prohibited activities and areas. Visitors are then allowed to walk on their own to view the cultural sites. Security monitors these activities and takes appropriate action if needed to ensure compliance.

CHAPTER 2
PROJECT DESCRIPTION AND ALTERNATIVES

2.1 PROJECT NEED AND OBJECTIVES

Kamehameha Schools' mission is to fulfill Bernice Pauahi Bishop's desire to create educational opportunities in perpetuity to improve the capability and well-being of people of Hawaiian ancestry. The *Kamehameha Schools Strategic Plan 2000-2015* established a set of goals and priorities to guide future decisions, and integrates and balances multiple values (five-value approach) as shown on Exhibit 2.1 (KPMG, 2000).

Exhibit 2.1 Kamehameha Schools Multiple Values Concept

After several years of evaluating the rich cultural resources in the West Hawai‘i region, KS has taken a different approach with the management of some of its land assets, by recognizing and embracing the cultural significance and opportunities for cultural education at the project site. This approach supports the strategic plan's multiple values concept. It has also resulted in the re-investment toward a new approach focusing on cultural education. The goal is to create a unique educational setting that serves KS beneficiaries, Hawai‘i island and other residents and visitors to the State of Hawai‘i.

As a result, the *Kahalu‘u Manowai Education Plan* was developed to serve as an educational strategy that embraces the power of the ‘āina and community to empower learning and living. Prioritization is given to optimizing the land, practicing good land stewardship, and fostering a dynamic learning environment. West Hawai‘i is viewed as a place that will build upon the strong alignment between education and endowment goals epitomizing the next step in the evolution of the school's mission. The four core strategies of this plan are:

1. Excel in ‘āina- and culture-based, applied learning experiences;
2. Boost post-secondary and career success;
3. Create an integrated 21st century Hawaiian landscape and facility; and
4. Optimize people, places, and programs in West Hawai‘i (KS, 2013).

The lands of Kahalu‘u-Keauhou have been a center of politics and learning for ali‘i for over 18 generations of paramount chiefs from pre-contact to Kamehameha III. Therefore, it is fitting that Kahalu‘u-Keauhou is emerging as the center for KS staff, programs, and facilities in West Hawai‘i (see Exhibit 2.2). KS collaborations with over a dozen education and ‘āina partners provide rich applied learning experiences for children that bridges the content areas learned in classrooms (KS,

2013). The purpose of this project is to facilitate KS's mission by restoring a historically and culturally significant property (wahi pana), and in the process support ‘āina-based educational and the culture-based instructional approach in West Hawai‘i.

As part of efforts to implement the strategic and education plans, KS evaluated the Kahalu‘u Ma Kai property in relation to other land holdings in the Keauhou to Kahalu‘u region. An educational delivery strategy was determined to take the best long-term advantage of the property's resources, and align the multiple interests of education, cultural preservation, economics, stewardship, and community in the region. Based upon this consideration, the following statement describes the desired future long-term goal and direction for the region that guides decision-making.

> *"Keauhou-Kahalu‘u will be a piko, a mauka to makai land-base rich in cultural, intellectual, and "ike-nomic" assets that drives the elevation and engagement of its community."*

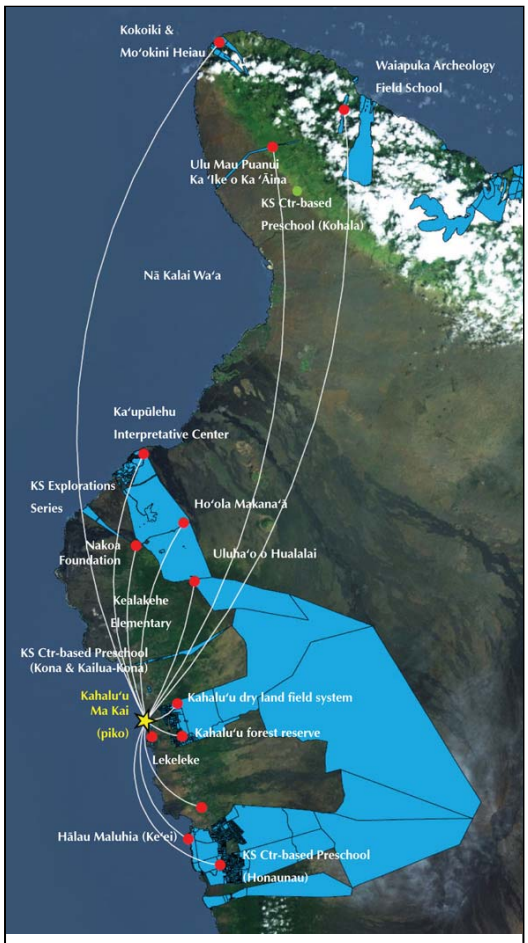


Exhibit 2.2 Kamehameha Schools Emerging Landscape of Learning

Project Objectives

The cultural education vision for this property is to provide a place for the teaching and learning of applied Hawaiian knowledge that supports the development of 21st century skills. The competencies related to cultural resource management, natural resource management, sustainable living practices, and leadership development, enables learners who come to the project site to apply that content to sustain the ‘āina, culture, and people in their communities.

The Kahalu‘u Ma Kai project is intended to: 1) be developed into a piko for the greater cultural education complex in the region; 2) function as an integral part of education delivery in West Hawai‘i (‘āina based approach); and 3) serve as a world-class educational institute and learning center. This project balances the five-value approach under the KS strategic plan of education, economic, culture, community, and environment, and it also implements the *Kahalu‘u Manowai Education Plan* (KS, 2013).

The continued restoration of this culturally significant property will support KS's ‘āina-based educational and cultural activities, and its mission for West Hawai‘i. This approach is reflected in the recent restoration of two heiau (Ke‘ekū and Hāpaiali‘i) on the shoreline within the project site (completed in 2009). The context of these closely situated heiau creates powerful images and

teaching opportunities that will inspire future generations by serving as a source of Hawaiian culture and knowledge.

Benefits from the education and leadership components of the strategic plan are the extension of the learner outreach and impact; an increase in learner engagement; the strengthening of classroom learning; and instilling leadership values. Additionally, learners gain analytical thinking skills through the interdisciplinary nature of place-based studies that allow students to see the connections between the concepts they are studying and the increased relevance of the curriculum that encourages students to become self-motivated learners. Benefits to the community and economic condition of the region include the support of on-going community capacity building efforts, and the increase in long-term economic sustainability of ecological resources.

2.2 PROJECT DESCRIPTION

KS is proposing to redevelop the project site, and change the property's primary use from resort to an educational complex supporting ‘āina-based education and culture-based instruction. This change in land use reflects a much lower intensity of development, and changes activities occurring on the site from being visitor-oriented to primarily educational-oriented. The main components of the project consist of the following:

1. Demolition and removal of the existing KBR hotel structure and associated amenities such as the tennis courts and support building, most parking areas, and swimming pool. Any remnant facilities still present from the Kona Lagoons Hotel will also be removed.
2. Construction of facilities supporting the Kahalu‘u Ma Kai educational complex, and conducting ‘āina-based educational and cultural related activities on the site.
3. Conducting landscape restoration and preservation activities of historic sites within the property (located inland of the shoreline boundary).

The redevelopment will not include Parcel 42 which is the current State-owned parcel of 0.13 acres (TMK 7-08-013: 042) associated with the large tide pool fronting the KBR hotel. The existing KBR hotel structure will be demolished and structures within the tide pool removed. This will result in termination of the current easement with the State, and the property will be restored as close as possible to its original condition.

2.2.1 Keauhou Beach Resort Hotel Demolition

The KBR hotel has a 7-story super structure with basement parking and storage/service rooms below the ground floor lobby. The footprint of the building is approximately 47,000 square feet in size. About 2,550 square feet of this building extends makai of the shoreline into Parcel 42. There are 8 footings installed in the water, with another 11 columns on the rocky shoreline under the building, along with a concrete slab and walkway (see Exhibit 2.3). Each column in the tide pool is about 3-foot square, and is installed on an approximate 6-foot square footing. Based on the

available record drawings, the hotel was built in 1969 and was likely designed in accordance with the 1967 Uniform Building Code.

Exhibit 2.3 View of Columns in Tide Pool Supporting Hotel Structure

Preliminary Hotel Demolition Plans

The KBR structure is planned to be demolished in a controlled manner from the top down, with as much work done from the shore side as possible. More details on the methodology for the building's demolition are being evaluated, but a general description of the main components planned is discussed along with best management practices that would be implemented.

A form of "soft demolition" of the interior would first be initiated to remove all wood, plaster, glass, drywall, etc., leaving only the building's exterior walls and structural members. The windows and exterior openings will be sealed, and the interiors will be gutted floor by floor possibly using a small "bobcat excavator" with a hoe ram. Debris would be deposited in an enclosed chute directly discharging into a roll-off bin.

Exhibit 2.4 Typical Long Reach Excavator Boom

The exterior building shell would then be removed by a large crushing machine working from the exterior inward. A hydraulically operated long-reach excavator boom "muncher" with a reach of approximately 80 feet could be used (see Exhibit 2.4). If necessary, a raised temporary platform/ramp could be built to facilitate the building demolition. Building portions located over the lagoon could be removed with chipping guns and wire saws, and conducted in a manner so that debris, dust, and resulting particles are contained. Existing columns in the tide pool would need to be removed to restore the site as close as possible to original conditions. Columns would be first cut off at or near the footings, and the remaining concrete footings removed to bring the concrete level with the bottom of the tide pool.

The building's basement would also be demolished, and the site of the excavated area would be stabilized for redevelopment as part of a new basement supporting the project's facilities and operations.

Materials Processing and Disposal

Waste materials generated from the hotel demolition are planned to be source-separated on the project site by the demolition contractor. The hotel's adjacent parking lot would be used to segregate recyclable material such as scrap iron and steel. Recyclable materials would be placed into recycling containers that are clearly labeled. The concrete will be processed on site by removing the reinforcement bar from the concrete, and it would then be crushed on site and screened to the appropriate size. Most (estimated at about 80%) of this concrete material is planned to be recycled for reuse with the property's redevelopment as general fill material, pavement aggregate, and possibly material for drainage improvements.

Certain hazardous materials present within the KBR hotel will need to be properly removed by the contractor before demolition of the KBR hotel commences. Removal of such material will be conducted and disposed of in conformance with applicable State and Federal requirements. As an example, PCB light ballasts would be placed in 55-gallon drums, incinerated, and disposed of by the Oasis Environmental Group.

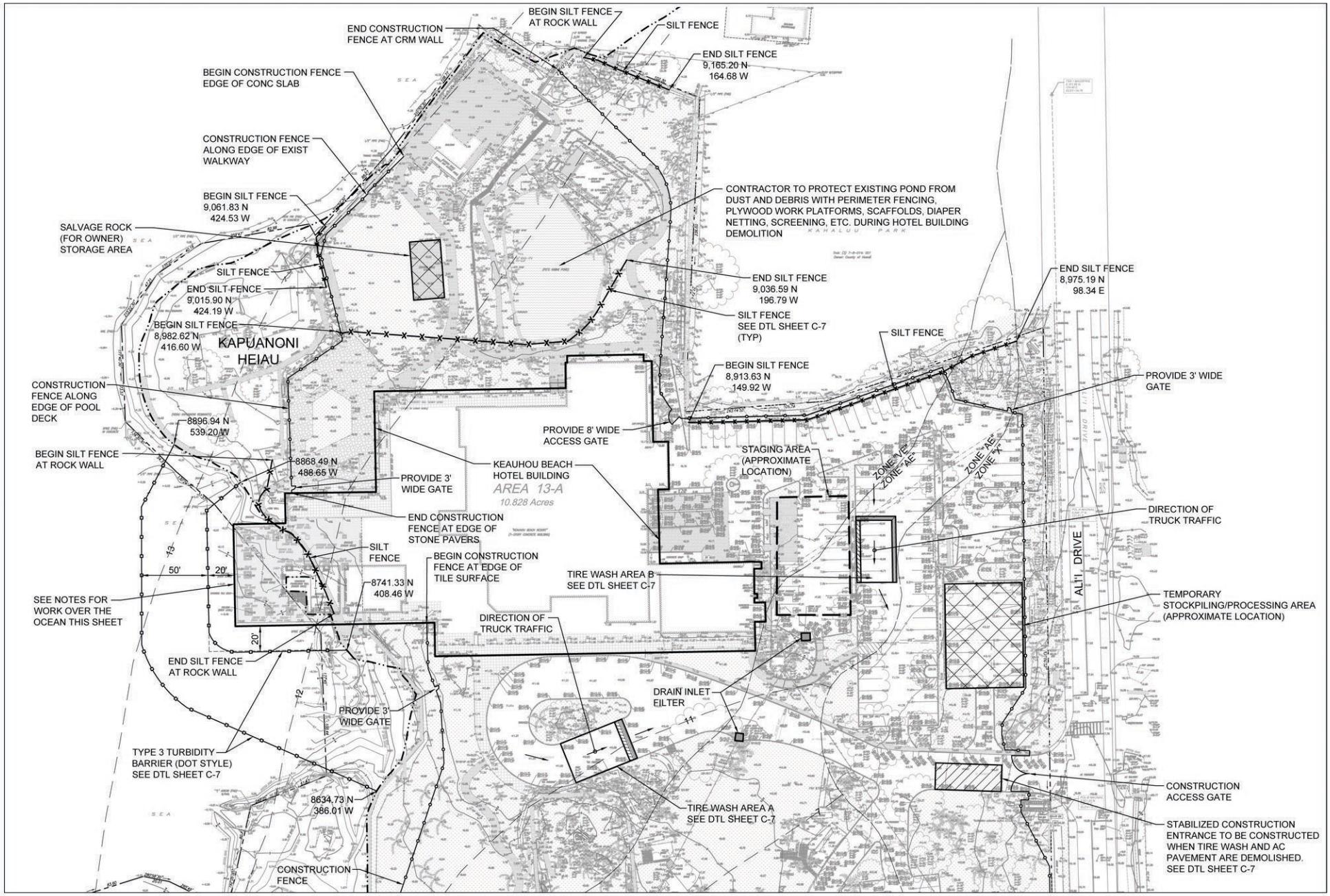
Other materials would be taken to various recycling centers on island for reuse. Scrap iron and steel material would be taken to Big Island Scrap Metal to be recycled, and other non-ferrous metals taken to Atlas Recycling Center. Asphalt pavement would be taken to the West Hawai‘i Sanitary Landfill site for recycling. Vegetation such as trees, palms, and other plants would be taken to the Kealakehe (Kailua-Kona) Greenwaste Facility for recycling. Concrete material not reused on the project site would be taken to the West Hawai‘i Sanitary Landfill along with other construction debris for disposal.

A solid waste demolition diversion report would also be prepared during the project's design phase in compliance with the County Department of Environmental Management's (DEM) solid waste management plan guidelines and requirements. This report would include more details on recycling and reuse procedures, and identify and quantify anticipated waste material.

Best Management Practices

Best management practices (BMPs) for demolition work would be developed for both land-based areas and areas within the lagoon. Details associated with appropriate BMPs for use are still being evaluated, however, Figure 2.1 shows a preliminary plan identifying erosion control and BMPs measures being considered at this time. Final BMP measures would be determined during the design phase and as part of ministerial permits obtained (e.g. NPDES, demolition permit). A description of some of the methods being considered are listed below.

- Controlled watering would be used to allay dust during the demolition work. This could be performed with a fire hose and dust screen around the perimeter of the building.
- Use specialty surgical saw cutting at required areas. Robotic equipment used for demolition of upper floors of the hotel to minimize falling debris.



Source: BELT COLLINS

Kahalu'u Ma Kai

Figure 2.1 - Preliminary Erosion Control Measures

Kahalu'u, Hawai'i

50' 0' 50' 100'
Scale: 1"=50'

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- Collect and place building debris, as it is created, into roll-off bins or trucks for hauling and removal from the site.
- Install silt fences or other means to mitigate silt laden runoff from leaving the site.
- Reuse of the building debris will be done to the extent practicable. A location within the project site is being considered for temporary use to process the concrete rubble and stockpile it before being hauled away.
- Establish work zones prior to demolition activities consisting of:
  - ✓ Demolition Exclusive Zone – Zone where active demolition activities would be established with barricades and signage.
  - ✓ Support Zone – Zone where access is allowed for site personnel and visitors.
- Trucks will be washed down prior to exiting the site.
- Possible BMP measures to protect the tide pools being considered are:
  - ✓ Install a perimeter fence with vinyl tent and scaffold with safety netting or screening. The amount of sunlight needed for the lagoon would be evaluated as part of this method.
  - ✓ Installation and maintenance of Type III silt and turbidity curtains within 20 feet of the work area (fall zone). Also installing another barrier of Type III silt and turbidity curtains outside the fall zone (up to 50 feet).
  - ✓ Place a floating boom outside the "fall zone" for dust and particle control within the outermost areas of the lagoon.
  - ✓ Use a floating boom with netting or cloth extending into the lagoon, around the immediate work area, similar to a silt curtain.
  - ✓ Install, a platform of plywood or netting with a filter cloth under the structure that serves as a debris catchment system, beneath the work area using the existing columns for support. The work would proceed from the top down, with the catchment system moved closer to the water as needed.
  - ✓ Place a filter fabric or a dust screen in between the columns and adjusted as the supports are removed.
  - ✓ Install boxes and/or chutes on the platform for debris deposit and removal to an on-shore collection bin.
  - ✓ Work in the water would be done at low tide, when surf conditions permit, and when winds conditions are not extreme.
  - ✓ Visual monitoring for floating debris (trash, oil sheet, etc.) conducted during construction activities so that debris retrieval can be implemented, if necessary.

2.2.2 Kahalu‘u Ma Kai Redevelopment Plan

The redevelopment of the project site will involve constructing several new structures to support ‘āina-based education and culture-based instruction for learners, visitors, and the public as shown on Figure 2.2 (Conceptual Site Plan). The siting of these facilities was based upon the functional use intended for the project site and the cultural educational activities anticipated to occur. The site's functional planning involved establishing various areas designated for primary uses, gatherings, and activities. Primary structures planned for this project include a Heritage Center, multi-purpose building, hālau, reuse of the existing Kalani Kai structure on the north side of the property, camping hale (Hale Ho‘omaha) with a comfort station/storage building and facilities supporting existing canoe (wa‘a) and tiki (ki‘i) making activities.

Built Components

The total floor area for structures shown on the preliminary conceptual site plan would be about 59,700 square feet. This would reflect a significant decrease (over 73%) from the present 225,000+ square feet of total floor area existing on the project site, which includes the KBR hotel, Kalani Kai structure, storage sheds, and tennis complex. A summary of the various structures proposed under this project is shown below. It should be noted that the existing Kalani Kai building would be retained resulting in a net of approximately 53,700 square feet of new floor area for project facilities once the existing KBR facilities are demolished. Sustainability elements are also planned to be integrated into the design of all building structures.

	Description	Floor Area (sf)
1.	Heritage Center	3,200
2.	Multi-Purpose Building	6,300
3.	Hale Ho‘omaha (Camping)	7,300
4.	Hālau	2,400
5.	Hale Wa‘a	3,300
6.	Hale Ki‘i	1,800
7.	Comfort Station	1,200
8.	Basement	28,000
	● Maintenance / Storage	5,000
	● Parking	23,000
9.	Gate House	200
10.	Kalani Kai (Existing)	6,000
	Total Floor Area	**59,700 sf**

Source: KYA Design Group

LEGEND

- Bioswale / Rain Garden / Bioretention
- Bioretention / Rain Catchment
- Constructed Wetland
- Greywater Garden

Kahalu'u Ma Kai

Figure 2.2 - Preliminary Conceptual Site Plan

Kahalu'u, Hawai'i

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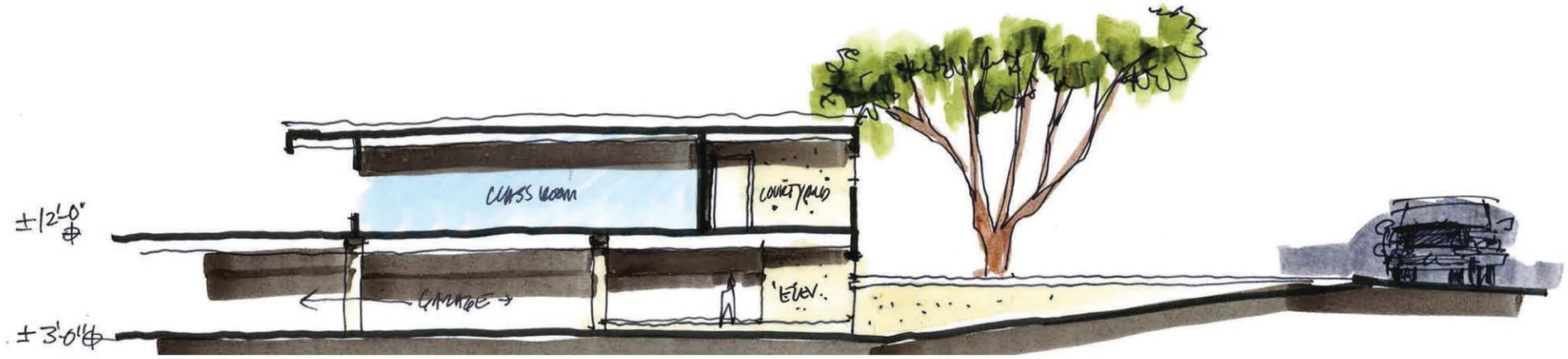
Heritage Center. The concept for this center is intended be a simple, yet flexible, open building to allow it to be adjusted to accommodate the needs of the program and educational outreach occurring. The building's location and structural design is intended to accommodate views of the property by allowing for unobstructed site line views to cultural sites. This building would also serve as the primary entry point for visitors to the site as part of the managed public access planned for the property.

The building's final design would occur in the future because this center would be implemented as a later phase of the project after the main facilities supporting 'āina-based educational programs are implemented first. Initially, a larger size building was being considered; however, after further programming for this building, only about 3,200 square feet is being considered at this time. The actual design may be smaller when completed. The concept planned for this center is to have a minimalistic design of the interior to provide maximum flexibility for cultural and informational displays, as well as to provide opportunities for future build-out of the center for additional programmatic requirements when needed. The building would have an entry lobby and assembly area to accommodate museum-like display cases and boards sharing information and cultural artifacts. Telecommunication infrastructure would be provided such as a large monitor for videos/movies for visitors to watch. Other features would include a restroom and storage area.

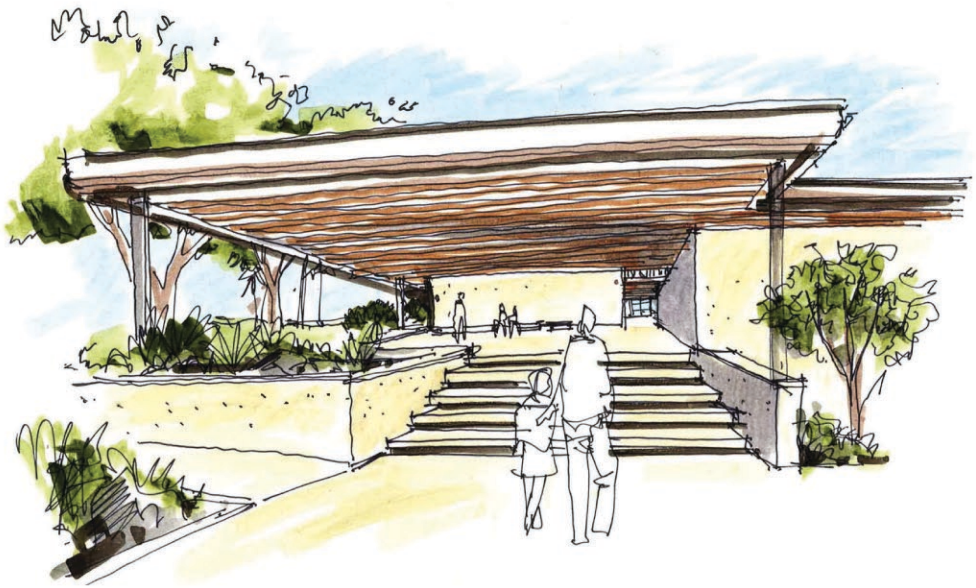
Supporting the main building is a central, flat lawn that can accommodate larger gatherings and/or performances. A large lawn would allow visitors to exit out into, as well as create an outdoor assembly-type space for users to congregate prior to walking and experiencing the property. Envisioned are six (6) spaces for pavilions to encourage multiple group activities and/or possible covered areas for booths during special event gatherings. A parking lot accommodating about 21 vehicles or less is planned, and access would be off of the main site entrance driveway.

Multi-Purpose Building. This building is envisioned to serve as the primary support facility used for educational programs and activities. It is intended to be flexible, accommodate multi-media, technology, and support instructional functionality for 'āina-based programs. The entry's layout is planned to support cultural practices such as processional ceremonies. The building would accommodate several multi-purpose rooms and educational spaces for programs and activities. The facility could be a split-level structure connecting to a basement, and having a more modern-influenced style, but sensitive to site topography and surrounding conditions. Figure 2.3 shows preliminary concepts associated with this building.

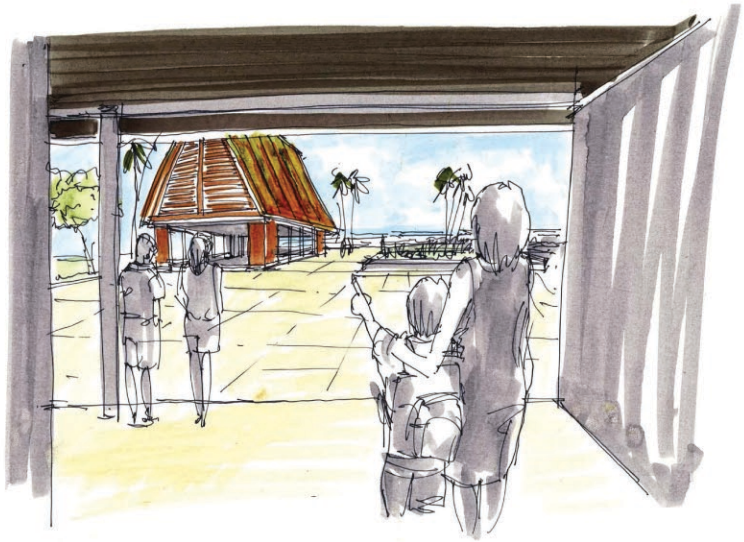
The existing KBR hotel basement would be redeveloped to support the multi-purpose building. The building is intended to serve as the primary entry point for students and teachers where people are dropped off at a large open area in the front of this facility. As a result, the present site entrance and existing parking lot would be modified to create a new entrance feature allowing for buses to pick-up and drop-off students at this facility.



MULTI-PURPOSE BUILDING CONCEPTUAL SECTION VIEW



ENTRANCE TO MULTI-PURPOSE BUILDING



OPEN VIEW PERSPECTIVE FROM MULTI-PURPOSE BUILDING

Source: KYA Design Group

Kahalu'u Ma Kai

Figure 2.3 - Preliminary Conceptual Section View and Perspectives

Kahalu'u, Hawai'i

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Classrooms are planned to be designed with glass partitions and operable walls along the sides to provide flexibility in creating varying sized rooms for particular activities along with providing open access to lawns and outdoor areas. Classroom space would be supported by whiteboards, tack able surfaces, audio and visual equipment, telecommunication service, and flexible furniture. Other components would include a conference room, office spaces, nurse station, commercial kitchen, restrooms, outdoor showers, storage areas, and an elevator for access to the basement. Sustainable design principles will be utilized in the building's design including recycled and non-toxic materials, indoor air quality strategies, daylight, water and energy efficient fixtures.

Basement Redevelopment. With demolition of the KBR hotel, the existing basement remaining would be redeveloped to support the multi-purpose building and hālau structures built above it. The new concrete basement walls is planned to be setback away from existing adjacent cultural sites to support on-going restoration efforts of Po‘o Hawai‘i, and Kapuanoni Heiau. The basement would also be setback away from the VE flood zone boundary to ensure its conformance with the National Flood Insurance Program requirements.

The basement would be used for underground parking and storage space. About 61 underground parking stalls are planned to reduce the amount of parking stalls required aboveground and to reduce visual clutter. Storage space would be created to house telecommunication and audio-visual servers, mechanical rooms (air conditioning, water heater, etc.), excess furniture (tables, chairs), other necessary storage items, and for grounds maintenance equipment. An elevator would be provided for efficient access between the multi-purpose building, and also to simplify the transport of furniture.

Hālau. The hālau is also intended to be flexible to serve as instructional space, a secondary camping location, or a formal space to host events. It would be designed as a large pavilion-like structure with full electronic equipment connectivity capabilities with audio-visual connections to servers in the basement. The structure is planned to be an open, flexible, and covered structure built above the redeveloped basement, and will have large oversized doors on all four walls. These doors would provide the capability to be opened up on all four sides for optimal viewing of cultural sites on the property. The placement and orientation of the rectangular shaped structure would be sensitively designed for both Po‘o Hawai‘i and Hāpaiali‘i Heiau.

Kalani Kai. This is an existing building that was previously used as a bar and grill restaurant for the KBR and was open to the public. The building's location provides excellent access to the existing shoreline and tide pools. Therefore, it is planned to be renovated to support potential opportunities as an open-air marine lab and/or a multi-purpose building for educational activities. There would be no increase to the existing floor area of this building. The outdoor lānai would provide shelter and accommodations to support group meetings, classroom space, and resting.

All repair and maintenance work done on the structure will be a one-for-one replacement to retain the existing character of the building. The two existing single-stall restrooms would be updated to comply with current American Disability Act standards. The existing commercial kitchen and serving area would be renovated to provide a kitchen on-site. Outdoor showers would be provided to allow learners to rinse off after activities conducted in the ocean or along the shoreline. Storage space may be provided for supplies and equipment.

Hale Ho‘omaha (Camping). This area would support overnight camping as part of educational activities, and would accommodate a maximum of 90 persons. Envisioned to reflect the 1800's ranch-style sleeping hales that were commonly found near the shore at that time, the sleeping quarters would be built as an elevated or slab-on-grade wood structure. Separate modular structures (one for boys, one for girls) would accommodate 30-learners each. If additional sleeping space is needed, a pavilion located at a comfort station area could be used as a flexible space for an additional 30 learners to sleep under.

Large operable windows will allow for natural ventilation as well as provide a visual connection to the site. Ceiling fans will provide air circulation within the sleeping quarters to keep the interior of the structures comfortable. These structures would be equipped with sufficient outlets for recharging handheld and other electronic equipment (laptops). Covered lanai along the makai side of the sleeping structures would serve as gathering space for persons to collaborate and interact. Some space for storage would also be provided. Rainwater catchment cisterns would be located next to each camping structure to collect rainwater for plant irrigation around the facility, and serve as an educational feature.

Comfort Station and Storage Building. This building would be the main support facility for educational activities conducted at the southern end of the project site. Located next to the camping facility, structures are envisioned to complement Hale Ho‘omaha's (camping) architectural style. A large lanai or pavilion would serve as multi-purpose space, and used for many different educational activities, while providing supportive needs to the surrounding facilities.

Roll down canvas along the openings of the lanai/pavilion would provide shade from rain and other natural weather elements, and to support educational activities (e.g. surface for projection screen). This space would support setting up furniture or picnic tables and benches for activities. It would be designed to be flexible so that it can support the camping facility by serving as sleeping shelter for an additional 30 campers.

The restroom component of this facility would have toilets, showers, and a changing area. Outdoor sinks and showers will allow for rinsing off prior to entering the facility. Counter space with a sink, refrigerator, and propane-style barbecue grill would support preparing light meals and snacks. An imu would be located in this area for programmed gatherings and events. Storage for the belongings of campers would be provided. Rainwater catchment cisterns would also be located next to the facility to collect rainwater for plant irrigation around the facility, and serve as an educational feature.

Gate House. This small facility would serve as the central location for the site's security needs. It would be located at the main entrance driveway, and serve to monitor site access and guide visitors, students, and other guests entering the site. Closed-circuit television (CCTV) cameras established at various areas of the project site would monitored at this facility for security. The facility would include a restroom, security office, and parking for a security golf cart.

Hale Wa‘a. This building is intended to support canoe making activities currently occurring at the site, and would be used for housing up to four (4) 6-man outrigger canoes and storage for associated equipment. The structure is planned to be an A-framed wooden structure that can be opened on all sides reflecting an indigenous Hawaiian hale architectural style.

Hale Ki‘i. This building would be an open, covered structure to support the ki‘i carving apprenticeship program and others learning the art. It could provide areas for two (2) workstations and storage units for power tools, equipment, and raw materials for ki‘i carving. A storage unit for sacred wood chips would be provided. The structure is planned to be an A-framed wooden structure that can be opened on all sides reflecting an indigenous Hawaiian hale architectural style. The driveway located in close proximity to the site provides easy loading and hauling of materials to and from their designated locations.

Site Improvements and Infrastructure

Site improvements and infrastructure would incorporate sustainability elements into their design. An aim toward "net-zero water[1]" would be incorporated along with renewable energy opportunities (photovoltaic systems) to sustain the educational program. Site improvements will include improvements to driveways, parking areas, walkways, and "soft" reinforced vehicular/pedestrian paths. The existing Kalākaua Cottage structure next to Po‘o Hawai‘i would be demolished. Low impact design (LID) elements such as constructed wetlands, greywater gardens, bioswales, rain gardens, bioretention areas, rain catchment systems, and seepage pits (shallow sumps) will similarly be incorporated (see Figure 2.1). Further discussion of infrastructure system requirements and improvements planned is provided in Chapter 4 under pertinent subsection headings.

Vehicular Access, Driveways, and Parking Lots

The property presently has four driveway access locations along Ali‘i Drive. With the project's redevelopment, the site will only have three driveway access points thereby eliminating one access location sited near the middle of the property. Primary vehicular access to the project site will continue to occur via the former resort's main driveway access on the northern end of the property off Ali'i Drive. A security checkpoint will be stationed at this main driveway entrance.

[1] Water conservation measures aimed to reduce annual potable water use to no greater than annual rainfall.

A second service entrance for the site located further south will be used for maintenance access and parking at the Hale Ho‘omaha site. A third existing driveway at the southern end of the property will be used for vehicular access to a public parking lot for shoreline access and to serve the Hale Ki‘i and Hale Wa‘a buildings. This third access location would also allow for permitted vehicles to access the existing Kahalu‘u sewer pump station located closer to the shoreline as part of maintenance activities. Access for fire protection apparatus would be provided to all structures through these driveway locations.

As shown on the Conceptual Site Plan (Figure 2.1), the driveway from the site's main entrance forks to provide vehicular access to either the Heritage Center or Multi-Purpose building. About 108 parking stalls are planned over the entire project site. A parking lot for about 21 stalls is provided for visitors to the Heritage Center. Vehicular access to the Multi-Purpose building is via a one-way entrance driveway as shown on the conceptual plan. This driveway entrance would be designed to accommodate larger buses along with providing parking areas on the side for several buses. This driveway also leads to the basement where an additional 61 underground parking stalls are provided.

At Hale Ho‘omaha, the driveway entrance leads to a parking lot with about 13 stalls. Space will be provided for turn-around of larger vehicles along with loading areas. The purpose for this parking lot is for maintenance and delivery service supporting activities conducted in this area.
The third driveway entrance at the southern end of the property leads to a parking lot of 10 stalls intended for general public access to the shoreline via a public access along this property's southern boundary (next to Keauhou Kona Surf and Racquet Club). Restricted access from this parking lot would extend along the driveway leading to Hale Ki‘i and Hale Wa‘a, and this section is only intended for use by activities associated with those structures. A few parking stalls (3) would be provided at these buildings for authorized personnel. This third entrance would be managed by security and open to the public only during daylight hours.

Water System Improvements

The project would implement sustainable water management practices; as such, projected potable water demand would be lower than that previously occurring under the KBR's operation. Therefore, on-site water system improvements will include down-sizing the service meters and installing new laterals off the 12-inch diameter water line in Ali‘i Drive. Fire protection services will also be designed in accordance with applicable building and fire codes.

Sewer System Improvements

The sewer collection and treatment system serving the project site and surrounding areas is operated by a private operator with eventual treatment at the He‘eia Wastewater Treatment Plant. The project would result in reduced wastewater generation due to lower projected water demand than that occurring when the KBR was in service. Existing sewer lines will either be demolished and removed or abandoned in place and backfilled with grout based upon the proposed buildings. New sewer lines connecting to the Kahalu‘u sewage pump station (SPS) and existing 12- inch diameter

sewer line in Ali‘i Drive will be constructed to provide service to Kalani Kai along with accommodating flows generated from occasional large events (e.g. makahiki).

New facilities planned would consist of an on-site wastewater collection and treatment system (on-site wastewater system) and greywater gardens. The on-site wastewater system will be gravity driven and consist of septic tanks, equalization tanks, small diameter collection pipe, a constructed wetland, turbidity filters, and an ultraviolet (UV) disinfection system. The treatment system would be designed to produce R-2 water for irrigation at the project site. The intent of the proposed treatment system is to reuse all wastewater on-site with zero discharge of wastewater to the privately operated treatment plant, except during occasional large events. The civil design will include conveying this volume from periodic large events to the private wastewater system via pump stations and force mains that will outfall into manholes along the existing 12-inch gravity main on Ali`i Drive.

Greywater from outdoor showers would be treated with planted, shallow absorption beds before ground infiltration. The beds would be established using native Hawaiian plants. Planned locations of greywater areas are shown on the conceptual site plan (Figure 2.1).

Drainage System Improvements

Storm water runoff generated on-site would decrease with the project improvements implemented due to increased green space, removal of the hotel and support buildings, a reduction of paved parking areas, and implementation of LID elements. However, the County Department of Public Works (DPW) has requested that storm water runoff for project developed conditions be reduced to pre-development conditions (prior to the KBR) and the net runoff be retained onsite. To meet these requirements, the following LID concepts planned would include the following, and were shown on Figure 2.1 (Conceptual Site Plan).

- Seepage Pits (Shallow Sumps). Seepage pits will be incorporated to infiltrate excess storm water runoff into the ground.
- Rain Gardens. Rain gardens, also referred as bioretention basins, are engineered shallow depressions that collect and filter storm water runoff using vegetation and conditioned planting soil beds.
- Bioretention Swales. Bioretention swales are shallow linear channels with a planting bed and covered with turf or other surface material (other than mulch or plants) to all runoff to be filtered through the planting bed and collected in an underdrain system.
- Rainwater Harvesting Rainwater harvesting is the collection and temporary storage of roof runoff in rain barrels or cisterns for subsequent landscape irrigation.

Electrical and Telecommunication Systems Improvements

At the project site, electrical utility lines are distributed underground, and available power is sufficient to accommodate the project. New padmount transformers would be implemented and existing primary circuits will be extended to these transformers. The availability of telecommunication services to the site is sufficient for the proposed redevelopment, and service will be extended to all buildings.

2.2.3 Description of Activities

Gathering Areas

The center of this site is the "Pā" shown on the conceptual site plan that encompasses about 50,000 square feet. It serves as an important cultural area for this property, and accommodates site lines from the Papa Koholua Heiau, situated further mauka across Ali‘i Drive, toward Ke‘ekū Heiau. As a result, this area would remain open and support mauka and makai views of the shoreline and inland areas. Other open space gathering areas consist of the following:

1. Event Lawn. This grassed open space area encompasses about 135,000 square feet and is located on the southern half of the project site, in the area north of Mākole‘ā Heiau. This area is currently used for educational and cultural activities, and will continue to support this use along with other events held at the site.
2. Area Makai of Heritage Center. This open space area of about 45,000 square feet is present that is heavily vegetated, and includes a spring. Removal of existing tennis courts would create more open space for activities, and support educational activities (e.g. study of the spring).
3. Area Between Heritage Center and Camping. This open space area along Ali‘i Drive would be created by removing existing tennis courts and paved parking areas. It would primarily serve to open mauka-makai views of the Pā, and create open space separating Heritage Center visitor related activities from the student camping facility (Hale Ho‘omaha).

Educational Activities and Special Events

There would be three types of activities and associated access occurring on the project site, which are: 1) ‘āina-based educational and cultural activities; 2) general public/visitor education; and 3) shoreline public access. The primary purpose for this project and site improvements is to support ‘āina-based educational and cultural programs that are conducted in collaboration with KS partners in education, social service, and the community. Therefore, educational and cultural activities have the highest priority, and redevelopment of the project site is in support of those activities.

The Kahalu‘u Ma Kai project will continue to accommodate visitors interested in learning about the natural, cultural and historical resources present. In addition to general information, the Kahalu‘u Ma Kai project will continue to coordinate the managed access program providing visitors access to designated areas to learn about and view historic sites. Finally, public access to the shoreline and the small sandy beach area along the southern half of the property (Mākole‘ā Cove) would be provided for recreational activities (e.g. sun bathing, shoreline fishing) via a public access pedestrian path on the south boundary of the property. These three types of activities and associated access within the site are discussed in more detail.

Primary Educational and Cultural Activities

The framework for developing and implementing various educational programs are outlined in the *Kahalu‘u Manowai Education Plan* (KS, 2013). Programs and activities conducted on the site would be coordinated with other educational partners such as the State Department of Education, University of Hawai‘i, KS campus and enrichment programs, other private education organizations, and non-profit organizations. Collaborations with the Keauhou and Kahalu‘u communities, along with lineal and cultural descendants, will continue to expand and support pertinent programs and activities.

Educational programs are planned to occur throughout the week (Monday to Friday) as part of normal school day activities (8:00 a.m. to 2:00 p.m.), and activities would include access to the entire property. It is programmed that up to 100 students could be conducting activities at the site at any given time, plus 24 persons for educational staff (teachers, support staff, etc.). Educational activities would predominantly involve students (Kindergarten to 12th Grade), however, other programs would also involve college-level students, adult research programs, kupuna (grandparents), and other members of educational or non-profit organizations.

Certain activities would involve overnight stay as well (e.g. camping). Multiple groups of students and/or research groups could be conducting activities at the same time using different areas of the site. A maximum of up to 90 students, including teachers and other support staff, are programmed as part of camping facilities.

Lineal and cultural descendants, along with cultural practitioners, would also have access to the natural and cultural resources on the property to support their cultural practices and related activities. Coordination of all aspects of access to natural and cultural resources since the closing of the KBR has been performed by the KKEG, and management of these activities by KKEG will continue to be administered at the site with the project. KKEG will continue to work with descendants and cultural practitioners to maintain the integrity of the resources and ensure appropriate access is provided. Examples of activities could include: 1) lineal descendants who would like to share experiences with their ‘ohana by bringing a group down to visit the area; 2) those who want to study the heiau and traditional navigation techniques; 3) a visiting group of people wanting to do protocol as a show of respect; and 4) those wanting to exercise native gathering rights within the property or along the shoreline.

Culturally related special events would also be conducted at the project site. This would consist of life celebrations, makahiki, and hoike events that could each occur between two to four times a year. Estimated participants could reach up to 500 persons for hoike events and up to 800 persons at the makahiki. Special KS functions could include up to 1,000 persons and occur up to four times a year. Educational workshops may occur about six times a year and have about 75 persons. Seasonal ceremonies (about 8 times a year) may include about 100 persons.

Vehicle parking for most of these special events (e.g. workshops, seasonal ceremonies, some KS functions) could be accommodated on the property. Open grassed areas could be used to support temporary overflow parking for events. Vehicle parking for the few larger events would require establishing a shuttle service from the Keauhou Shopping Center. Visitors would park at the shopping center and be shuttled to and from the project site. KS would coordinate with the shopping center management to schedule and implement such service, and assistance using either hired off-duty police officers or other KS staff or volunteers would be utilized as part of the traffic control plan.

Visitor Education Program with Managed Access

The Heritage Center would be programmed to accommodate about 200 visitors per day during normal business hours (8:00 a.m. to 5:00 p.m.), every day except for certain holidays. The purpose for this center is to manage access within the property for visitors wanting to visit the cultural resources (e.g. heiau). Although the demand by the public for visiting this site may be greater, KS needs to manage access and the number of visitors allowed daily to: 1) maintain the integrity and intrinsic values of cultural sites; 2) maintain the integrity of the overall on-site experience; 3) prevent conflicts with educational and cultural activities occurring throughout the day; and 4) manage security, safety, and discretion for learners and practitioners.

A more robust and formal visitor education program is slated to be developed as a later phase of this project as part of the design phase and construction of the Heritage Center. The concept planned is for visitors interested in the property to be led on docent tours to view areas, and learn about the natural and cultural resources present. Pedestrian paths with signage would be established from the Heritage Center leading visitors to designated viewing areas of the heiau. Visitors would be required to stay within designated areas and paths. Access to the beach would not be allowed from these managed paths since a public pedestrian path is provided along the southern boundary of the property for that purpose. The Heritage Center would have staff responsible for coordinating aspects of this managed access within the property for visitors. An example of what a typical experience envisioned would be is summarized below.

1. Visitors would enter at the main gate, receive a flyer, and be directed to the Heritage Center parking area. They would be able to register for tours, if not already registered.
2. They would receive information about the property and cultural resources, and be able to view cultural artifacts and displays.

3. Visitors would then assemble at a designated area and proceed on their tour (e.g. 60 minutes) of the natural and cultural resources at the property.
4. Once the tour is complete, visitors would return to the center before leaving the property.

Information about the property could be made available on the internet via a website along with supporting other social media sites promoting tourism and information on the island. The Heritage Center website would provide information on hours and days of operation, location information, activities offered, special events, and other pertinent information to inform the visitor of the experience offered and expectations. Details of such a program and the procedures for signing up for tours would be developed in the future during the design phase for this center.

Public Shoreline Access

A public pedestrian path providing shoreline access to the beach area at the southern half of the property would be provided. A 10-foot-wide pedestrian path down to the beach would be located along the southern boundary of the project site, within the KS property and along an existing property fence near the existing Hale Wa‘a shed (see Exhibit 2.5). This public access would extend from the 10-stall public parking lot proposed off Ali‘i Drive. The Keauhou-Kona Surf and Racquet Club property also has a pedestrian path to the shoreline of off Ali‘i Drive approximately 550 feet south of the project site serving their development.

Exhibit 2.5 Mauka View of Planned Public Shoreline Access Corridor Inside (Left) of Property Fence

The parking lot would be open every day during normal daylight hours. Further details on managing the operation of this public access would be developed during the project’s design. A gate will be provided at the parking lot driveway entrance to close access at the end of the day. Lateral public access would be allowed along this sandy beach from the public pedestrian path north up to Hale O Papa Heiau. This heiau has a 25-foot buffer, and signage would be provided to notify the public to respect this buffer around the historic site. Signage would be provided at the northern end of the project site bordering Kahalu‘u Beach Park to notify the public that a public access is provided at the southern end of the property. Figure 2.4 conceptually shows the locations for these public access areas.

Source: KYA Design Group

Kahalu'u Ma Kai

Figure 2.4 - Public Access Plan

Kahalu'u, Hawai'i

Not to scale

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Interim Managed and Public Shoreline Access

The Heritage Center would be developed as a later phase in the project after first redeveloping the site with core facilities to support the ‘āina-based educational programs. Therefore, managed access within the property for visitors is planned to occur under the current process previously discussed under Section 1.4. This involves visitors checking in at the main gate, receiving a flyer informing them of the site and designated areas for access, and then being able to walk on their own to visit the heiau. Security would be monitoring activities to ensure visitors follow procedures.

Once the Multi-Purpose Building is completed, visitors checking in at the main gate would then probably be directed to an office at this building. Visitors would then be able to check in, receive a flyer and information, and then proceed on their own to visit the heiau. This would serve as the main interim managed access program until the Heritage Center is constructed.

Until the public shoreline access is completed on the southern end of the property, those individuals wanting to access the sandy beach would also follow the current process in place as previously discussed (Section 1.4). They would check in at the main gate, and then be allowed to proceed to the beach following a designated path. Once the public access path is constructed, shoreline access would not be permitted through the main gate. Security at the main gate will redirect the public to the designated shoreline access path at the south end of the property.

During demolition of the KBR, public access to the beach and to view the heiau will be restricted. The contractor will need to secure the area for construction activities and to ensure public safety. Therefore, this access will inevitably need to be temporarily restricted. Security at the main gate will monitor activities and notify the public. Signage would also be provided at the main driveway entrance to inform the public of this temporary situation.
Construction activities associated with site’s redevelopment would also result in access being restricted on a temporary basis. This would primarily be associated with construction of the Multi-Purpose Building, Hālau, new entry and bus drop-off area, and other site development (e.g. drainage, utilities). Public access should be available through the main gate during construction of facilities and site improvements planned on the southern half of the property (e.g. Hale Hoʻomaha). Construction of the public shoreline access on the south end is planned to be included in the earlier phases of the property’s redevelopment to minimize time associated with this temporary restriction. Further details on access and timeframes would be developed during the design phase of this project.

2.2.4 Restoration Activities

Restorations activities will continue on the property to supplement other restoration activities completed for Keʻekū Heiau and Hapaialiʻi Heiau. This will include restoration of Kapuanoni Heiau, finishing restoration work at Makoleā Heiau, and restoration activities at Poʻo Hawaiʻi pond. Restoration of Kapuanoni Heiau would involve work within the lagoon and nearshore waters, and design plans for this heiau restoration would be developed in the future.

Landscape restoration would similarly be implemented on the property to remove non-native and invasive plants and trees along with diseased trees. Native plants and trees will be used as part of landscape restoration and improvements implemented on site. Such plants would also support both educational and cultural practitioner activities.

2.2.5 Project Phasing and Estimated Costs

Proposed improvements can be implemented once this environmental review process is completed and applicable land use entitlements are obtained. Necessary ministerial permits would be required as part of the design implementation phase. This environmental review and entitlement process are planned to be completed by the middle of 2015.

The first phase of implementation for this project would be the demolition of the hotel. Construction activity is projected to start by the summer of 2015 and be completed in 2016. The next major development phase would be developing final design plans and construction of building improvements along with implementing site and infrastructure improvements (e.g. water, sewer). Individual buildings are planned to be implemented in phases over a 10-year period subject to available funding and program priorities. Therefore, the estimated completion date for all these improvements is about 10 years, or by 2023.

The estimated construction cost for the demolition of the hotel is about $11.5 million. The estimated cost for construction of the buildings and site work is about $22.8 million. Therefore, the total cost for this project including demolition of the KBR is about $34.3 million.

2.2.6 Listing of Permits and Approvals

A listing of required discretionary land use approvals and ministerial permits for this project is provided.

Federal Permits and Approvals

U.S. Department of Army, Corps of Engineers
- General Permit (Nationwide Permit)
- Section 106 Consultation, National Historic Preservation Act

U.S. Fish and Wildlife Service
- Section 7 Consultation, Endangered Species Act

U.S. National Marine Fisheries Service
- Section 7 Consultation, Endangered Species Act

State of Hawai‘i Permits

Department of Health

- National Pollutant Discharge Elimination System (NPDES) Individual Permit - Construction Activities
- Section 401 Water Quality Certification, Clean Water Act
- Construction Noise Permit

Board of Land and Natural Resources

- Special Use Permit

Department of Land and Natural Resources, Historic Preservation Division

- Chapter 6E, HRS, Historic Preservation Review

Department of Business, Economic Development and Tourism, Office of Planning

- Coastal Zone Management Act Consistency Determination

County of Hawai‘i Permits

Planning Commission

- Special Management Area Use Permit

Planning Department

- Plan Approval

Department of Public Works

- Grading Permit
- Building Permit

2.3 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

This section discusses alternatives to the proposed Kahalu‘u Ma Kai Project that were identified and considered. Alternatives discussed include: 1) not implementing the redevelopment project, otherwise referred to as the "No-Action" Alternative; 2) adaptive reuse of the hotel building as part of the Kahalu‘u Ma Kai Project; 3) design modifications to the location of buildings and site development from what is currently proposed.

These three alternatives are being eliminated from further consideration due to several factors that are discussed below. The No Action Alternative would serve to establish baseline conditions (without project) to assess impacts resulting from the project.

2.3.1 No Action Alternative

The No-Action Alternative would entail KS not proceeding with the redevelopment of the project site as an educational complex. Under this scenario, the northern half of the property would be re-established as a resort with an operator that would need to be identified. The southern half of the property would continue to be used by KS for limited educational and cultural programs that are currently on-going.

This alternative was eliminated from consideration because it would not meet the purpose and need for the project. The operation of the hotel would likely encounter problems similar to the former operation, and thus would not be an economically feasible long-term operation. Evaluation of the resort's recent operations determined that it had not been profitable for several years, and there were years of deferred maintenance required which the resort operator likely did not have the capital to address.

Conflicts with Project Need and Objectives

Continued use of the resort on the northern half of this property would conflict with KS's overall mission and objectives for West Hawai‘i. The KS goals and priorities of integrating and balancing multiple values (education, cultural preservation, economics, stewardship, and community), articulated in their strategic plan along with their *Kahalu‘u Manowai Education Plan* (KS, 2013), would not be served under this alternative. The economic impracticality of a continued resort operation conflicts with both the educational emphasis identified for the site and the continued cultural preservation of this unique property. Construction of the KBR over 40 years ago resulted in the demolition of portions of the Kapuanoni Heiau. Restoration of this heiau is of upmost importance and cultural significance that would not be possible with the existing hotel and associated facilities. If the proposed project is not pursued, these objectives will not be met under this alternative.

The purpose and need for this project is twofold; 1) to support KS's ‘āina-based educational approach by developing a world-class educational complex; and 2) serve as the piko for an integrated education delivery system in West Hawai‘i. The presence of the property's natural resources, historic sites, and cultural resources are essential to facilitate educational awareness of the environment, sustainability, and cultural practices, for which the project site is uniquely suited to support. Continued resort use on half the project site would severely limit the implementation of the Kahalu‘u Mānowai Education Plan, and compromise learner development in cultural and natural resource management, sustainable living practices, and individual leadership growth. Therefore, the purpose for the Kahalu‘u Ma Kai project would not be realized under this alternative.

Continued Resort Use Not Economically Feasibility

KS evaluation of the KBR property determined that it had not been profitable for at least the past six years, and the resort operator likely did not have the capital to address years of deferred maintenance. Outdated facilities on the property contributed to the resort's operational losses, and it was not able to compete with larger and more contemporary resort destinations such as Waikoloa and Hualālai. It has been estimated that about $25 million in deferred maintenance costs would likely have been required to improve the resort's aging facilities, and an additional $25 million needed to upgrade the resort to reach a "brand standard" as a resort on the Kona coast. In addition, the following changes would have been needed to obtain a positive return on the investment:

1. The average room rate would need to increase significantly (about $250 per night compared to a prior average rate of $150);
2. The occupancy rate needs to average around 80 percent annually; and
3. The operating costs need to be kept at 40 percent.

With these changes to the operations, the expected return on investment would only be about 5.25 percent, which is much too low for such a major investment in the property. Additionally, maintaining 80 percent occupancy in such a competitive market given other resorts and visitor accommodations along the Kona coastline would likely be difficult to achieve. Therefore, upgrading the resort to try to compete with other resorts on the Kona coast does not appear economically feasible.

Need for Restoration of Project Site

A significant change was needed at the project site or it would inevitably result in the hotel's closure even if undertaken by another operator. After several years of evaluating the rich cultural resources in the region, KS acknowledged the cultural significance of the project site, which resulted in a new approach to managing this property, focusing on education.

KS has taken a different approach in the region; to recognize and embrace the cultural significance and opportunities for education at various sites under its ownership. This approach is noteworthy as KS has made the decision to "undevelop" a resort property, and in its place, provide a world-class educational complex. This education complex will serve not only the beneficiaries of Princess Pauahi Bishop's will, but also the current and future residents of West Hawai‘i, the Island of Hawai‘i, the State of Hawai‘i, and visitors as well. This is reflected in the recent restoration of two heiau (Keekū and Hāpai‘ali‘i) that was completed along the shoreline at the project site in 2009. This restoration effort was a step in starting to correct (ho‘oponopono) what has long been an issue for this community and region.

2.3.2 Adaptive Reuse of Hotel

The Adaptive Reuse of Hotel Alternative would entail KS proceeding with redevelopment of portions of the project site to serve as an educational complex. However, the existing hotel structure would remain and be reused as dormitories as part of the program. Under this scenario, the southern half of the property could be redeveloped with some facilities to support educational activities and cultural programs. An investment of about $25 million would likely be required to address deferred maintenance of the hotel, and additional funds would be needed to implement renovations needed to improve the functionality of facilities to serve as dormitories.

This alternative was eliminated from consideration because: 1) it would not meet the purpose and need for the project; 2) it is incompatible with the desired low-impact site development and educational programming use of the property; and 3) it would not be financially feasible or prudent to fund the hotel's renovation and operation to simply serve as a dormitory.

Similar to the No Action Alternative, continued use of the hotel building structure would conflict with KS's overall mission and objectives for West Hawai‘i, and impede implementing the core strategies in the *Kahalu‘u Manowai Education Plan*. Continued use of the hotel structure contradicts with the ʻāina-based education approach KS is implementing at the project site. The hotel is a remnant of Hawai‘i's development history that overlooked cultural, historical, and environmental concerns, which resulted in impacts to the nearshore environment and portions of the Kapuanoni Heiau. Restoration of the shoreline fronting the KBR and Kapuanoni heiau is of high environmental and cultural importance and significance. These objectives would not be met under this alternative.

The renovated hotel would also take up a large portion of the north half of the property, reducing the amount of available space to construct other educational facilities more in line with the ʻāina-based approach that emphasizes the natural environment as a living classroom. The large hotel structure would also be visually and culturally incompatible with the low impact site development intended for this project. A portion of the hotel and its existing support columns would continue being located within the large tide pool and into portions of the Kapuanoni Heiau.

Finally, the need for over 300 dormitory rooms (reusing the hotel) on this site would be excessive and impractical from an operational standpoint. The number of students camping overnight on the site is programmed for only up to 90 persons plus educators and support staff. The size of the hotel exceeds the operational requirements of the educational mission. The experience of sleeping in the renovated former hotel would also detract from the overall cultural experience intended for future learners. Therefore, spending about $25 million to renovate the hotel is not financially prudent or feasible. Furthermore, potential operational costs to run and maintain such a large facility as a dormitory would drain economic resources and not be prudent or practicable.

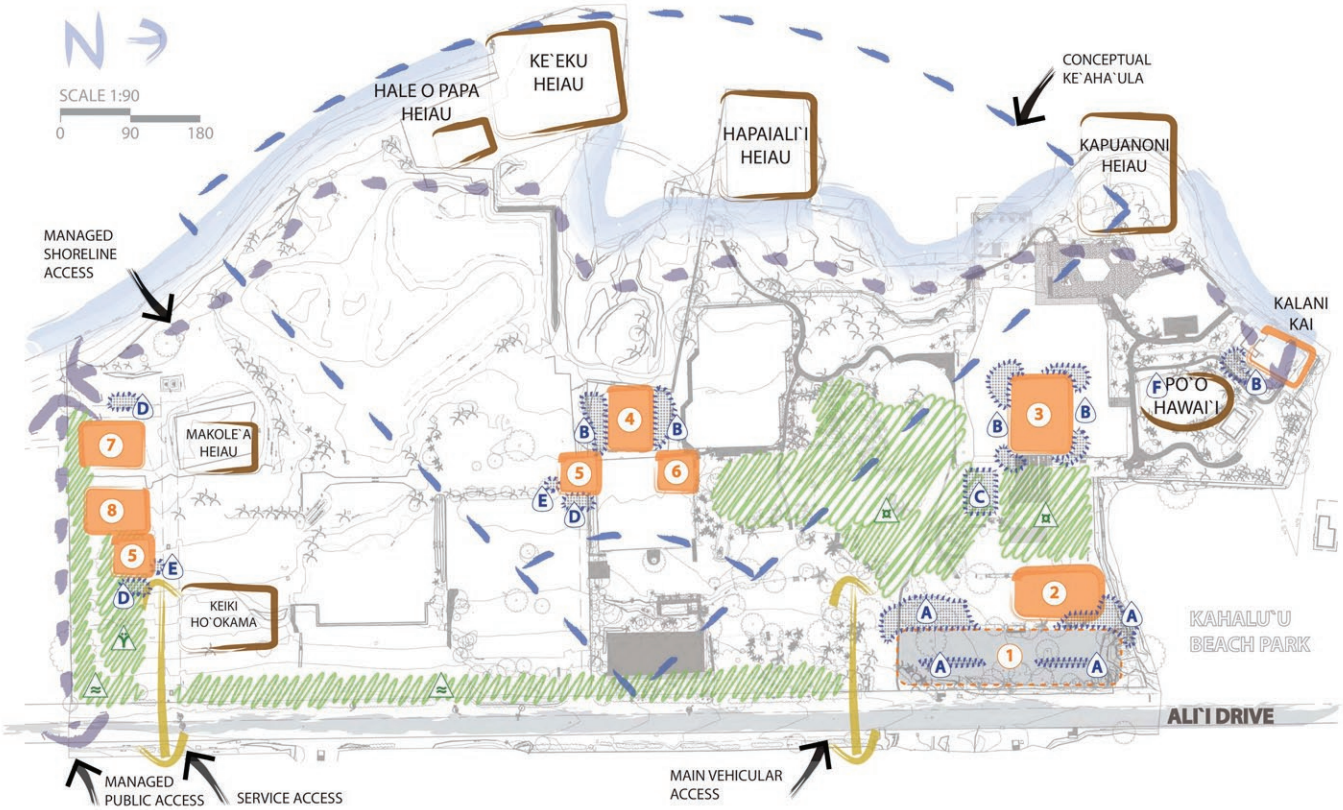
2.3.3 Modifications to Kahalu‘u Ma Kai Site Plan

Three alternative schemes of the currently proposed conceptual site for the project were developed over a four month period in a series of charettes and meetings with stakeholders that included KS staff, educational partners, and community members. Stakeholders were presented the three alternatives, and their input was solicited to identify preferences, opportunities, and constraints. Based upon this input, a hybrid of Schemes 2 and 3 was identified as a preferred plan. Additional discussions with stakeholders were held to further refine the site plan and ensure a high degree of support by the stakeholder group. This resulted in the project’s proposed conceptual site plan identified as “Mālama.” These alternative schemes are identified below and shown on Figures 2.5 to 2.7.

Scheme 1. “Ke‘ahu‘ula”: A sacred boundary, in the form of a Hawaiian cape, preserves the central area as a clear and pure open space, positioning the Halau as the center of the space.

Scheme 2. “Lōkahi”: Develops an experience where the visitor/user transitions from a state of modernity to pre-western contact via environmental changes in experience and procession. The scheme provides an experience of old vs. new. Programmatically, the Camping Hale and Multi-Purpose Building were split apart in this scheme.

Scheme 3. “Ho‘i Ho‘i”: This scheme peels off the existing layers of the modern built environment to reveal and restore the original natural state of the ‘āina, close to or similar to how the ‘āina once was. It restores the sacredness of the site by minimizing site disturbance and planning for all new construction to occur on previously developed areas. In this scheme, Hale Ki‘i is repositioned at the north end of the site near the Camping Hale/Multi-Purpose Building.



Concept
A sacred boundary, in the form of a Hawaiian cape, or 'ahu'ula preserves the central area as a clear and pure open space, housing the Hālau only as the piko of the space.

1. Parking
2. Maintenance
3. Camp/Multi-purpose
4. Hālau
5. Comfort Station
6. Storage
7. Hale Wa'a
8. Hale Ki'i

A. Rain Garden/Bioswale
B. Rain Garden/ Rainwater Catchment
C. Constructed Wetland/ Waste Water Treatment & Storage of Reclaimed Water for irrigation
D. Greywater Garden
E. Compost Toilets
F. Stock with Native Fish

Landscape Buffer
Hawaiian Garden
Transitional Landscape/ Garden

Pros
1. Allows some use of existing building structure and its lower elevation to site new buildings, slightly hiding them from view.
2. Preserves most of the existing landscape on site.
3. Allows Hale Wa`a direct access to existing canoe landing area.
4. Allows for future expansion.
5. Recognizes the significance of the central space of the site, inline with the summer/winter solstice of Hāpai Ali`i and Ke`ekū heiau with a built structure.
6. Consolidates activities of Hale Ki`i and Hale Wa`a.
7. Provides wide flexibility of some open space for larger events if needed, depending on use.
8. Provides clear views from mauka areas above Ali`i Drive and existing mauka heiau to makai heiau, ocean and horizon, with the exception of the Hālau.
10. Constructed wetland onsite wastewater treatment system is on the existing footprint of the hotel to be demolished and near the existing (outdoor) pumping station for an easy tie-in to the existing sanitary sewer.
11. The tie-in to the existing infrastructure could be used in the event treated water from the wetland is not needed for reuse or as a backup system if the system needs to be temporarily offline for any given reason.
12. Nonpotable water sources are available for reuse as irrigation water in a variety of locations on the site.
13. Expands potential for an 'exploratory' path showcasing these sustainable water management features across the site.
14. Centralized onsite wastewater treatement lessens costs.

Cons
1. Farther walk between various buildings and areas. Multiple comfort stations may be required.
2. Harder to secure site with multiple buildings scattered throughout the site.
3. Multiple fire lane access roads will be required.
4. Maintenance storage is not centralized.
5. May require strategic landscape placement to create a buffer/ transition between visitor parking and significant arrival areas.
6. Minimizes flexibility of future expansion with boundary of cape.
7. Buildings are widely separated which increases the number of rain gardens and/or catchment systems, which could increase costs.
8. Building distributed over the entire site increases the development's ecological footprint.

Source: KYA Design Group

Kahalu'u Ma Kai

Figure 2.5 - Ke'ahu'ula Alternative Site Plan

Kahalu'u, Hawai'i

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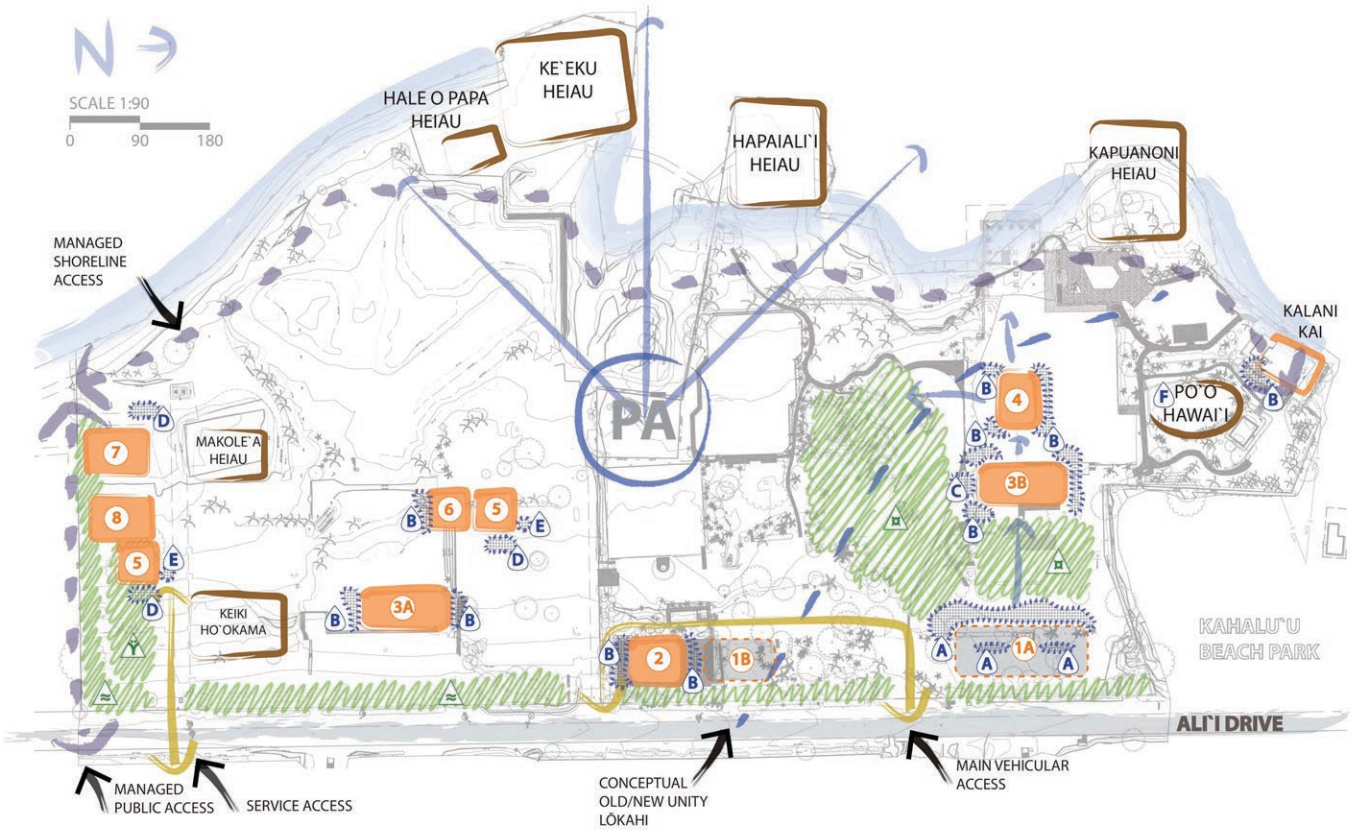

Concept

Develop an experience where the visitor/user transitions from a state of modernity to pre-western contact via environmental changes in experience and procession

Provide an experience of old vs. new

- 1A Visitor Parking
- 1B Staff Parking
- 2 Maintenance
- 3A Camping
- 3B Multi-purpose
- 4 Hālau
- 5 Comfort Station
- 6 Storage
- 7 Hale Wa'a
- 8 Hale Ki'i

- A Rain Garden/Bioswale
- B Rain Garden/ Rainwater Catchment
- C Constructed Wetland/ Waste Water Treatment & Storage of Reclaimed Water for irrigation
- D Greywater Garden
- E Compost Toilets
- F Stock with Native Fish

- Landscape Buffer
- Hawaiian Garden
- Transitional Landscape/ Garden

Pros

1. Allows some use of existing building structure and its lower elevation to site new buildings, slightly hiding them from view.
2. Provides connection to existing Po`o Hawai`i pond, King Kalākaua structure and Kapuanoni heiau with new Hālau.
3. Preserves most of the existing landscape on site.
4. Allows Hale Wa`a direct access to existing canoe landing area.
5. Allows for future expansion.
6. Recognizes the significance of the central space of the site, inline with the summer/winter solstice of Hāpai Ali`i and Ke`ekū heiau with a open space.
7. Consolidates activities of Hale Ki`i and Hale Wa`a.
8. Provides wide flexibility of some open space for larger events it needed, depending on use.
9. Provide clear views from mauka areas above Ali`i Drive and existing mauka heiau to makai heiau, ocean and horizon, depending on heights of Maintenance, Storage and Camping Hale.
10. Isolates use of Camping to just the Camping Hale. This structure can be simplified for this use only.
11. Great access to areas of the site with longer driveway.
12. Allows easier bus/car drop off with driveway configuration.
13. Allows easier drop off for Campers with direct access to Camping Hale.
14. Parking is readily accessible for Maintenance, Multi-purpose and Hālau.
15. Allow for new grading for Pā.
16. Constructed wetland onsite wastewater treatement system is on the existing footprint of the hotel to be demolished minimizing and near the existing (outdoor) pumping station for an easy tie into the existing sanitary sewer. The tie-in to the existing infrastructure could be used in the event treated water from the wetland is not needed for reuse or as a backup system if the system needs to be temporarily offline for any given reason.
17. Potential for a variety of non-potable water gardens at the entrance (greenery without the need or minimization of use of potable water for irrigation).
18. Demonstration of a multitude of natural systems for wastewater management (i.e. compost toilet and constrcted wetlands), which expands the educational experience relating to sustainability.
19. Non-potable water sources are availible for reuse as irrigation water in a variety of locations on the site.

Cons

1. Farther walk to Hale Ki`i and Hale Wa`a.
2. Multiple comfort stations may be required .
3. Harder to secure site with multiple buildings scattered throughout the site.
4. Multiple fire lane access roads will be required.
5. Maintenance storage is not centralized.
6. Sanitary infrastructure is not centralized to just one treatment system which could increase costs.
7. The addition of the camping grounds building places a moderate additional ecological footprint on the property.

Source: KYA Design Group

Kahalu'u Ma Kai

Figure 2.6 - Lokāhi Alternative Site Plan

Kahalu'u, Hawai'i

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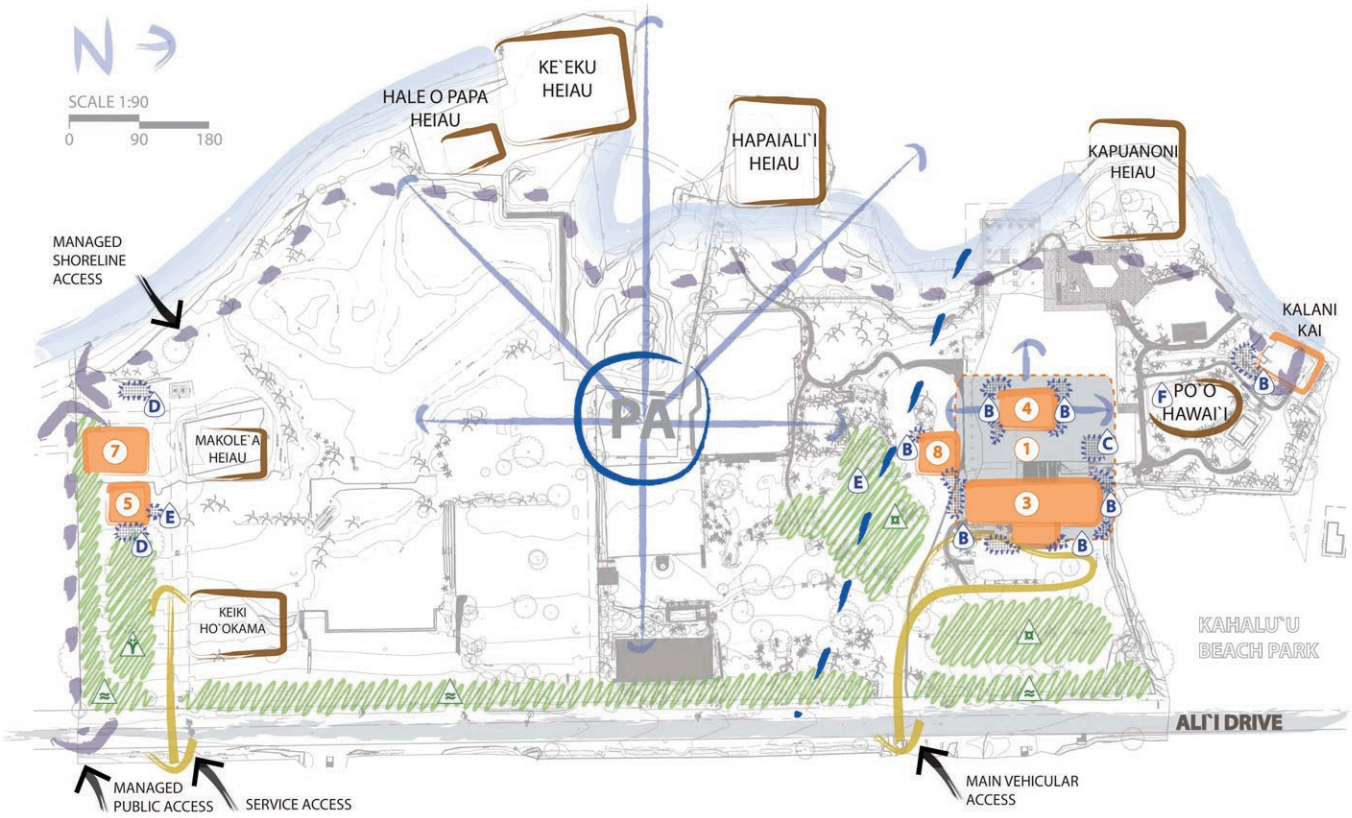

Concept

Peel off the existing layers of the modern built environment to reveal and restore the original natural state of the aina, close to or similar to how the aina was when native Hawaiians inhabited the aina.

Restore the sacredness of the site by minimizing site disturbance and planning for all new construction to be developed on previously constructed areas.

Acknowledge and allow future development of the Mauka site to flow with the Makai site. Blur the physical boundaries between the two areas and reveal the entire ahupua'a of Kahalu'u.

1. [underground] Visitor & Employee Parking, Maintenance/Storage
3. Camp/Multi-purpose
4. Hālau
5. Comfort Station
7. Hale Wa'a
8. Hale Ki'i

A. Rain Garden/Bioswale
B. Rain Garden/ Rainwater Catchment
C. Constructed Wetland/ Waste Water Treatment & Storage of Reclaimed Water for irrigation
D. Greywater Garden
E. Compost Toilets
F. Stock with Native Fish

Landscape Buffer
Hawaiian Garden
Transitional Landscape/ Garden

Pros

1. Allows some use of existing building structure and its lower elevation to site new buildings, slightly hiding them from view.
2. Provides connection to existing Po`o Hawai`i pond, King Kalākaua structure and Kapuanoni heiau with new Hālau.
3. Preserves most of the existing landscape on site.
4. Minimized structural damage due to flood inundation.
5. Allows Hale Wa`a direct access to existing canoe landing area
6. Allows for future expansion.
7. Recognizes the significance of the central space of the site, inline with the summer/winter solstice of Hāpai Ali`i and Ke`ekū heiau with an open space.
8. Consolidates multiple programmatic uses.
9. Provides wide flexibility of some open space for larger events it needed
10. Provide clear views from mauka areas above Ali`i Drive and existing mauka heiau to makai heiau, ocean and horizon.
11. Consolidates supportive facilities, infrastructure, fire lane access
12. Minimizes walking distances between facilities and uses, with the exception of Hale Wa`a.
13. Provides flexibility with natural land uses, i.e., agriculture, landscape, rain water collection, wetland construction, gray water collection, student experimentation/education, outdoor camping, etc…
14. Easier to secure buildings and monitor small developed site
15. Minimizes activity on right (south site) near Hale Wa`a. Less disturbance to neighboring Keauhou Kona Surf and Racquet Club.
16. Allow for new grading for Pā.
17. Vehicular access is minimized to north side and only at Hale Wa`a.
18. Allows visitors/users closer access to Hale Ki`i and its activities.
19. Minimizes areas of disturbance to aina, existing artifacts, known and unknown historically significant areas.
20. Eliminates the need for multiple comfort stations.
21. This scenario minimizes the overall ecological footprint of the development on the site. It allows for the most 'healing' of the land since building footprints are clustered in one location.
22. Potential for a variety of non-potable water gardens at the entrance (greenery w/out or minimizing the need for potable water irrigation).
23. Centralized onsite wastewater treatement lessens cost.
24. Constructed wetland onsite wastewater treatement system is on the existing footprint of the hotel to be demolished and near the existing (outdoor) pumping station for an easy tie-in to the exisiting sanitary sewer. The tie-in to the existing infrastrcture could be used in the event treated water from the wetland is not needed for reuse or as a backup system if the system needs to be temporarily offline for any given reason.
25. Places the sustainable water features in close proximity for onsite learning.

Cons

1. Farther walk between developed area and Hale Wa`a.
2. If development is restricted to North side, future expansion is potentially minimized .
3. Non-potable water sources are limited to just one side of the property. All other irrigation needs for the other side of the propery may need to come from potable water sources.

Source: KYA Design Group

Kahalu'u Ma Kai

Figure 2.7 - Ho'i Ho'i Alternative Site Plan

Kahalu'u, Hawai'i

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CHAPTER 3
DESCRIPTION OF AFFECTED ENVIRONMENT

This chapter describes the existing environment that would be affected by the Kahaluʻu Ma Kai project. The existing natural environment and resources present on the property along with the infrastructure and public facilities serving the site and surrounding area are described.

3.1 GEOGRAPHY, TOPOGRAPHY AND SOILS

Climate

The State of Hawaiʻi climate is relatively moderate throughout the island chain, although some differences in these conditions may occur from one location to another due to the mountainous topography associated with each island. Annual and daily variation in temperature depends to a large degree on elevation above sea level, distance inland, and exposure to the trade winds. The topography of the island of Hawaiʻi is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualālai, the Kohala Mountains and Kīlauea. The island consists entirely of the slopes of these mountains and of the broad saddles between them.

The annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than at higher elevations. At the Old Kona Airport, located approximately 12 miles north of the project site, average daily minimum and maximum temperatures are 67 degrees Fahrenheit and 83 degrees Fahrenheit, respectively. Temperatures at the project site located along the coastline are similar.

Nearly the entire western coast of the island is sheltered from the trade winds by high mountains, except when unusually strong tradewinds sweep through the saddle between the Kohala Mountains and Mauna Kea. Due to wind shadow effects caused by the terrain, winds in the project area are predominantly light and variable. Local winds such as land/sea breezes or upslope/down slope winds dominate the wind pattern for the area. During the daytime, winds typically move onshore because of sea breeze and upslope effects. At night, winds generally are land breezes that move down slope and out to sea. During winter, occasional strong winds from the south or southwest occur in association with the passage of winter storm systems (B.D. Neal & Associates, 2013).

Rainfall in Hawaiʻi is highly variable depending on elevation and location with respect to the trade winds. The climate of the project area is somewhat wetter than might be expected for a leeward location due to the persistent onshore and upslope movement of marine air resulting in rainfall during afternoons and evenings. Available information from a Hōlualoa Beach weather station (about 3 miles north of the project site) had a mean annual rainfall of about 30 inches, with each month registering about 2 to 3 inches (WRCC, 2013).

3.1.1 Geography

The Island of Hawai‘i is the largest of the State's eight major islands, and has a total area that exceeds the rest of the other island areas combined. Geologically, this island is the youngest in the Hawaiian Archipelago with rocks from its earliest volcano indicating an age of about 700,000 years. In contrast, Kaua‘i is over 5 million years old. Five shield volcanoes formed the Island of Hawai‘i: Kohala, Mauna Kea, Mauna Loa, Hualālai, and Kīlauea. Kohala is considered extinct, Mauna Kea and Hualālai are considered dormant, and Mauna Loa and Kīlauea are active volcanoes (Fukunaga and Associates, Inc., 2010).

Because of the highly pervious nature of many of the surface rocks, the island has only a limited number of perennial streams. These streams are found on the eastern (or windward) slopes of Mauna Kea and Kohala Mountain. A few streams flow perennially in their upper reaches but lose their water flowing over the permeable ground well before reaching the coast.

There is little evidence of extensive coastal-plain sedimentation and of deep erosion, except in the northeastern slopes of the Kohala and Mauna Kea mountains. As a result, sedimentary materials are sparse and scattered. They include alluvium, talus, dune and beach deposits, and glacial deposits on Mauna Kea (Fukunaga and Associates, Inc., 2010).

3.1.2 Topography

The topography associated with most of the project site is generally level, and gently sloping from Ali‘i Drive toward the shoreline in a western direction. Much of the area has been previously modified as part of the development of the KBR and Kona Lagoon Hotel. Elevations at the site are greatest along Ali‘i Drive starting at an elevation of about 15 feet above mean sea level (AMSL) to the north (near Kahalu‘u Beach Park), increasing to about 25 to 27 feet AMSL near the center of the site, and then decreasing to 25 feet AMSL at the southern end. Being a shoreline parcel, elevations then decrease to 0 feet AMSL at the shoreline. The property generally slopes towards the ocean at a grade of between 4.0 to 4.4 percent.

There are no perennial or intermittent streams or large drainageways routed through the site. The property does have other distinctive site features consisting of large tide pools fronting the KBR hotel and existing tennis courts that are bounded by rock walls on the mauka side (Exhibit 3.1). The Po‘o Hawai‘i anchialine pond is located on the northern end of the site at the 4-foot elevation situated between the KBR hotel and Kalani Kai structure. Another small anchialine pond is located between the KBR hotel and tennis courts in a heavily landscaped area at the 6-foot elevation.

The south beach section of the project site has a slight slope down toward the ocean (Exhibit 3.2). The grade change in this area is about 18 percent from the grassed area (8 feet AMSL) to the ocean.

Exhibit 3.1 Existing Tide Pools

3.1.3 Soils

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service classifies soils of the project site as comprised of: 1) Lava Flows, Pāhoehoe; and 2) Punalu‘u Series association of soils. The majority of the project site is designated as Lava Flows while the northern end of the project site has the Punalu‘u Series. Figure 3.1 shows the soils classification for the project site.

Exhibit 3.2 South Beach Section of Property

A description of this soil type based upon the *Soil Survey of Island of Hawaii, State of Hawaii* (SCS, 1973) study is provided below.

- <u>Punalu‘u, Extremely Rocky Peat, 6 To 20 Percent Slopes, (rPYD).</u> The Punalu‘u series consists of well drained, thin organic soils over pāhoehoe lava bedrock. These soils are gently sloping to moderately steep. A representative profile shows the surface layer as black peat about 4 inches thick, and underlain by pāhoehoe lava bedrock. The permeability of peat is rapid, while the pāhoehoe lava is very slow, although water moves rapidly through the cracks. Runoff is slow, and erosion hazard is slight.
- <u>Lava Flows, Pāhoehoe (rLW).</u> This lava has a billowy, glassy surface that is relatively smooth. Pahoehoe lava typically has no soil covering and is typically bare of vegetation except for mosses and lichens. In areas of higher rainfall, scattered ‘ōhi‘a trees, ‘ōhohielo berry, and ‘a‘ali‘i have gained a foothold in cracks and crevices.

Soils on the project site have been modified considerably as part of the resort’s construction, and thus current soil conditions do not reflect typical Pāhoehoe lava characteristics. Much of the project site has been modified to allow for extensive landscaping with grass and other vegetation along with creating foundations for building structures, pavement, etc.

Source: Soils Survey of Island of Hawai'i, State of Hawai'i (SCS, 1973)
State DBEDT GIS Data

LEGEND

- rLW - Lava Flows, Pahoehoe
- rPYD - Punalu'u, Extremely Rocky Peat, 6 to 20% Slopes

Kahalu'u Ma Kai

Figure 3.1 - Soil Survey Map

Kahalu'u, Hawai'i

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3.2 NATURAL HAZARDS

This section addresses natural hazards that may be applicable to the project which consist of earthquakes, lava flows, hurricanes, tsunami flooding hazards, and sea level rise.

3.2.1 Earthquake Hazards

Earthquakes in the State are mainly associated with volcanic eruptions resulting from the inflation or shrinkage of magma reservoirs beneath the surface of the earth, which shift segments of the volcano. Volcanism is the source of energy for approximately 95 percent of the earthquakes on the Island of Hawai‘i. The central region of the State encompassing Maui and O‘ahu has seismicity generally related to tectonic activity on the seafloor near the Hawaiian Islands (USGS, 2002).

The Island of Hawai‘i experiences thousands of earthquakes each year, however, most are so small that they can only be detected by instruments. There are some earthquakes strong enough to be felt, and a few cause minor to moderate damage. Most of this island’s earthquakes are directly related to volcanic activity, and are caused by the movement of magma within Kīlauea or Mauna Loa. A few quakes are related to movements along fault zones located at the base of the volcanoes or deeper within the crust.

Seismic tremors on the island have caused ground cracks, landslides, ground settlement, tsunami, and mudflows. Strong earthquakes of magnitude 5 or higher on the Richter Scale can cause property damage and endanger lives. The locations of larger damaging earthquakes of magnitude 6 or greater since 1868 on the Island of Hawai‘i have generally occurred on the southern half of the island primarily on the eastern end. The most recent large earthquake occurred in October 2006 with a magnitude of 6.7 at a distance of 10 miles north-northeast of Kailua-Kona (USGS, 2012). Exhibit 3.3 graphically shows the history of larger earthquakes in the State up to 2002. The seismic risk for the entire Island of Hawai`i is Zone 4 Seismic Probability Rating (Uniform Building Code, Appendix Chapter 25, Section 2518). Zone 4 areas are at risk from major earthquake damage, especially to poorly designed and/or built structures.

3.2.2 Lava Flow Hazards

The U.S. Geological Survey completed a mapping program to determine the history and severity of the Island of Hawai‘i’s volcanic hazard. Volcanoes in Hawai‘i erupt either at their summits where lava collects, and may over-flow from craters called calderas, or along their flanks through fractures called rift zones. The hazard is associated with lava flows, explosive eruptions, airborne lava fragments, poisonous and corrosive volcanic gases, and ground cracks and settling. Lava flows rarely endanger human life, however, loss of property and economic devastation are the most frequent consequences. At the coastal zone with diminished slope in topography, flowing lava tends to slow and spread laterally causing damage along the shoreline (USGS, 2002).

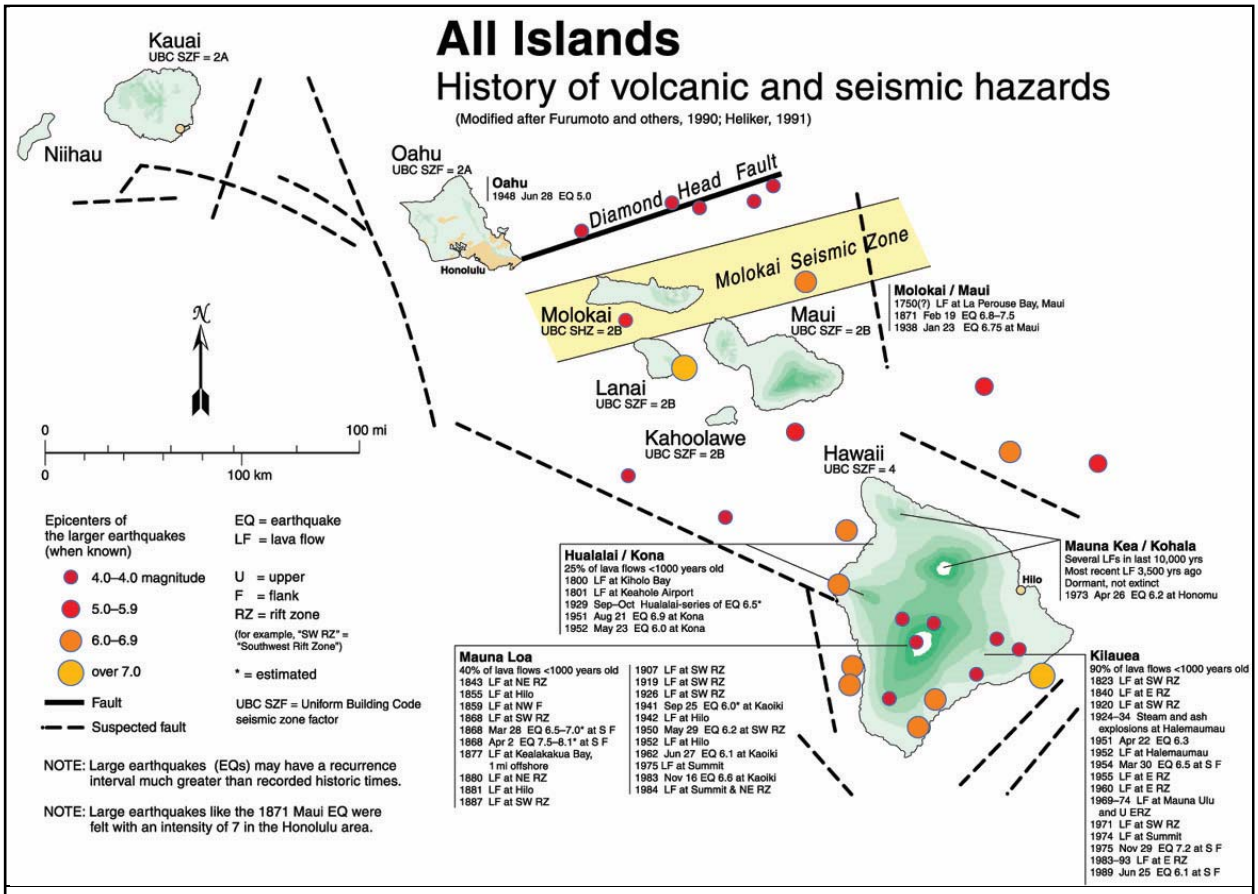


Exhibit 3.3 History of Volcanic and Seismic Hazards (USGS, 2002)

A lava flow hazard zone map divides the island into zones ranked from 1 through 9 based on the occurrence probability of lava flows, with 1 indicating the greatest risk and 9 the least. Based upon this map shown on Exhibit 3.4, the project site has a hazard zone rating of 4. Zone 4 areas have experienced 1 to 5 percent lava coverage since 1800 and less than 15 percent coverage in the last 750 years. It includes all of Hualālai, where the frequency of eruptions is lower than Kīlauea and Mauna Loa (USGS, 2002).

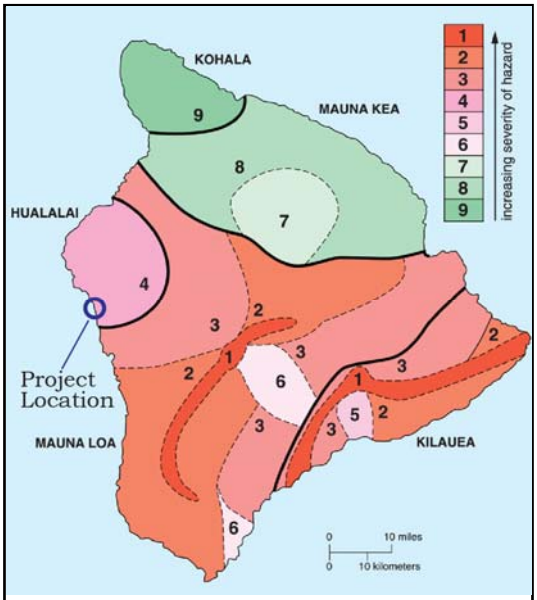


Exhibit 3.4 Lava Flow Hazard Map (USGS 2002)

3.2.3 Hurricane Hazards

Hurricanes are one type of tropical cyclone affecting the State that also include tropical storms and tropical depressions. Hurricanes are tropical storms with winds equal to or greater than 74 miles per hour. They have

affected every island and can cause major damage and injury usually resulting from high winds, marine over-wash, heavy rains, and other intense small-scale winds and high waves.

Between 1970 and 1992, 105 tropical cyclones were identified in the central Pacific region resulting in an average of 4.5 storms per year. Not all of these storms directly pass thru the State, and actual hurricane strikes on the Hawaiian Islands are relatively rare in the modern record. Exhibit 3.5 graphically shows the paths of hurricanes affecting the Hawaiian Islands. More commonly, near-misses generating large swells and moderately high winds causing varying degrees of damage are the result of hurricanes passing close to the islands. The greatest threat related to hurricanes is due to water-level rise from wave forces rather than wind forces. All coastal areas of the State are equally vulnerable to hurricane impacts, and the only mitigating variables are local in nature (e.g. slope, elevation, geology, offshore barriers) (USGS, 2002).

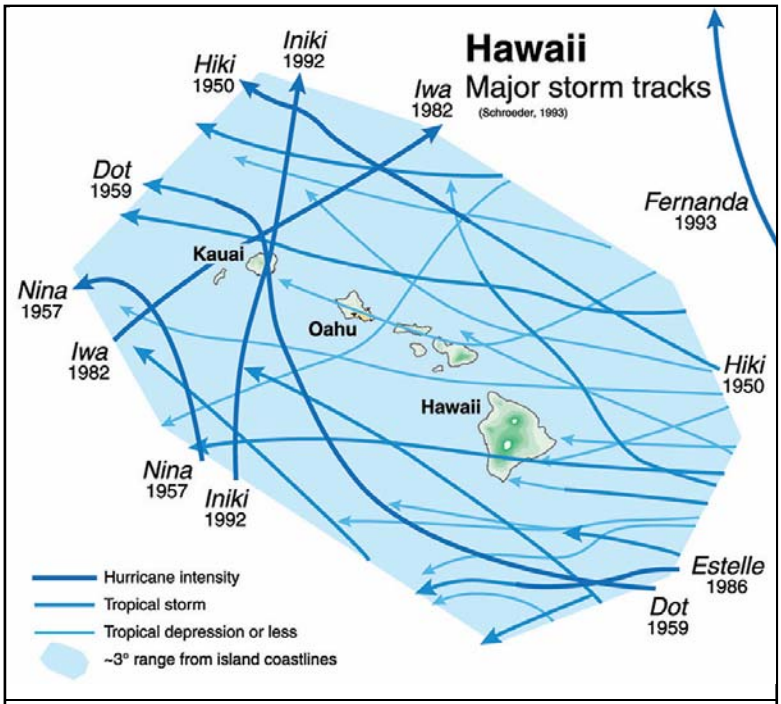


Exhibit 3.5 Major Storm Tracks (USGS, 2002)

3.2.4 Tsunami and Flood Hazards

<u>Tsunami Hazards</u>

Tsunamis are caused by a sudden movement of the seafloor that generates a series of waves which travel across the ocean until they reach a coastline. Seafloor movements may include faulting, landslides, or submarine volcanic eruptions. Landslides originating either under the sea or above sea level and then sliding into the water may also generate a tsunami. Tsunamis manifest themselves as either large breaking waves, often largest around headlands where they are concentrated by wave refraction, or as rapidly rising sea level like a flooding tide. The high degree of volcanism and seismic instability in and around the Pacific Ocean has contributed to a history of tsunami occurrences.

The coastline of the Hawaiian Islands is under the continuous threat of tsunami inundation because this region is one of the most geologically active regions on Earth. The geography of the shoreline often plays an important role in the form of the tsunami. Tsunami waves may be very large in an embayment, actually experiencing amplification in long funnel-shaped bays. Fringing and barrier

reefs, along with protective structures such as the jetties and breakwaters, appear to have a mitigating influence on tsunamis by dispersing the wave energy (USGS, 2002). The project site has a broad basaltic bench along the coastline about 725 feet wide that extends from the shoreline to the outer shoreline cliff face.

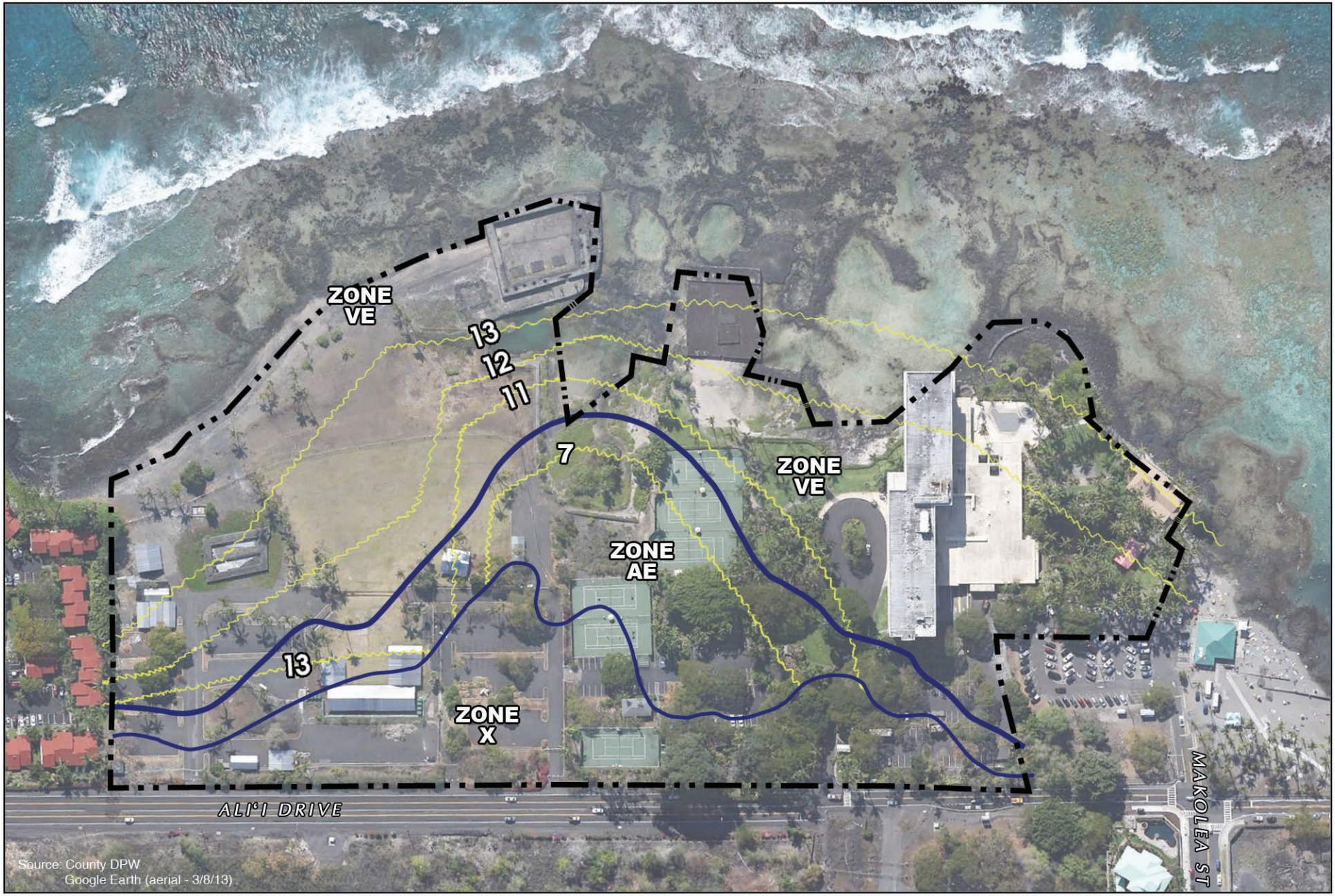
The coastline between Kailua-Kona and Kealakekua Bay has recorded tsunami run-up heights from a low of 2 feet (1952) up to 16 feet (1960) (USGS, 2002). In March 2011, a tsunami was generated from a large earthquake generated off of Japan which affected the entire State. Recorded tsunami run-up heights at Keauhou Bay from that tsunami ranged from about 2 to 3.5 feet in height (NOAA, 2014). The tsunami evacuation zone designated at the project site extends to the area slightly inland (mauka) of Ali‘i Drive.

Flood Hazards

Floods caused by heavy rainfall and strong winds normally occur during the winter months. However, historic rainfall data for this leeward coastline shows the most frequent rainfall generally occurs during the summer (May to July) with July having the highest average (3.02 inches) (WRCC 2013). Overall, annual rainfall along this coastline is fairly low reducing the potential for flooding. However, the project site is subject to flooding hazards associated with wave action with a large portion of the property situated within the flood zone.

Figure 3.2 shows the flood zones present within the property based upon Flood Insurance Rate Map (FIRM) information from the State’s flood hazard assessment tool. As shown on this figure, much of the flood area is designated as Zone VE; that is the coastal flood zone with velocity hazard (wave action). The remaining flood area is designated as Zone AE, 100-year flood with base flood elevations determined. The remainder of the site is located in Flood Zone X, areas outside of the 500-year floodplain. Zone VE areas include much of the northern and southern sections of the property extending up to Ali‘i Drive, and encompasses the KBR hotel and some existing structures on the south end. The Zone VE hazard area does not extend as far inland in the middle section of the project site, however, the Zone AE (100-year flood) hazard area does encompass most of these inland areas.

However, the flood hazard lines do not match contours of actual ground conditions at the site based upon a topographic survey conducted. Actual site conditions reflect elevations that could reduce the extent of the flood hazard areas shown for the site by the FIRM. Consultation with the County’s National Flood Insurance Coordinator was conducted by Belt Collins Hawai‘i to address this situation, and the County decided that interpretation of flood boundaries will be determined by the County under Section 27-16(c) of the Hawai‘i County Code.



LEGEND

12 Base Flood Elevation

Zone VE: Coastal Flood Zone with Velocity Hazard

Zone AE: 100-Year Flood with Base Flood Elevations Determined

Zone X: Areas Outside the 500-Year Flood Zone

Kahalu'u Ma Kai

Figure 3.2 - Flood Zone Map

Kahalu'u, Hawai'i

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This code allows the Director of the County Department of Public Works (DPW) to make interpretations of the boundaries of special flood hazard areas. The County determined that a detailed flood elevation study would not be required for this project; a Conditional Letter of Map Revision is not anticipated; and FEMA review and approval is not anticipated. New construction and substantial site improvements will require compliance with the County's floodplain management regulations (Section 27 of the County Code), and coordination with the County to interpret the specific boundaries of flood hazard areas.

3.2.5 Sea-Level Rise

Sea level in Hawai'i and around the globe is rising due to ocean thermal expansion and the melting of ice sheets and glaciers. These underlying causes of sea level rise are driven by climate change, and as the climate and the oceans continue to warm, it is projected that global mean sea levels will rise at an increasing rate over the next century and beyond. Sea level rise can exacerbate the impacts of coastal hazards, and render low-lying coastal areas more vulnerable to inundation from tsunami, storm surge, and high water events. Similarly, as sea levels and the adjacent landside water tables rise, coastal areas will experience drainage issues and an increased risk of flooding especially during heavy rainfall events.

The Intergovernmental Panel on Climate Change has projected a global mean sea level rise ranging from 0.26 m (10.2 in.) to 0.98 m (38.6 in.) (IPCC 2013). The Sea Level Rise and Coastal Land Use Policy Toolkit published by the University of Hawai'i Sea Grant College Program in 2011 suggests, "the governor or state legislature should direct state agencies to incorporate a sea-level rise benchmark of 1-foot-by-2050 and 3-feet-by-2100 in planning and permitting processes and decision-making" (CICAP 2011). Based upon a model and flooding viewer available by the National Oceanic and Atmospheric Administration showing projected sea level rise, the area within the project site affected by a 1-foot rise would generally include only the area of the tide pools along the shoreline (http://www.csc.noaa.gov/digitalcoast/tools/slrviewer).

This policy toolkit has identified three basic approaches to sea level rise adaptation:

- *Accommodation* - Adjustment of an existing system to changing natural conditions (e.g., strengthening flood-proofing regulations or expanding hazard zones).
- *Protection* - Hardening of a system in its existing location to withstand impacts from changing conditions (e.g., shoreline hardening such as seawalls and revetments).
- *Retreat* - Relocating existing structures to avoid impacts.

The project site generally slopes from Ali'i Drive down towards the ocean, leaving the low-lying coastal areas most vulnerable as sea levels increase. Currently these low-lying lands are occupied by native Hawaiian cultural sites, as well as the KBR hotel. New facilities planned would be located a considerable distance away from the shoreline as part of efforts to adapt to sea level rise, and is discussed in Chapter 4.

3.3 HAZARDOUS MATERIALS

A hazardous material inspection of the KBR hotel was conducted by EnviroQuest, Inc. between January and March, 2013. The inspection's objective was to determine the possible presence and location of asbestos-containing materials (ACM), lead-based paints (LBP), arsenic containing materials, polychlorinated biphenyl (PCB) containing fluorescent light ballasts, polychlorinated biphenyls containing oils, underground storage tanks (USTs), aboveground storage tanks (ASTs), and smoke detectors that would be disturbed by the building's demolition (EnviroQuest, Inc., March 2013). A summary of the inspection results is provided.

1. Asbestos. A total of 1,146 samples were collected from suspect asbestos-containing materials. Sampling methodology followed the general guidelines for bulk asbestos sampling under Section 40, Part 763 (AHERA) of the Code of Federal Regulations (CFR) and Hawai'i Administrative Rules (HAR) 11-501 and 11-502. The laboratory analytical report determined that 131 of the 1146 samples were identified as ACM. As a result, the ACMs must be removed prior to demolition of the hotel.
2. Lead. One hundred fifty three (153) surface measurements were collected from painted or coated materials; 61 paint chip samples were collected from painted or coated materials; and about 127 roof pipe vents with lead sheathing were observed on the 2nd floor roof and the main roof of the hotel building. Sampling methods generally followed the "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing" published by the Department of Housing and Urban Development (HUD) in 1995. Four lead in paint measurements and two paint chip samples exceeded EPA guidelines for lead in paint. The EPA does not require that lead paint and materials be removed prior to any renovation or demolition activity. However, the requirements of the Occupational Safety and Health Administration (OSHA) and Hawai'i Division of Occupational Safety and Health (HIOSH) would need to be complied with regarding worker exposure. This requires workers being informed of the material containing lead, and receiving proper training under OSHA.
3. Arsenic. The interior and exterior of buildings were visually surveyed for suspect arsenic-containing materials. Two composite samples from potential arsenic containing materials were collected from a 2nd floor roofing insulation and pressed wood wallboard from space used by local artists at the hotel. Laboratory analysis determined the insulation and wallboard were not arsenic-containing materials.
4. Polychlorinated Biphenyl (PCB) Ballasts. The interior of the buildings were visually surveyed for fluorescent light fixtures, and about 10 percent were randomly selected to be a representative cross section of the property. The light fixtures were dismantled to expose the ballasts for inspection to determine if they were marked with a manufacturer's label of "No PCBs". About 60 light fixtures were examined, and no PCB's containing ballasts were identified.

5. PCB In Oil. One oil sample was collected from the oil reservoir in the elevator machine room, and submitted for analysis. PCBs were not identified in the sample.
6. Underground/Aboveground Storage Tanks (USTS and ASTS). There is an out of use UST located in the northeast corner of the property. Further research will be conducted during the project's design to verify if the tank was removed and closed properly. Two ASTs observed behind a fence on the northwest end of the hotel site were removed.
7. Smoke Detectors. A total of 616 individual smoke detectors were identified throughout the hotel building. The smoke detectors may contain a small amount of radioactive source material. Therefore, the smoke detectors should be collected and disposed of or recycled in accordance with state and federal guidelines prior to demolition.

3.4 BOTANICAL RESOURCES

Geometrician Associates conducted a botanical survey of the project site which included a full assessment of flora and vegetation. The objectives of the botanical survey were to: 1) describe existing vegetation; 2) list all species encountered; and 3) identify threatened or endangered plant species. This study is included in Appendix C of this document.

The project area was surveyed in May 2013, and plant species identified in the field with special attention given to the possible presence of any federally listed threatened or endangered plant species. Definitive identifications to at least the genus level were made for all but a few species. Those not identified were due to specimens being sterile or juvenile, however, these species were non-native ornamental or weed species.

Existing Vegetation on Project Site

The vegetation in fairly undisturbed littoral areas of Kona are described as strand vegetation, in which the flora consists of largely pantropical species that disperse in the ocean, are tolerant of salt, and do not often occur inland. Early Hawaiian agricultural and residential activities, together with the spread of weedy plants and trees, have largely transformed these areas, although remnants of the original shoreline plants remain.

The current landscape planting theme of the property is generally typical of resort hotels in the Kona area. Some native plant material exists on site (very little), but most of the landscape is represented by commonly used non-native tropicals. A distinctive feature of the landscape at Kahalu'u is the collection of tropical palm trees on the property. The southern half of the project site is generally open grass area now used by KS for Hawaiian cultural and educational activities. There are also a few small waste areas dominated by weeds within these former KLH grounds. Finally, the coastal fringe has natural or semi-managed littoral areas, and other areas that appear to contain wetland vegetation. These areas are shown on Figure 3.3.

Most of the plants present on the project site are non-native species, with only 11 certain native species. A full list of the roughly 150 plant species found in the surveyed areas is contained in Table 1 of Appendix C. Of the many non-native species present, some individuals are notable because of their size, beauty and general cultural significance, including Polynesian introductions such as coconut palms (*Cocos nucifera*), kukui (*Aleurites moluccana*) and kamani (*Calophyllum inophyllum*); 19th century introductions with special meaning in Kona, such as tamarind (*Tamarindus indica*); and later introductions that are especially scenic, including royal poinciana (*Delonix regia*).

There were 10 indigenous (found in Hawai‘i as well as elsewhere) species which included the trees hala (*Pandanus tectorius*) and kou (*Cordia subcordata*); the shrubs ‘uhaloa (*Waltheria indica*) and naupaka (*Scaevola sericea*); the herbs akulikuli (*Sesuvium portulacastrum*) and pohinahina (*Vitex rotundifolia*); the vine pohuehue (*Ipomoea pes-caprae*); the fern ally moa (*Psilotum nudum*); and the sedges ahuawa (*Mariscus javanicus*) and *Pycreus polystachyos*. There were also three (3) species likely to be indigenous consisting of: the trees hau (*Hibiscus tiliaceus*) and milo (*Thespesia populnea*), and the grass *Chrysopogon aciculatus*.

Five (5) individual palms of the listed endangered plant species loulu (*Pritchardia maideniana*) were found on the project site. Geometrician Associates also had a follow-up visit conducted by the Manager of the Amy B.H. Greenwell Ethnobotanical Garden in Captain Cook to confirm the identification and location of these specimens of the *Pritchardia maideniana*. Figure 3.4 is a portion of an existing tree map that identifies the locations of the *Pritchardia maideniana*. This species is federally listed as endangered and is almost extinct in the wild. This species of palm is native to the Keauhou/Kahalu‘u area, and may have been a dominant plant in the area in pre-historic times. These endangered loulu palms (*Pritchardia maideniana*) were presumably planted as part of landscaping for the property.

In general, the flora of the project area is not sensitive from a conservation biology perspective, as the property is essentially a garden consisting of mostly non-native ornamental plants that have mainly aesthetic value which are consistent with the site’s former resort use. There were no other endemic species (found in Hawai‘i and nowhere else) identified on the project site. No existing or proposed federally designated critical habitat is present on the property. No other threatened or endangered species was observed on the property, and given the context of this environment, none are likely to be present.

Source: Geometrician Associates, 2014

Kahalu'u Ma Kai

Figure 3.3 - Location of Strand Vegetation and Potential Wetland Areas

Kahalu'u, Hawai'i

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Kahalu'u Ma Kai

Figure 3.4 - Existing Tree Plan Identifying Loulu Palm (*Pritchardia Maindeniana*)

Kahalu'u, Hawai'i

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Pritchardia Maideniana Description

Pritchardia maideniana is a long-lived fan palm that can reach up to 33 to 82 feet (10 – 25 m) in height. It has a smooth, grayish trunk 6 to 12 inches in diameter. It is one of 19 native species of the fan palm genus Pritchardia, distinguished by undulating, pale green and often yellowing blades, and almost round black fruits (seeds) (NTBG, 2014). It's crown typically contains 20 to 30 ascending, spreading, and sometime drooping leaves with the 3- to 4-foot-long and wide wavy and folded, diamond-shaped blades (Hodel, November 2012).

It is typically grouped around brackish water ponds near sea level to scattered or grouped in dry to moist forest up to 2,300 feet elevation. This range encompasses an area with a long history of intense human activity, and thus it is difficult to determine if individuals are natural and wild versus remnants of cultivated plants. This palm played a significant role in Hawaiian culture and everyday life, and was probably commonly cultivated. It was readily accessible, and utilized for several uses such as hats (leaves), food (fruits), and shelter (leaves) (Hodel, November 2012).

3.5 AVIFAUNA AND FAUNAL RESOURCES

Rana Biological Consultants conducted an avian and terrestrial mammalian survey of the project site, and this study is included in Appendix D of this document. The primary purpose of the survey was to determine whether any species currently proposed for, or listed as threatened or endangered under either federal of State of Hawai'i endangered species statutes are present within the project site. Fieldwork was conducted in August 2013. There is no federally delineated Critical Habitat present on or adjacent to the project site.

3.5.1 Avian Survey

Four avian count stations were sited across the project site, and a single eight-minute avian point count was made at each of the four count stations using binoculars and listening for vocalizations. The counts and subsequent searches of the site was conducted between 7:00 a.m. and 10:00 a.m. Time not spent counting the point count stations was used to search the remainder of the site for species and habitats not detected during the point counts.

Avian Survey Results

A total of 303 individual birds of 16 species, representing 12 separate families, were recorded during the station counts, and these species are identified on Table 3.1. Two of the species detected are native species consisting of: 1) Pacific Golden-Plover (*Pluvialis fulva*), and 2) Wandering Tattler (*Tringa inacana*). Both are indigenous migratory shorebird species. The remaining 14 species are alien to the Hawaiian Islands. No avian species currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs were detected during the course of this survey.

Table 3.1
Avian Species Detected Within the Project Area

Common Name	Scientific Name	Status	Relative Abundance
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Chicken (Domestic)	*Gallus sp.*	D	0.25
	CHARADRIIFORMES		
	CHARADRIIDAE – Lapwings & Plovers Charadriinae - Plovers		
Pacific Golden-Plover	*Pluvialis fulva*	IM	1.00
	SCOLOPACIDAE – Sandpipers, Phalaropes & Allies		
	Scolopacinae – Sandpipers & Allies		
Wandering Tattler	*Tringa incana*	IM	0.25
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	2.00
Zebra Dove	*Geopelia striata*	A	23.30
	PASSERIFORMES		
	ZOSTEROPIDAE - White		
Japanese White-eye	*Zosterops japonicus*	A	8.00
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	13.50
	THRAUPIDAE - Tanagers		
Yellow-billed Cardinal	*Paroaria capitata*	A	3.50
	EMBERIZIDAE - Emberizids		
Saffron Finch	*Sicalis Flaveola*	A	3.50
	CARDINALIDAE – Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	3.00
	FRINGILLIDAE - Fringilline and Carduline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Haemorhous mexicanus*	A	6.50
Yellow-fronted Canary	*Serinus mozambicus*	A	0.75
	PASSERIDAE - Old World Sparrows		
House Sparrow	*Passer domesticus*	A	4.00
	ESTRILDIDAE - Estrildid Finches		
Lavender Waxbill	*Estrilda caerulescens*	A	1.0
Common Waxbill	*Estrilda astrild*	A	2.75
Java Sparrow	*Padda oryzivora*	A	2.50

KEY:
A Alien Species
IM Indigenous Migrant – Native but not unique to Hawai‘i, migrant species that does not breed in Hawai‘i
D Domesticated – A species which is introduced and is not established in the wild on the Island of Hawai‘i
Relative Abundance: Number of birds detected divided by the number of count stations (4)

As shown on Table 3.1, avian diversity was low, though in keeping with the habitat present on the site. Three species accounted for 57 percent of all birds recorded during the station counts, and these were the Zebra Dove (*Geopilia striata*), Common Myna (*Acridotheres tristis*), and House Finch (*Haemorhous mexicanus*). Zebra Dove was the most frequently recorded species, accounting for 31 percent of the total number of individual birds recorded during station counts.

3.5.2 Mammalian Survey

The mammalian survey was conducted concurrently with the avian survey, and 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 site.

Mammalian Survey Results

All terrestrial mammals currently found on the Island of Hawai‘i are alien species, and most are ubiquitous. The exception to this is the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or ‘ōpe‘ape‘a as it is known locally. The endangered Hawaiian hoary bat was not detected during this survey. Although no Hawaiian hoary bats were recorded during this survey, this species is regularly seen foraging over the nearshore areas of the property on a seasonal basis. This species is found in almost all areas in the mid-to-low elevation areas on the island that still maintain dense tree cover.

Three terrestrial mammalian species were detected during the survey. One dog (*Canis familiaris*) was seen on the property adjacent to the area along the southern boundary. Three cats (*Felis catus*) were seen on the grounds of the KBR hotel, and several small Indian mongooses (*Herpestes auropunctatus*) were seen at various locations on the property.

The findings of the mammalian survey are consistent with the location of the site, and the habitat present on it. All of the terrestrial mammalian species recorded during this survey are alien and deleterious to avian and floristic components of the remaining native ecosystems present on the Island.

Although no rodents were detected during the course of this survey, it is probable that the four established *muridae* known from the Island of Hawai‘i use resources within the subject site and within the general project area on a seasonal or temporal basis. These rodents are the European house mouse (*Mus musculus domesticus*), roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), and possibly the black rat (*Rattus exulans hawaiiensis*). All of these introduced rodents are deleterious to native ecosystems and the native faunal species that are dependent on them.

3.6 AIR QUALITY

B.D. Neal and Associates conducted an air quality assessment of the project, and this study is included in Appendix E of this document. The study examined the potential short- and long-term air quality impacts that could occur due to the demolition of the existing KBR facilities and the construction and use of the proposed new facilities.

Ambient Air Quality Standards

Ambient concentrations of air pollution are regulated by both National and State ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawai'i AAQS are defined in Chapter 11-59 of the Hawai'i Administrative Rules. National and State AAQS have been established for six criteria pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), lead (Pb), ozone (O_3), and concentrations of particulate matter (less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$)). The State has also set a standard for hydrogen sulfide (H_2S). National primary standards are designed to protect the public health with an "adequate margin of safety." National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant." Table 3.2 summarizes both the National and the State AAQS.

Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment. State AAQS are designed "to protect public health and welfare and to prevent the significant deterioration of air quality." Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both National and State standards allow a specified number of exceedances each year.

Present Air Quality

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 3.3 presents an air pollutant emission summary for the Island of Hawai'i for 1993. The emission rates shown pertain to manmade emissions only, i.e., emissions from natural sources are not included.

Table 3.2
State and Federal Ambient Air Quality Standards

Air Pollutant	Averaging Time	Hawaii AAQS	Federal (NAAQS)	
			Primary	Secondary
Carbon Monoxide (CO)	8-hour	4.4 ppm	9 ppm	--
	1-hour	9 ppm	35 ppm	--
Lead (Pb)	Quarter	1.5 μg/m^3	1.5 μg/m^3	1.5 μg/m^3
	3-months	--	0.15 μg/m^3	0.15 μg/m^3
Nitrogen Dioxide (NO_2)	Annual	0.04 ppm	0.053 ppm	0.053 ppm
	1-hour	--	0.100 ppm	--
Ozone (O_3)	8-hour	0.08 ppm	0.075 ppm	0.075 ppm
Particulate Matter <10 microns in diameter (PM_{10})	Annual	50 μg/m^3	--	--
	24-hour	150 μg/m^3	150 μg/m^3	150 μg/m^3
Particulate Matter <2.5 micrometers in diameter ($PM_{2.5}$)	Annual	--	15 μg/m^3	15 μg/m^3
	24-hour	--	35 μg/m^3	35 μg/m^3
Hydrogen Sulfide (H_2S)	1-hour	0.035 ppm	--	--
Sulfur Dioxide (SO_2)	Annual	0.03 ppm	--	--
	24-hour	0.14 ppm	--	--
	3-hour	0.50 ppm	--	0.50 ppm
	1-hour	--	0.075 ppm	--

Source: State Department of Health, 2008

Table 3.3
Air Pollution Emissions Inventory for Hawai'i Island, 1993

Air Pollutant	Point Sources (tons/year0	Area Sources (tons/year)	Total (tons/year)
Particulate	30,311	9,157	39,468
Sulfur Dioxide (SO_2)	9,345	nil	9,345
Nitrogen Dioxide (NO_2)	4,054	8,858	12,912
Carbon Monoxide	3,357	23,934	27,291
Hydrocarbons	1,477	203	1,680

Source: J.L. Shoemaker & Associates, Inc. *Review, Revise and Update of the Hawai'i Emissions Inventory Systems for the State of Hawai'i*. Final Report prepared for Hawai'i Department of Health. 1996

Much of the manmade particulate emissions originate from area sources, such as the mineral products of industrial and agricultural activities. Manmade sulfur oxides are emitted almost exclusively by point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions emanate predominantly from area sources (mostly motor vehicle traffic), although industrial point sources contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources. Based on previous emission inventories that have been reported for Hawai'i, emissions of particulate and nitrogen oxides may have increased during the past several years, while emissions of sulfur oxides, carbon monoxide and hydrocarbons probably have declined.

The Island of Hawai'i is unique from the other islands in the State due to the natural volcanic air pollution emissions that occur. Volcanic emissions frequently affect the project area with the latest eruption phase of the Kilauea Volcano that began in 1983. Air pollution emissions from volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these emissions are carried away by the wind, and either washed out as acid rain or gradually transformed into particulate sulfates or acid aerosols. Although emissions from Kilauea Volcano are more than 50 miles southeast of the project site, the prevailing wind patterns eventually carry some of the emissions into the Kona area. These emissions are present in the form of the volcanic haze (vog) which persistently hangs over the area.

The only major industrial source of air pollution in the project vicinity is Hawai'i Electric Light Company's Keahole Power Plant, which is located about 10 miles to the north. Air pollution emissions from power plant consist mostly of sulfur dioxide and oxides of nitrogen. The project site is situated along Ali'i Drive, which sometimes carries moderate volumes of traffic. Emissions from motor vehicles traversing this roadway, primarily carbon monoxide and nitrogen oxides, may affect local air quality at times.

The State Department of Health (DOH) operates a network of air quality monitoring stations at various locations around the State. An air quality monitoring site in Kealakekua area measures sulfur dioxide, and more recently (since 2008) particulate (PM 2.5) was also monitored at this site. Measurements of sulfur dioxide concentrations at this location from 2007 to 2011 were consistently low with annual average concentrations of 0.003 to 0.009 ppm (<30% of State and National standard), and there were no recorded exceedances of 3-hour and 24-hour AAQS. The annual average particulate (PM 2.5) concentrations between 2008 and 2011 ranged from 12 to 21 $\mu g/m^3$ which exceeded the national annual standard (15 $\mu g/m^3$). The 24-hour concentrations ranged from 21 to 37 $\mu g/m^3$ which are slightly above or equal to the national standard of 35 $\mu g/m^3$. These higher concentrations of fine particulate are primarily due to volcanic emissions

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems. Concentrations of lead and nitrogen dioxide generally have not been found to exceed AAQS elsewhere in the State.

Therefore, except for persistent impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion, the present air quality of the project area is believed to be relatively good. The limited air quality data available for the area indicates that air pollution concentrations are generally within State and national air quality standards except for the standard for fine particulate, which is elevated due to vog.

3.7 NOISE

D.L. Adams and Associates conducted a noise assessment study, and this report is included in Appendix F of this document. The study examined the potential short-term noise impacts on surrounding uses that could occur due to the demolition of the existing KBR facilities.

Noise Standards

Various State and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. A brief description of common acoustic terminology used in these guidelines and standards is presented.

1. State of Hawai'i, Community Noise Control. This regulation defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to stationary noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. It also regulates noise related to agricultural, construction, and industrial activities, which may not be stationary. The maximum permissible noise levels are enforced by the State DOHA for any location at or beyond the property line and shall not be exceeded for more than 10 percent of the time during any 20-minute period. The specified noise limits that apply are a function of the zoning and time of day as shown in Exhibit 3.6.

Zoning District	Day Hours (7 AM to 10 PM)	Night Hours (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)

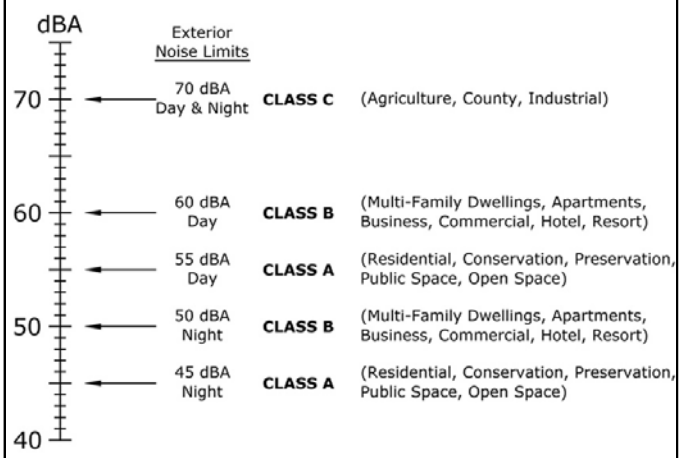

Exhibit 3.6 State DOH Community Noise Control Standards

2. Federal Transit Administration (FTA). The FTA is a relevant guideline for assessing construction noise even though demolition of the KBR activities are not associated with mass transit. This criteria takes into account the existing noise environment, equivalent sound levels (Leq) during construction activities, duration of the construction activities, and the adjacent land use. According to the FTA criteria shown below, there may be negative community reaction if noise levels are exceeded.

Federal Transit Administration Construction Noise Impact Threshold		
Land Use	8-Hour L_{eq} (dBA)	
	Day (7:00 a.m. – 10:00 p.m)	Night (10:00 p.m. – 7:00 a.m.)
Residential	80	70
Commercial	85	85
Industrial	90	90

3. Community Response to Change in Noise Level. Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, the ability of an individual to perceive changes in noise levels is documented, and the following guidelines shown permit estimation of an individual's probable perception of changes in noise levels.

Average Ability to Perceive Changes in Noise Level	
Sound Level Change (dB)	Human Perception of Sound
0	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	Two times (or 1/2) as loud
20	Four times (or 1/4) as loud

Another commonly applied criterion is the "community response scale" proposed by the International Standards Organization (ISO) of the United Nations. The scale shown below relates changes in noise level to the degree of community response, and allows for direct estimation of the probable response of a community to a change in noise level. The values stated in these two tables are not regulatory requirements, but are very useful in assessing the human perception to changes in sound levels.

Community Response to Increases in Noise Levels		
Sound Level Change (dB)	Category	Response Description
0	None	No observed reaction
5	Little	Sporadic Complaints
10	Medium	Widespread Complaints
15	Strong	Threats of Community Action
20	Very Strong	Vigorous Community Action

Existing Noise Environment

Continuous long-term (taken continuously over the course of multiple days) ambient noise level measurements were conducted to assess the existing acoustical environment in the vicinity of the project site. These measurements establish a baseline for existing ambient noise levels in the area so that future noise levels can be estimated by adding noise levels generated from demolition activities.

Ambient noise level measurements were conducted on the northern and southern ends of the project site. One sound level meter (Location 1) was located at the south end of the project site near the Keauhou-Kona Surf and Racquet Club, approximately 90 feet from Ali'i Drive. Dominant noise sources included vehicular traffic from Ali'i Drive. Secondary noise sources included wind and birds. The second (Location 2) was located at the north end of the project site near the County's Kahalu'u Beach Park. The dominant noise sources at this location were park users and the parking lot. Secondary noise sources included wind, birds, and surf.

The ambient sound levels at Location 1 are typical of a rural environment, and vary with the time of day based on environmental noise sources (such as birds) and to a lesser extent, vehicular traffic volumes. The ambient sound levels at Location 2 fluctuate based on environmental noise sources as well as noises from the park users at the beach and in the parking lot.

The range of Leq (equivalent sound levels) during the day (7:00 a.m. to 10:00 p.m.) and night (10:00 p.m. to 7:00 a.m.), along with average calculated day-night level, Ldn, are summarized for each location in Table 3.4 below. Also included in the table is the range of Leq during typical construction hours (7:00 a.m. to 6:00 p.m.). As shown on the table, the range of noise levels occurring during construction hours were within the 60 dBA for Class B zoning districts (e.g. Resort) with higher noise levels generated on the northern end of the project site next to Kahalu'u Beach Park.

Table 3.4
Summary of Noise Measurement Results (dBA)

Measurement Location	7 AM-10 PM L_{eq} Range	10 PM-7 AM L_{eq} Range	7 AM-6 PM L_{eq} Range	Average L_{dn}
Location 1 – Near Keauhou-Kona Surf Club	48 - 57	44 - 52	51 - 57	58
Location 2 – Near Kahalu'u Beach Park	48 - 64	46 - 56	49 - 60	58

3.8 HYDROLOGY

This section discusses the regional hydrology present in the project area, which includes ground water and surface water resources.

3.8.1 Hydrogeological Resources

The State DLNR, Commission on Water Resource Management (CWRM) established groundwater hydrologic units to provide a consistent basis for managing groundwater aquifers. Under the State's water resource protection plan, an aquifer coding system classifies the island's aquifers to identify and describe these aquifers. The system is comprised of Aquifer Sectors, and then Aquifer Systems located within these sectors (CWRM, June 2008). The County Department of Water Supply (DWS) prepared an updated Water Use and Development Plan in 2010 which serves as a continuing long-range guide for the water resource development in the County (Fukunaga, August 2010).

The project site is located within the Hualālai Aquifer Sector Area (809), which includes the entire Hualālai shield volcano and is surrounded by Mauna Loa. The sector area is divided into the Keauhou (80901) and Kiholo (80902) Aquifer System Areas along Hualālai's main northwest-southeast rift zone. The project site is situated within the Keauhou aquifer sector as shown on Exhibit 3.7. The total sustainable yield for the Hualālai aquifer sector is 56 million gallons per day (mgd). The Keauhou Aquifer System has a sustainable yield of 38 mgd, and the Kiholo Aquifer System has a sustainable yield of 18 mgd.

Exhibit 3.7 Aquifer Sectors Map (Fukunaga, 2010)

There are 65 production wells in the Hualālai sector area comprised of 21 municipal, 18 irrigation, 1 industrial, and 25 other wells. High-level groundwater was encountered in the early 1990's within the Keauhou system, which is reflected in the sustainable yield. However, the extent to which it could be developed was not known. Exploratory drilling at elevations above 1,600 feet msl encountered water elevations ranging from 25+ feet msl to 460+feet msl. Notably, 10 of the municipal wells and 14 of the irrigation wells were drilled between 1990 and 2002, as this new resource was developed. Growth in the area and the associated increase in demand for water supplies led to competition among large landowners/developers for the new sources of water supply and well sites. With the help and partnership of the private sector, the CWRM collects data and continues to monitor groundwater in West Hawai'i.

The Hualālai sector's existing water use was estimated to be 16.33 mgd, with agricultural use. The County water system uses 9.45 mgd, and private-public water systems use 2.10 mgd. The Keauhou system uses 12.02 mgd, which is well below the system's sustainable yield. The County water system uses 9.44 mgd, and private-public water systems use 0.48 mgd from this system. (Fukunaga, August 2010).

3.8.2 Surface Waters

Waiʻaha Stream is the only perennial stream in the area, due to the high permeability of the basaltic lava flows from Mauna Loa and Hualālai volcanoes in this region (Fukunaga, August 2010). This stream is located in Holualoa over 4 miles well north of the project area. Consequently, there are no perennial or intermediate streams running through the project site or in the immediate vicinity. Currently, storm water generated on-site infiltrates into the ground, and excess storm water runoff sheet flows toward lower lying areas on the property before eventually discharging into the ocean on the south end or into tide pools present on the property.

A unique feature of the project site is the existence of a series of salt-water tide pools seaward (makai) of the property that extends over 600 feet from the shoreline. A portion of the tide pool which fronts the former KBR hotel building was historically known as Keʻalialia Lagoon. These tide pools along the shoreline extend from Kahaluʻu Beach Park south past Keʻekū and Hāpaialiʻi Heiau, and stop at the southern end of the property (see Exhibit 3.8). Figure 3.5 identifies these tide pools along with other surface waters associated with the project site.

Exhibit 3.8 Southern View of Tide Pools

There is also a wetland area present on the property that is situated inland from the tide pools and located between Keʻekū and Hāpaialiʻi Heiau, and makai of the tennis courts. A low rock wall borders the inland portion of this wetland area. Exhibit 3.9 identifies this wetland area, and a delineation of this wetland is being conducted to define its boundaries.

Exhibit 3.9 Wetland Area Within Property

A large, walled anchialine water pond identified as Poʻo Hawaiʻi is located just north of the hotel structure between the KBR hotel and Kalani Kai structure (see Figure 3.5). This pond is somewhat rectangular in shape, and is about 7,700 square feet in size. A small spring is also located just north of the tennis complex.

Kahalu'u Ma Kai

Figure 3.5 - Surface Water Features Associated with Property

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3.9 MARINE RESOURCES AND WATER QUALITY

Marine Research Consultants, Inc. conducted a marine water chemistry and biotic community structure assessment, and this report is included in Appendix G of this document. A baseline marine assessment of the nearshore areas off the project site was conducted. The baseline data collected depicts both qualitatively and quantitatively the existing physical, chemical, and biological setting of marine areas and water quality fronting the property.

The project site is characterized by a unique set of marine tide pools that occur seaward of the shoreline (see Figure 3.5). The nearshore marine biotic communities off the property consist of a well-developed and relatively undisturbed Hawaiian coral reef habitat. The survey area encompassed approximately 2.25 miles of linear coastline, and extended from the shoreline to a water depth of approximately 65 feet.

Survey Methods

Three transect survey sites were established downslope (makai) of the property and are graphically shown on Exhibit 3.10. Transect 1 was located through the approximate center of the project site, originating at further mauka point of the tide pool complex, and progressing seaward (makai) into the ocean to a distance beyond the influences of land. Transect 2 was located near the northern boundary of the property, originating at the most inland point of the tide pool adjacent to the KBR hotel structure and extending into the ocean. Transect site 3 was located at the southern end of the property, and extended seaward from the highest wash of waves on the beach. In addition to ocean transects, a sample was collected from a walled anchialine pond located between the KBR and Kahalu‘u Beach Park (Po‘o Hawai‘i).

Exhibit 3.10 Transect Survey Locations

3.9.1 Description of Marine Biological Community

All fieldwork was conducted in June 2013. Tide pools were assessed by investigators walking the shoreline, while offshore reef surveys were conducted by SCUBA divers working from a boat. Benthic substratum types were delineated using a method for ground truthing remote sensing data.

The main structural composition of the marine area fronting the project site consists of a broad basaltic bench up to approximately 720 feet wide that extends from the shoreline to an outer ocean cliff face. The elevation of the bench is approximately at sea-level, resulting in the flooding of low areas to form a complex of tide pools fed primarily by an incoming flow of seawater through tides and waves. The largest tide pool is located near the northern end of the property. In the approximate center of the property, water from the tide pools extend inland beyond the basalt bench into areas bounded by shrubbery, resulting in marshy estuarine habitats (wetland). Along the southern end of the property, the bench disappears, and the shoreline consists of a steeply sloping coarse sand beach. Figure 3.6 includes photos of these areas.

Description of Offshore Marine Environment

The basaltic bench terminates in a steeply sloping offshore cliff approximately 10 feet in height, which separates the basaltic bench from the open ocean. Physical and biotic zonation of the offshore marine environment at this property generally conforms to patterns characterizing much of the west coast of the Island of Hawai'i. The zonation scheme consists of three predominant regions: 1) nearshore zone; 2) seaward of nearshore zone; and 3) outer boundary. Figure 3.7 includes photos of these three regions.

1. Nearshore Zone. Beginning at the shoreline and moving seaward, the shallowest zone is comprised of a seaward extension of the basaltic shoreline benches and cliff, along with rounded basaltic boulders that have entered the ocean after breaking off from the shoreline. This nearshore zone is typically the most physically stressed area on the reef as it absorbs the majority of impact from breaking waves. Coral cover in this zone is generally limited to flat encrustations of *Porites*, and sturdy hemispherical colonies of *Pocillopora meandrina*. These species and growth forms are able to flourish in areas that are physically too harsh for most other species, particularly due to wave stress.
2. Seaward of Nearshore Zone. Seaward of the nearshore boulder zone, this bottom structure is composed predominantly of a wide, gently sloping reef bench, or platform that is composed primarily of accreted colonies of several species of a single genera of coral (*Porites lobata, P. lutea and P. evermanni)*. Several colonies of *Porites* were observed up to 10 feet in diameter, suggesting an age of about a century. Over parts of the reef platform, colonies of *P. lobata* have merged, creating fused "supra-colonies" that completely cover the reef surface over several hundred square feet of area.

1. Shows origin of water chemistry Transect 1, located approximately in the center of the Kahalu‘u Ma Kai Project site.

2. Origin of Transect 2, located at shoreward end of tide pool with KBR hotel structure built over the tide pool.

3. Photo showing steeply sloping coarse sand beach abutting rocky intertidal bench off the southern portion of the project site.

4. Water surface illustrating flushing of tide pools with open ocean water carried by wave wash. Rock structures serve as effective barrier to penetration of propelled sea water.

5. Photo shows shallow tide pools fronting the Hapaiali‘i Heiau off the center of the project site.

6. Bottom of tide pool consisting of coarse sand and rocks covered with a green film of microalgae.

Source: Marine Research Consultants, Inc. (2014)

Kahalu‘u Ma Kai

Figure 3.6 - Photos of Shoreline Structural Composition

Kahalu‘u, Hawai‘i

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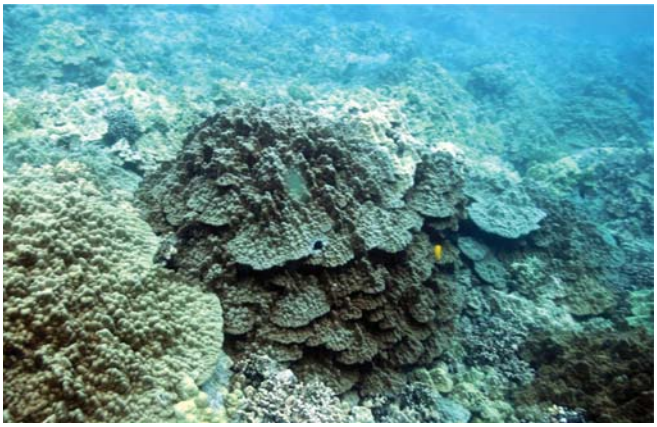
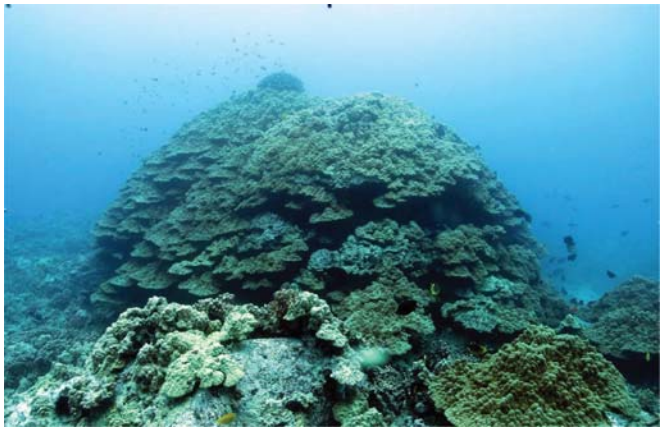
1. Bottom of tide pools on outer section of basalt shoreline platform fronting the project site. Shows living colonies of reef corals, primarily of the green-colored *Porites lobata*.

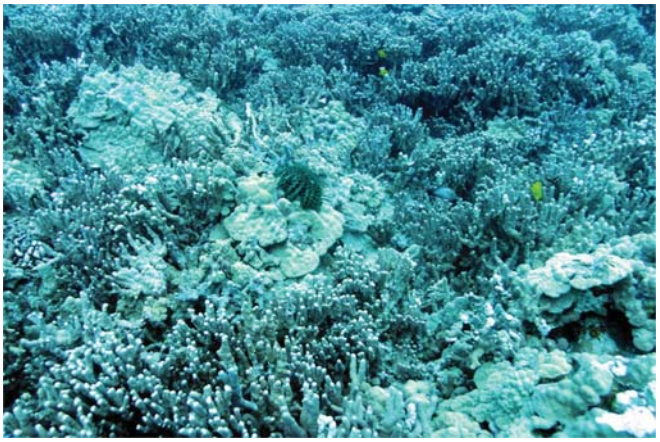
2. Shows coral colonization of bottom tide pools on outer section of basalt shoreline platform fronting the project site.



3. Photo shows mid-depth area of reef platform with near total bottom cover of living corals, primarily of *Porites lobata and P. lutea*.



4. Shows large colony of *Porites lobata* on reef platform fronting the project site.



5. Shows outer reef platform terrace with near total bottom cover of living corals, with cover split between lobata colonies of *Porites lobata* and branching colonies of *Porites compresa.*

6. Finger of mixed *Porites lobata* and *P. compressa* extending into the reef slope rubble zone fronting the project site.

Source: Marine Research Consultants, Inc. (2014)

Kahalu'u Ma Kai

Figure 3.7 - Photos of Biotic Zones

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Wave stress in this region is substantially less than in the shallower areas, and suitable hard substrata is plentiful which provides an ideal area for colonization of reef corals. The large size of individual colonies and near complete cover of the reef surface with living corals indicates that the area has not experienced a large-scale disturbance (destructive storm waves) in many decades. As a result, the area is essentially a "climax" community with near complete coverage by a single competitively superior species. The widest assortment of species and growth forms are encountered in this region.

3. Outer Boundary Zone. At the outer boundary of the reef platform, bottom composition grades into a steeply sloping shelf break at a depth of approximately 66 feet. Above and below the shelf break, bottom cover is a mix of large lobed colonies of *P. lobata*, and an interconnected framework consisting of colonies of *Porites compressa* (finger coral). These mats of finger coral extend into the rubble and sand plains at a depth of about 80 feet. The entire reef platform, including both the reef platform and the reef slope zones, show no evidence of recent damage from storm waves, and as a result are essentially completely covered with living coral colonies. No major storm events have occurred in Hawai'i since Hurricane Iniki in 1992, about 19 years ago. Thus, coral communities have had a chance to proceed toward a climax successional stage, which can be considered nearly complete at this time.

Description of Tide Pool Biotic Composition

Biotic composition of the tide pools showed a marked gradation from the landward to seaward regions. The landward areas, including the large open pond fronting the KBR structure, are essentially barren of macrobenthos, with bottom composition consisting of bare rocks, and a layer of fine sediment (see Figure 3.6). This barren area corresponds to the locations of water sampling at Transect 2 where salinity was depressed at inland distances greater than approximately 330 feet from the shoreline. Similar barren tide pools were encountered on Transect 1 about an equal distance from shore.

At the approximate center of the basalt bench, corals began appearing in tide pools, with increasing density with distance seaward. The predominant corals in the tide pools were *Porites lobata, P. lutea*, and *Pocillopora meandrina*. Other species observed was *Montipora flabellate, M. patula* and *Pavona varians*, and Figure 3.7 included some photos of these colonies. Of note was the occurrence of several donut shaped "microatolls" consisting of circular colonies of *Porites*. The water depth in the tide pools is shallow, often less than 3.5 feet. Thus, corals are restricted in upward growth, with the tops of the colonies killed likely from exposure to light, air and extreme high temperatures. However, lateral growth of these colonies continues, forming the characteristic round colonies with vertical sides and dead center portions. Other dominant biota in the tide pools consisted primarily of a variety of sea urchins, particularly the long-spined *Echinothrix diadema*. No dominant macroalgae were observed in the tide pools.

The distinct gradation of biotic composition of the tide pools is likely a response to several water quality constituents, which also show a distinct gradation in the area. Because of groundwater input

and shallow depth, it is likely that the tide pool area is too "fresh" for most marine species. Wave driven flushing of the ocean side of the basaltic bench appears to diminish rapidly with distance shoreward so that the most interior areas of the basaltic bench are subjected to limited water exchange. As a result, the temperature of the shallow water in the back bench areas (mauka) may exceed the tolerance levels of marine organisms. In the marshy back bench areas of Transect 1, an additional factor that may restrict the colonization by marine organisms may be the preponderance of the soft muddy floors of the tide pools.

Quantitative Analysis of Coral Reef Community Structure

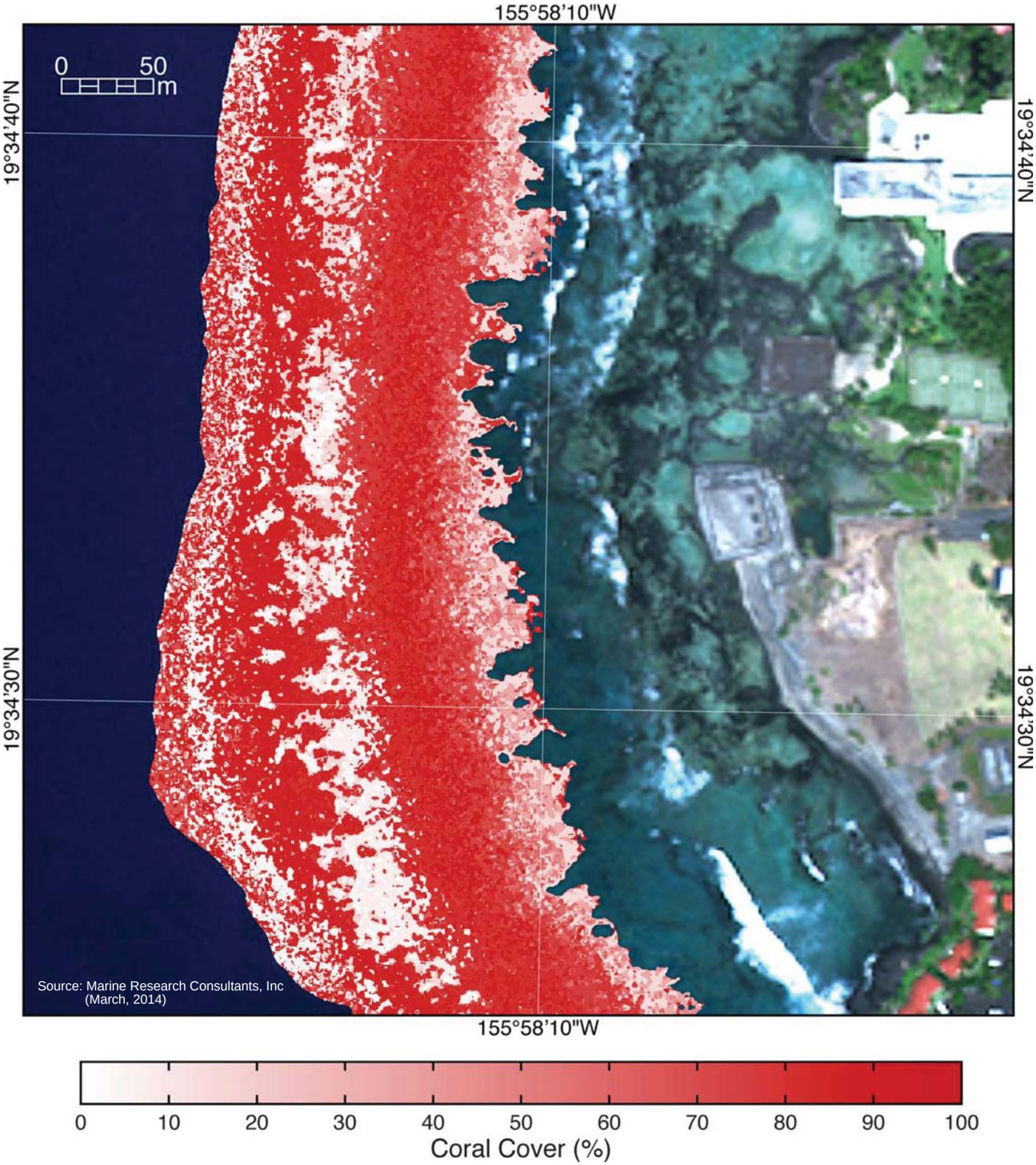
A summary of the data analysis with photoquadrats of the coral reef structure generated from the marine survey is shown on Table 5 of Appendix G. Eight (8) species of coral were identified, with a total coral cover of the bottom of about 58 percent. Considering individual species, *Porites lobata* comprised the highest cover (34% bottom cover, 58% coral cover), while *Porites compressa* accounted for 15% of bottom cover and 26% of coral cover. The third most abundant species was *Porites lutea*, accounting for 9 percent of bottom cover and 15 percent of coral cover.

Hence, these three species of *Porites*, which are typically the most abundant on all Hawaiian reefs, accounted for about 57 percent of bottom cover and 98 percent of coral cover. When considering non-coral bottom cover, the most abundant classes were bare limestone (21%), rubble (10%) and crustose coralline algae (2.6%). In total, about 42 percent of the bottom cover consisted of non-coral classes, while about 58 percent consisted of living coral.

Quantitative estimates of the reef community structure based on the classification scheme were generated by converting the spectral signatures of satellite images into classes of coral cover. Figure 3.8 is a map color-coded to show seven combinations of the coral abundance classes. Of the total mapped area of about 387 acres, the largest single type of bottom cover consists of coral cover between 70 to 90 percent of bottom cover, comprising about 57 percent of the area. The next most abundant size class is 10 to 30 percent coral cover that occupies about 14 percent of the bottom. The class of bottom cover containing no coral occupies only about 2.76 percent of the bottom, while the highest coral cover class of 90 to 100 percent cover occupies about 5 percent of the bottom.

3.9.2 Description of Motile Benthic Macrofauna

The dominant group of motile macroinvertebrates observed on the reef was the sea urchins (Class Echinoidea). The most common urchin is *Echinometra matheai*, which occurred in all reef zones. *E. matheai* are small urchins that are generally found within interstitial spaces bored into basaltic and limestone substrata. *E. matheai* were most abundant at the mid-reef.



Kahalu'u Ma Kai

Figure 3.8 - Coral Coverage Map

Kahalu'u, Hawai'i

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Echinostrephus aciculatus is another small urchin with thin spines that is found in bored holes on the reef surface. *Tripneustes gratilla, Echinothrix diadema* and *Heterocentrotus mammillatus* are other species of urchins that occurred across the reef platform. All of these urchins occur as larger individuals (compared with *E. matheai*) that are generally found on the reef surface, rather than within interstitial spaces.

Sea cucumbers (*Holothurians*) observed during the survey consisted of three species: *Holothuria atra, H. nobilis*, and *Actinopyga obesa*. Individuals of these species were distributed sporadically across the mid-reef and deep reef zones. The most common starfish (*Asteroidea*) observed on the reef surface were *Linckia spp*. Several crown-of-thorns starfish (*Acanthaster planci*), a potentially invasive species, were observed during field studies.

The most common algae observed on the reef were the encrusting red calcareous algae (e.g., *Porolithon spp., Peysonellia rubra, Hydrolithon spp.*). These algae were abundant on bared limestone surfaces, and on the non-living parts of coral colonies. Crustose calcareous algae covered about 9 percent of the reef surface. Total algae cover comprised about 2.6 percent of the reef surface. While crustose algae were abundant, frondose algae were essentially absent from the reef surface in all zones. The near complete absence of frondose algae noted at the project site is typical of the reefs of West Hawai'i.

3.9.3 Reef Fish Community Structure

The reef fish community off the project site is typical of that found along most of the Kona Coast. Appendix G has a table with counts taken of reef fish. A total of 854 fish, distributed among 24 species, were observed.

The two most numerous families were the Pomocentridae (damselfish) and Acanthuridae (surgeonfish) which comprised about 80 percent of the fish population. Labrids (wrasses) and Chaetodonts (butterflyfish) were the next most abundant families comprising about 8 percent of the fish. Hence, these four families accounted for about 88 percent of all the fish observed. The most common individual species were the damselfish (*Chromis ovalis, C. vanderbilti*), yellow tang (*Zebrasoma flavescens*), and the goldring (*Ctenochaetus strigosus*).

Distribution of the reef fish community structure indicated that abundance was not largely determined by the topography and composition of the benthos. The number of species in terms of fish abundance per sampling site ranged from four to eight. The number of individuals per site ranged from 14 to 96. Fish distribution was not distinguishably different anywhere across the reef track as all of the sites contained substantial topographical relief in terms of coral structures and/or hard bottom. The highest individual fish counts were attributable to the observance of large schools of an individual species, particularly the damselfish (*Chromis ovalis*).

The structure of fish community along the West Hawai‘i coastline can be divided into six general categories: 1) juveniles; 2) planktivorous damselfishes; 3) herbivores; 4) rubble-dwelling fish; 5) swarming tetrodonts; and 6) surge-zone fish.

Juvenile fish belonged mostly to the family Acanthuridae (surgeon fish), with representatives from the families Labridae (wrasses), Mullidae (goat fish) and Chaetodontidae (butterfly fish). Juveniles were most abundant in areas dominated by finger coral (*P. compressa*), or basalt boulders. The complex habitat created by the spreading growth form of *P. compressa* provides shelter for small fish.

Planktivorous damselfish, principally of the genus Chromis were abundant in all areas surveyed. Agile chromis (*Chromis agilis*) were very abundant along the outer edge of the shelf and in deeper water, whereas blackfin chromis (*C. vanderbilti*) was the primary shallow water species.

Herbivores, primarily the yellow tang (lau‘i-pala, *Zebrasoma flavescens*) and goldring surgeonfish (kole, *Ctenochaetus strigosus*) were abundant. On the shallower reef terrace, adult whitebar surgeonfish (maikoiko, *Acanthurus leucopareius*), orangeband surgeonfish (na‘ena‘e, *A. olivaceus*), brown surgeonfish (ma‘i‘i‘i, *A. nigrofuscus*) and parrotfish (uhu, *Scarus spp.*) were also observed occasionally.

The inner surge zone along the wave-swept basalt terraces supported a large number of fish, principally herbivores such as surgeonfish (*Acanthurus spp.*) and unicornfish (mostly umaumalei, *Naso lituratus*). Saddle wrasses (hinalea lau-wili, *Thalassoma duperrey*) were also abundant throughout all zones of the reef. Black durgons (humuhumu-ele‘ele, *Melanichthys niger*) and pinktail durgons (humuhumu-hi‘u-kole, *M. vidula*) were also observed congregating in the water column over the reef platform.

Overall, fish community structure at the project site is fairly typical of the assemblages found in undisturbed Hawaiian reef environments. However, the lack of fish species that are prized as food fish suggests that the area has been subjected to significant amounts of fishing pressure.

3.9.4 Endangered and Protected Species

Several species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly along the Kona Coast, and turtles are frequently observed on beaches throughout the area. The endangered hawksbill turtle (*Eretmochelys imbricata*) is known infrequently from waters off the Kona Coast. Several green sea turtles were observed during the course of underwater surveys.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) winter in the Hawaiian Islands from December to April. The survey was conducted in June, when whales are not present in Hawaiian waters.

The Hawaiian Monk Seal, (*Monachus schauinslandi*), is an endangered earless seal that is endemic to the waters off of the Hawaiian Islands. Monk seals commonly haul out of the water onto sandy beaches to rest. Thus, while there is no greater potential for haul out to occur at the project site's beach than any other area, there is a probability that seals will haul out on these beaches. No individuals were observed on the beach or in the water during the course of the survey.

3.9.5 Water Quality Results

Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters under the State DOH's Water Quality Standards (Chapter 11-54, HAR). These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3-+NO_2-, hereafter referred to as NO_3-), ammonium nitrogen (NH_4^+), total phosphorus (TP), Chlorophyll a (Chl *a*), turbidity, temperature, pH, and salinity. In addition, orthophosphate phosphorus (PO_4^{3-}) and silica (Si) were also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater mixing.

Water quality was evaluated at stations spaced along each transect, and 50 water samples were collected. Two samples were collected at each station where water depth exceeded about 3 feet (10 centimeters within of the air-water interface, and at the ocean floor), and one sample collected where water depth was less than 3 feet. Sampling was more concentrated in the nearshore zone (tide pools) because this area is most likely to show the effects of shoreline modification.

Data of water samples collected from three wells (Kahalu'u 1, 2, 3) operated by the County located upslope from the project site was used in order to determine chemical concentrations in unaltered groundwater. These data were taken from a report entitled "Potential Impact on Water Resources of the Proposed Development on Parcel 26, TMK 7-8-10:4 in North Kona, Hawaii" prepared by Tom Nance Water Resources Engineering in 2012.

<u>Horizontal Stratification Findings</u>

The water quality results showed that dissolved nutrients Si, NO_3-, PO_4^{3-}, TP, and TN, as well as salinity, displayed substantially different patterns of horizontal stratification between the three survey transects. These differences were particularly evident in transect sections passing through the tide pool complex. Correspondingly, salinity was lowest closest to the shoreline, and increased with distance from the shore through the tide pool. These patterns are indicative of groundwater efflux at the shoreline of the tide pool, producing a zone of mixing where nearshore waters are a combination of ocean water and groundwater.

However, similar gradients were not detected along Transect 1 (central region of the property), which includes marshy environments within inland areas. The absence of strong gradients of nutrients and salinity in this central portion of the property indicate little mixing of groundwater and ocean water in this region. It is evident in the patterns of nutrient and salinity gradients that water chemistry composition in the tide pools is in direct response to the degree of flushing of the area

with ocean water driven across the basaltic bench by wave action. Tables showing the results of all water chemistry analyses for samples collected are included in Appendix G.

Groundwater Influence

On Transect 1 (center of the project site), concentrations of the nutrients displayed only small decreases in concentrations with increasing distance seaward, with overall values not substantially higher than open ocean water. The minimum salinity (32.5‰) on this transect was only slightly lower than seawater (35.0‰) indicating relatively little groundwater is entering the tide pools at this location and mixing with seawater.

In contrast, the horizontal gradients on the makai half of Transect 2 were substantially steeper for dissolved nutrients (Si, NO_3-, PO_4^{3-}, TP, and TN), as well as salinity (15.4 to 29.6‰). This indicates there is considerable groundwater input into the tide pool area fronting the KBR hotel structure and extending makai about 280 feet toward the ocean. From this seaward point (makai edge of the tide pool), water composition consists of marine water that is not substantially different in nutrient composition than offshore seawater.

Transect 3 located along the southern end of the property didn't have tide pools, and the shoreline consists of a steeply sloping coarse sand beach. Horizontal gradients indicated a sharply sloping decline within 15 to 30 feet from shore, with a corresponding increase in salinity. These sloping gradients indicate a source of submarine groundwater input flowing into the nearshore zone from land along the beachfront. This condition is similar to many areas of the Hawaiian Islands, particularly off the coast of West Hawai‘i, where groundwater percolation results in steep horizontal gradients of increasing salinity and decreasing nutrients with distance from shore.

Organic Nutrients Influence

Water chemistry parameters not associated with groundwater input, particularly organic nutrients (NH_4^+, total organic nitrogen (TON), total organic phosphorus (TOP)), did not show the same pattern of decreasing concentration with respect to distance from the shoreline as dissolved nutrients (Si, NO_3-, PO_4^{3-}, TP, and TN). Along Transect 1, gradients of organic nutrients exhibited peak values and steepest slopes within the tide pool zone. This is likely the result of biotic activity in the tide pools, particularly in the back shore region where flushing with wave-driven ocean water is restricted.

Po‘o Hawai‘i Pond

A water sample was also collected from Po‘o Hawaii, which is a walled anchialine pond on the northern end of the project site. Examination of the pond's water chemistry constituents indicated that concentrations of all nutrient and other water quality constituents (except salinity) were substantially higher than in any of the tide pool or ocean sampling sites. Salinity was substantially lower than at any of the tide pool or ocean sampling points. The relatively low salinity, as well as

elevated nutrients, indicates that water in the pond consists of a higher percentage of groundwater than any of the other areas. Such elevated concentrations of nutrients, and particularly Chl *a*, was likely a result of the elongated residence time of groundwater in the pond.

Vertical Stratification Findings

The mix of groundwater and ocean water creates a buoyant surface lens of low salinity, high nutrient water that is evident throughout the nearshore waters fronting the project site. With the relatively low level of physical mixing from wind, waves, and currents along the West Hawai'i shoreline, a stratified water column persists along the entire length of the transects off of the project site.

There is distinct variation between surface and deep samples, as evident by the inorganic nutrients that displayed distinct horizontal gradients (particularly Si, and NO_3-). Surface values of Si and NO_3- were slightly higher than deep values, while salinity was lower in surface samples relative to deep samples from the same location. There were no clearly distinguishable differences in surface and deep concentrations of PO_4^{3-}, NH_4^+, TP and TN. Likewise, turbidity and Chl *a*, also showed no consistent trend with surface values not consistently elevated relative to bottom values.

Conservative Mixing Analysis

Application of a hydrographic mixing model to the water chemistry data was used to indicate if increased nutrient concentrations in nearshore waters are the result of mixing of natural groundwater with oceanic water, or are the result of inputs from activities on land. Comparison of the curves produced by the distribution of data with conservative mixing lines provides an indication of the origin and fate of the material in question. If no input or removal from any process other than physical mixing occurs, data points should fall on, or near, the conservative mixing line. If however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as biological uptake, data points will fall below the mixing line.

Exhibit 3.11 shows plots of the concentrations of Si, NO_3-, PO_4^{3-}, and NH_4^+ as functions of salinity for the samples collected along the transects. A summary of the results from these graphs is provided.

1. Silica (Si). This represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. Silica is also not utilized rapidly within the nearshore environment by biological processes. For the three transects, there is an alteration of groundwater with removal of Si. Most of the removal appears to take place within the tide pools of Transect 2 and the nearshore ocean of Transect 3.

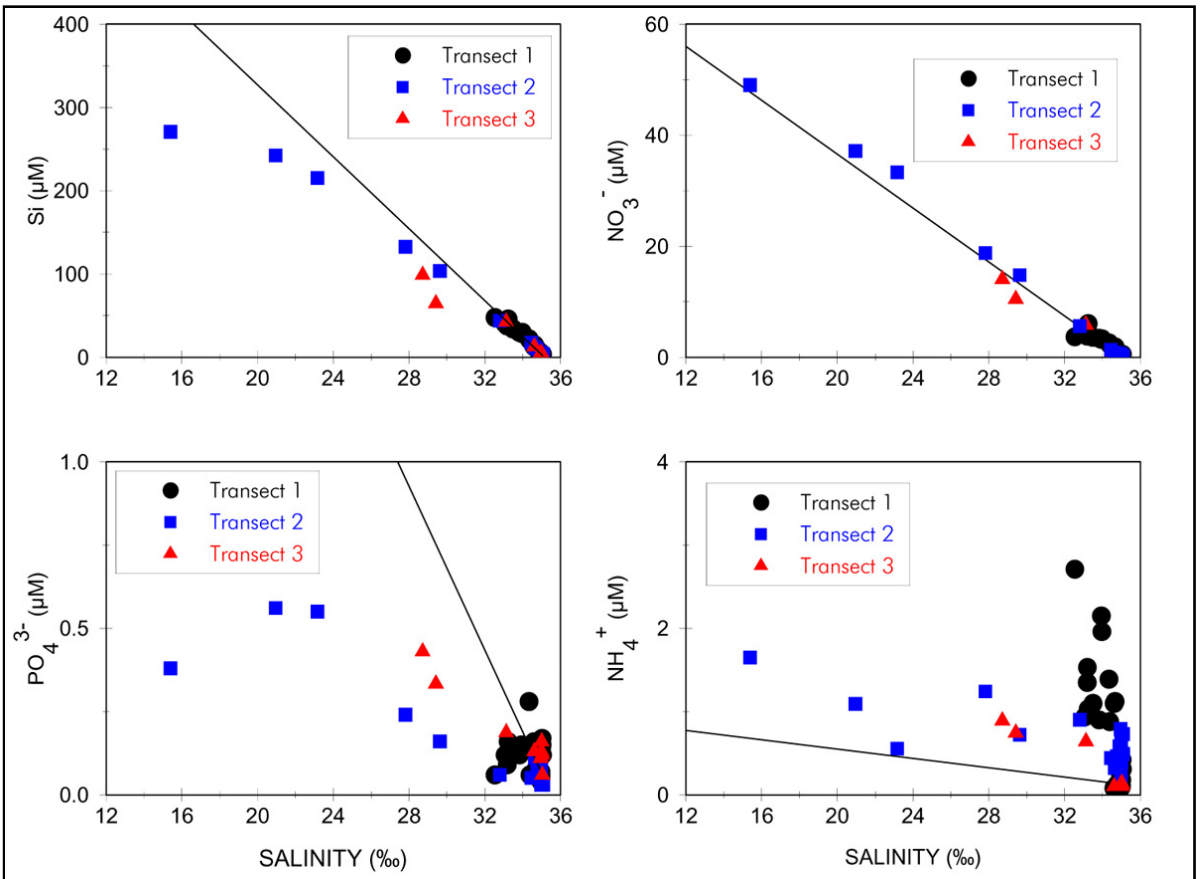

Exhibit 3.11 Mixing Diagram of Dissolved Nutrients (MRC, 2014)

2. Nitrate+Nitrite Nitrogen (NO_3-). These plots show a slightly different distribution as compared to Si with most of the data points falling in a linear array along the conservative mixing line. Hence, there is a slight subsidy of NO_3- in groundwater entering the ocean from activities on land inland from Transects 1 and 2, but not at Transect 3.
3. Orthophosphate Phosphorus (PO_4^{3-}). This is a major component of fertilizer and sewage, however, it is usually not found to leach to groundwater to the extent of NO_3- due to a high absorptive affinity of phosphorus in soils or rock. On all transects, there is removal of PO_4^{3-} relative to what would be expected from simple mixing of upslope groundwater and ocean water.
4. Ammonium Nitrogen (NH_4^+). The other form of dissolved inorganic nitrogen (NH_4^+) shows a different relationship than the other three nutrients. The mixing line is considerably different than the other inorganic nutrients in that there is no indication of overall linearity. The highest values occur an at approximately 34‰ in the tide pools of Transect 1. This pattern suggests that the source of most of the NH_4^+ in the tide pools is not from runoff from land, but rather from biological processes occurring in the marine environment.

The model indicates that there were small, but detectable subsidies of NO_3- nitrogen to the tide pools and ocean that could be attributable to upslope anthropogenic activities. However, the magnitude of these subsidies was well within the envelope of natural variability found in the coastal areas of West Hawai'i.

Compliance with State DOH Criteria

The West Coast of the Island of Hawai'i has area specific Water Quality Standards detailed in Chapter 11-54, HAR. In areas where nearshore marine water salinity is greater than 32‰, specific criteria for geometric means apply. As geometric means require multiple samplings at the same location, it is not technically possible to use a single sample set taken to evaluate compliance of water quality off the property with area specific State DOH standards. However, comparison of the values for the single sampling event off the project provides an estimate of compliance with area specific State DOH water quality standards. In addition, it is not clearly stated in the standards whether water bodies present in the survey area defined as "tide pools" located behind the actual shoreline are included in the class of "coastal ocean waters."

These criteria for the four nutrients are shown in Table 3.5. As shown, NO_3- exceeded the specific criterion (-31.9) on Transect 2, while TN exceeded the standard criterion (-40.4) on Transect 1. The slopes of TP and PO_4^{3-} were below the DOH criteria on all three transects, indicating that concentrations of these constituents exceeded DOH standards. Therefore, at the present time, it appears that existing baseline conditions of water quality off the project site exceed DOH water quality standards for NO_3- and TN at separate areas, but do not exceed the standards at any location for TP and PO_4^{3-}.

Table 3.5
Summary of Water Quality Sampling with State DOH Standards

		NO_3-	TN	PO_4^{3-}	TP
State DOH Water Quality Standards		**-31.9**	**-40.4**	**-3.2**	**-2.9**
Transect 1	upper 95%	-24.1	-67.4	0.7	-0.8
	lower 95%	-34.3	-91.3	-1.0	-3.1
Transect 2	upper 95%	-35.3	-36.5	-0.7	-0.5
	lower 95%	-37.1	-39.5	-1.0	-0.9
Transect 3	upper 95%	-31.0	-32.7	-0.8	2.4
	lower 95%	-22.1	-21.9	-1.8	-0.1

Note: Shaded Cells Exceed DOH Standard

3.10 VISUAL RESOURCES

This section identifies existing visual resources that are associated with the project area. Various references were used to assist in identifying visual resources associated with this area along with public viewing locations.

3.10.1 Visual Resources References

The County's *General Plan*, adopted under Ordinance 05-025, is a policy document for the long-range comprehensive development of the island which identifies goals, policies, and standards (County, February 2005). Sites of natural beauty in the North Kona District identified by the *General Plan* included the following:

1. Viewplane from Kuakini Highway going mauka and makai.
2. Viewplane from Kamehameha III Road going mauka and makai.
3. Keauhou.
4. Kahalu‘u Bay area.

The County's *Kona Community Development Plan, Volume 1* (September, 2008) articulates the vision for the Kona community development plan area in terms of regional development, infrastructure, and a framework for implementation and monitoring. Although no specific visual resources or viewsheds and public viewing areas were identified, the plan does support the "region retain its natural and visual character derived from topography, coastlines, and other natural features" (Planning Department, September 2008).

The County's *Royal Footsteps Along the Kona Coast Corridor Management Plan* (June 2011) was developed as part of the Federal Scenic Byways Program, and identifies the extraordinary intrinsic qualities of historic, cultural, natural, recreational, and scenic resources along a seven mile section of Ali‘i Drive (Ho‘okuleana, June 2011). This plan identified the following points of interest pertinent to the project, and their associated qualities.

1. Kahalu‘u Beach Park (archaeological, scenic, and recreational).
2. An interpretive signage and lookout along Kamehameha III Road.
3. Hāpaiali‘i and Ke‘ekū Heiau (archaeological and historic).
4. Mākole‘ā Heiau (archaeological).

3.10.2 Existing Scenic Resources and Views

The following visual resources pertinent to the project were identified based upon the reference documents identified.

1. Kahalu‘u Beach Park. This County beach park and associated bay is a scenic visual open space resource located immediately north of the project site. Public views of this beach park occur along Ali‘i Drive, and a view of this beach park from the roadway is shown on Figure 3.9.
2. Hāpaiali‘i, Ke‘ekū, and Mākole‘ā Heiau. These heiau are within the project site and situated along the shoreline, and are scenic resources with important historic and cultural value. However, views of these heiau are not available along Ali‘i Drive due to existing vegetation along the roadway (see photo on Figure 3.9). Viewing of the heiau was previously available for visitors to the KBR, and interest in them continues with many visitors stopping by the closed resort to inquire about viewing them. Viewing opportunities would continue with the project managed by the Heritage Center and a planned visitor program.
3. Scenic Viewing Point on Kamehameha III Road. A scenic viewing point with vehicular parking and interpretive signage is located along Kamehameha III Road. This public viewing area is located over 1/2 mile from the road's intersection with Ali‘i Drive and mauka of the Keauhou Shopping Center. The site offers panoramic views of the project area, coastline, and surrounding Keauhou area. A panoramic photo of the project site included in Figure 3.9, which shows the KBR hotel prominently situated along the shoreline.

The viewplane from Kuakini Highway looking makai was identified as a viewshed, and this could be applicable to the project site being situated along the shoreline. However, makai views of the project site from this highway in the vicinity of its intersection with Kamehameha III Road are not visible due to existing vegetation and development along the highway. Furthermore, the existing terrain of undeveloped areas makai of the highway further shield views of the shoreline from Kuakini Highway.

1. View of Kahalu‘u Beach Park from Ali‘i Drive (KBR Hotel in Background)

2. View of Project Site Along Ali‘i Drive.

3. View of Project Site and Coastline from Public Scenic Viewing Location Along Kamehameha III Road (Magnified).

Kahalu‘u Ma Kai

Figure 3.9 - Photos of Scenic Resources and Viewsheds

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3.11 HISTORIC AND ARCHAEOLOGICAL RESOURCES

An archaeological inventory survey (AIS) for the Kahalu‘u Ma Kai project was conducted by Cultural Surveys Hawai‘i, Inc. (CSH) in accord with State Historic Preservation Division (SHPD) rules governing standards for archaeological reports (HAR 13-13-276). A copy of the draft report is included in Appendix G, and has been submitted to SHPD for review. This study was conducted in accordance with an archaeological inventory survey plan (AISP) that was accepted by SHPD on April 22, 2014.

Scope of Work Conducted

The scope of work for the AIS consisted of the following:

1. Research of archival sources, historic maps, Land Commission Awards (LCA), and previous archaeological reports to compile a predictive model for the types and locations of historic properties that could be expected within the project area.
2. A complete (100%) systematic pedestrian inspection of the project area to identify any potential surface historic properties.
3. A ground penetrating radar (GPR) survey was completed after the pedestrian survey, but before inception of the subsurface testing program, to inform project planning and the placement of particular subsurface test units.
4. Subsurface testing with a combination of hand and backhoe excavation to identify and document subsurface historic properties.
    a. Twenty-eight test trenches, proposed under the AISP, were tested. One additional test trench was completed in an area where the initial proposed test trench reached a very shallow depth.
    b. Subsurface testing was conducted primarily by hand to determine the extent and nature of associated subsurface deposits. Mechanical excavation was undertaken at 16 of the 29 test trenches (55%).
5. Four core samples at two wells associated with a habitation site (State Inventory of Historic Properties (SIHP) #-12951 Features A and B) was completed. Coring at Po‘o Hawai‘i Pond (SIHP #-12953) was planned under the AISP, but another site was selected due to the culturally sensitive nature of the pond area expressed by a KS cultural representative. Another core location planned at the former Keawehala Pond was abandoned upon learning that the pond was filled with concrete during the construction of the Kona Lagoon Hotel.
6. Observation was conducted of all ground disturbance associated with geotechnical surveys undertaken for the project. The CSH archaeologist’s role was similar to that of an archaeological monitor, which was to obtain valuable data regarding the project area sediments that could provide context to the other findings of the AIS fieldwork.
7. Consultation with knowledgeable individuals regarding the project area’s history, past and use and the function and age of the historic properties within the project area.
8. Laboratory work to process and gather relevant environmental and/or archaeological information from collected samples.

3.11.1 Results of Background Research

This section discusses the results of background research conducted of the project area that is comprised of a summary of the region's history and prior archaeological studies conducted for the area. The history of the Kahalu‘u ahupua‘a has been documented in a number of studies. All of these studies detailed the place names of Kahalu‘u, legendary history and oral traditions, the legendary rulers and personalities, the early historic accounts, land ownership and changes during the Māhele, and changes in land use from traditional to modern times. More details on the traditional and historical background of the region are documented in Appendix G.

Pre-Contact to Early Contact Period

Kahalu‘u Ahupua‘a is suggested to have been initially settled sometime around AD 900. Early settlement was marine resource-oriented, with habitation focused around Kahalu‘u Bay. By AD 1300, upland areas at least 4,000 feet inland were cultivated. Settlement and cultivation activities in Kahalu‘u expanded between the fourteenth and sixteenth centuries, during which Kahalu‘u Ahupua‘a became a self-sufficient socio-economic land unit. With the neighboring ahupua‘a of Keauhou, Kahalu‘u was the home to many high chiefs, as evidenced through traditional histories and the construction of significant heiau and residential complexes.

During the historic period, the population in Kahalu‘u rapidly declined due to introduced diseases and demographic shifts to the urban centers at Kailua-Kona and Ka‘awaloa. During the first half of the nineteenth century, Keauhou Bay was utilized as an anchorage for ships, where vessels would replenish stocks of firewood, sandalwood, and various food stocks supplied by the abundance of the Kona Field System.

Western Contact: 1820s to Present

There were 56 Land Commission Awards (LCAs) granted within Kahalu‘u; seven within the project area. The settlement pattern evidenced by the kuleana data indicated coastal house lots with associated upland agricultural plots. The coastal house lots were all located makai (west) of the Kuakini Wall, and the agricultural plots were mauka (east) of the present day Kuakini Highway. Māhele data for the LCAs within the project area reflect the "idle" nature of the coastal lands up to this time (see Exhibit 3.12).

Exhibit 3.12 1962 Aerial Photo Showing Project Site (courtesy of KS)

Lacking sufficient water and easily developable land, the Kona Coast of Hawai‘i was largely spared the changes associated with plantation agriculture that affected so much of Hawai‘i. However, the economic opportunities created by this commercial agriculture elsewhere were another pull for relocation away from Kahalu‘u. The uplands of Kahalu‘u became more important as the century drew to a close with the growth of coffee cultivation, with small towns springing up along the belt highway during the early twentieth century.

Tourism grew almost exponentially in the decades after World War II and radically changed the face of Kahalu‘u. Hotels and resorts sprung up in Kahalu‘u and Keauhou in response to an influx of visitors flying into the new airport in Kailua-Kona. In 1968 and 1975, respectively, the Outrigger Keauhou Beach Resort and the Kona Lagoon Hotel were constructed within the project area, disturbing several archaeological features. Since the early 1980s, development has continued in the region with residential subdivisions, shopping centers, golf courses, and more.

The Kona Lagoon Hotel was demolished in 2004. Over the next several years, a shift began toward education and recognition of the cultural importance of this area. From 2007 to 2009, Hāpaiali‘i, Mākole‘ā, and Ke‘ekū Heiau were restored (Ke‘ekū Heiau is 90% restored). A preservation plan has also been completed for the restoration of Kapuanoni Heiau and the Po‘o Hawai‘i Pond.

Previous Archaeological Research

Keauhou/Kahalu‘u is one of the most studied areas in Polynesia. A large majority of the studies, especially archaeological surveys of the large habitation/heiau complexes, are near the coast, makai of Ali‘i Drive. Many of these sites are part of the Kahalu‘u Historic District (SIHP #-04150), which was placed on the National Register of Historic Places (NRHP) in 1974, and encompasses the project area (see Exhibit 3.13). In the mid-twentieth century, Mr. Henry Kekahuna produced maps referencing numerous coastal places within Kahalu‘u. One of these maps prepared in 1952 documented the sites present on the project site, and this map is shown on Figure 3.10.

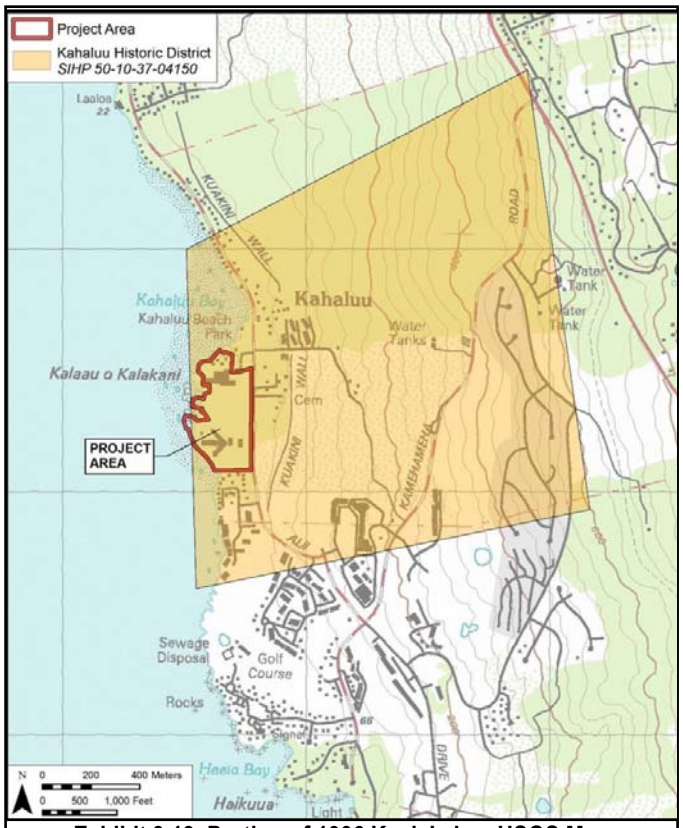
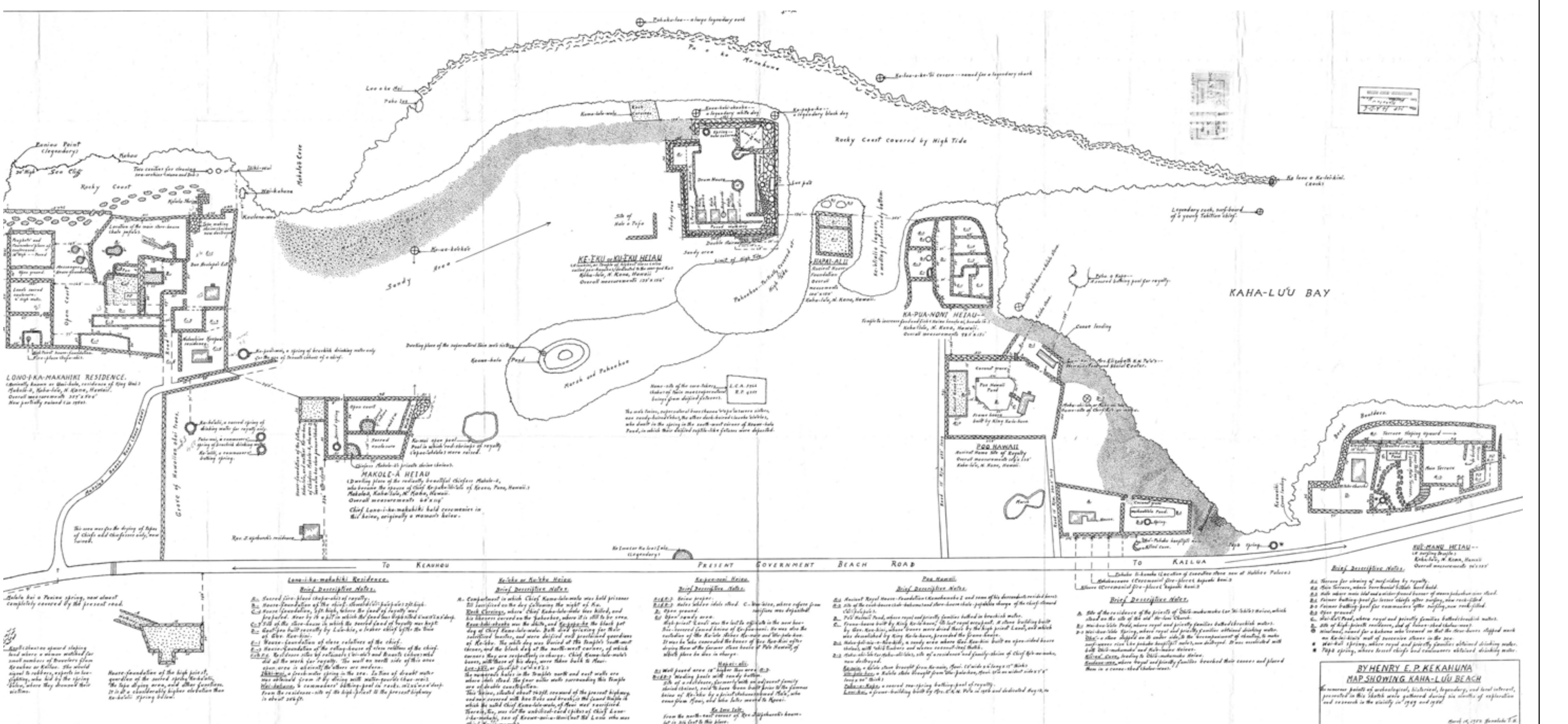


Exhibit 3.13 Portion of 1996 Kealakekua USGS Map Showing the Project Site Within the Kahalu´u Historic District



Kahalu‘u Ma Kai

Figure 3.10 - 1952 Sketch by Henry Kekahuna of Kahalu‘u Beach

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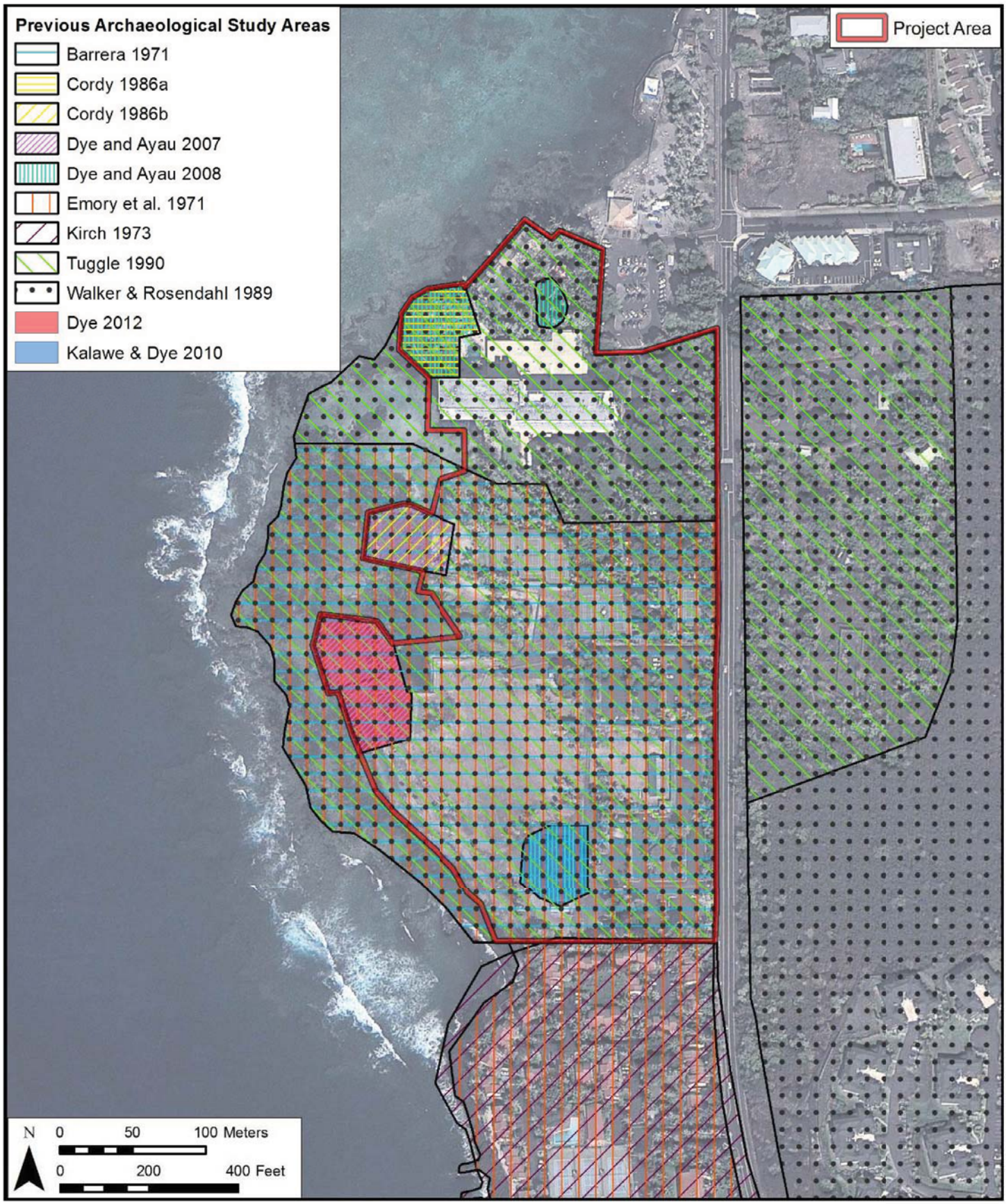
Virtually all of the archaeological studies documented not only provide evidence of human occupation, but also evidence of permanent habitation and agricultural development in areas that have not been previously disturbed. The extensive agricultural complexes in the inland portion of Kahalu‘u are part of the Kona Field System (SIHP #-6601), which was nominated to the NRHP in 1977. Nine archaeological studies were conducted within the present project area, and Figure 3.11 graphically shows the areas covered.

3.11.2 Previously Recorded Archaeological Sites Within the Project Area

Thirteen sites have been recorded within the project area, and Figure 3.12 identifies these sites within the property. Of these 13 sites, four are recognized as being part of the Kahalu‘u Historic District (SIHP #-04150). These include SIHP # -03817 (Hāpaiali‘i Heiau), SIHP # -03818 (Ke‘ekū Heiau), SIHP # -03819 (Mākole‘ā Heiau), and SIHP # -Ha-D4-34/-01616 (burial platform destroyed by the Kona Lagoon Hotel construction).

In 2009, Kamehameha Schools-Land Assets Division initiated an Archaeological Information Consolidation Project (AICP). This project was designed to manage the large amount of data on the Kahalu‘u and Keauhou 1 and 2 areas for future planning and development. The project resulted in three informational databases: 1) one for previous archaeological reports; 2) another for previously recorded sites; and 3) one containing Geographic Information System (GIS) data for the subject ahupua‘a. Brief site descriptions of the 13-recorded sites in the project area from this database are provided. Expanded site descriptions can be found in Volume II of the draft AIS report in Appendix G.

1. Hāpaiali‘i Heiau (SIHP # 50-10-37-03817). Hāpaiali‘i Heiau was first recorded by Stokes in 1906. Reinecke (1930) includes Stokes’ 1906 notes about the heiau in his report. Cordy (1986) documents the heiau as a rectangular, high platform measuring approximately 29 meters by 39 meters (1,131 square meters), and the maximum height is 2.4 meters. On top of the heiau are a pavement and three-sided enclosure.
2. Ke‘ekū Heiau (SIHP # 50-10-37-03818). Ke‘ekū Heiau is an irregularly shaped quadrilateral heiau enclosure formed by thick, high walls, with an open court on the south, 56 meters by 44 meters, and first recorded by Stokes in 1906. Reinecke (1930) includes Stokes’ 1906 notes about the heiau in his report. The site was said to be used for human sacrifices and as a pu‘uhonua (place of refuge). This site also includes the adjacent Hale O Papa.
3. Mākole‘ā Heiau (SIHP # 50-10-37-03819). Mākole‘ā Heiau, or Ke‘ekuapua‘a, was described by Stokes in 1906. Reinecke (1930) includes Stokes’ 1906 notes in his report. It is an irregular quadrilateral enclosure constructed of pāhoehoe. The walls vary from 1 to 2 meters in height and reach a maximum width of 3 meters. An interior wall divides the court into two sections.
4. Kapuanoni Heiau (SIHP # 50-10-37-10997). Kapuanoni Heiau was recorded by Stokes in 1906; it measures approximately 30 by 46 meters (1,380 sq meters) with walls approximately 2 meters high. There are two internal divisions; a set of three pavements and a set of two enclosures. Traditions suggest it was used as a heiau for general prayers.



Source: Cultural Surveys Hawaii, Inc. (2014)

Kahalu'u Ma Kai

Figure 3.11 - Prior Archaeological Studies of Project Area

Kahalu'u, Hawai'i

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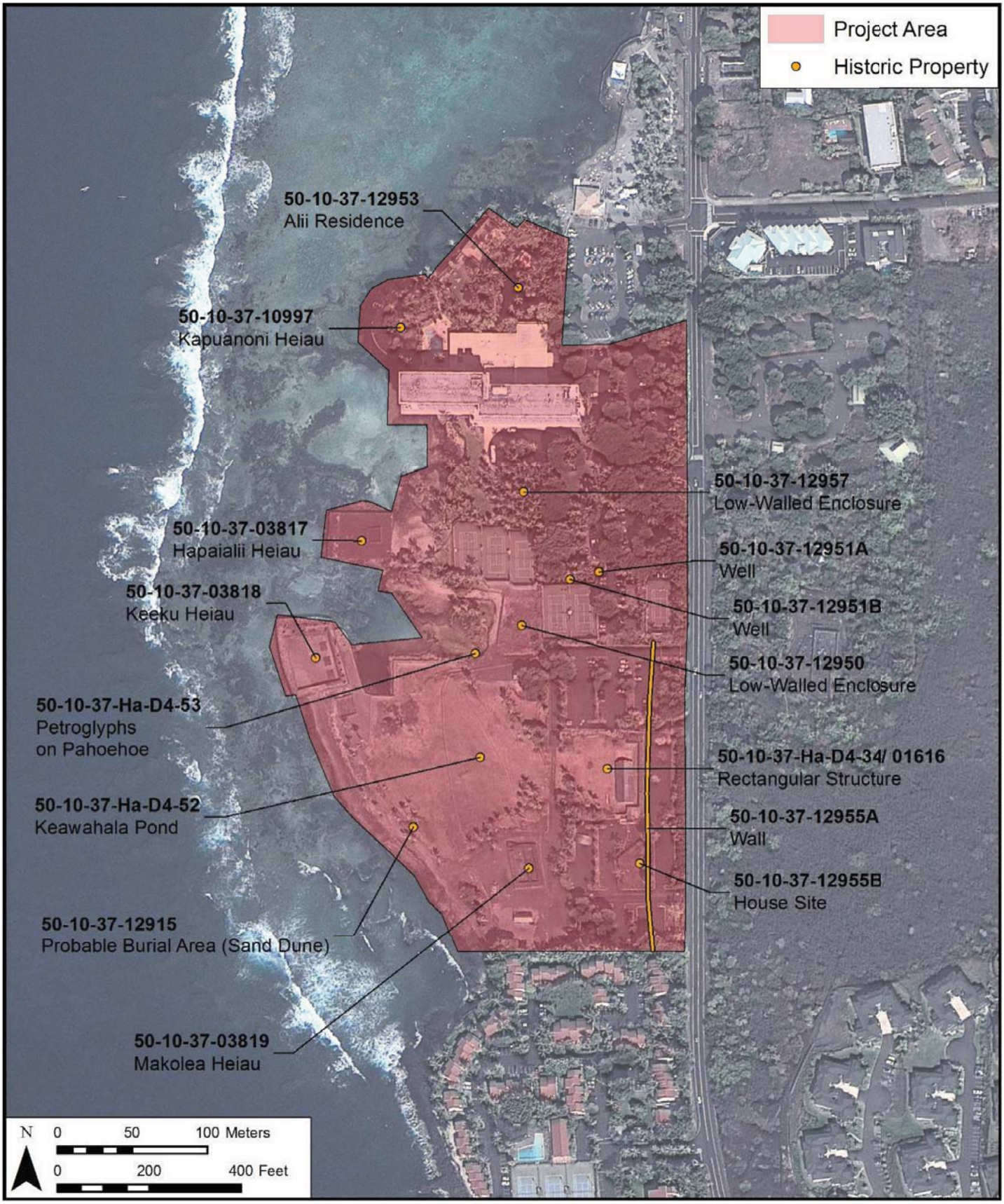

Source: Cultural Surveys Hawaii, Inc. (2014)

Kahalu'u Ma Kai

Figure 3.12 - Previously Recorded Sites Within Project Area

Kahalu'u, Hawai'i

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5. Probable Burial Area—Sand Dune (SIHP # 50-10-37-12915). This site is classified as the dune area along the coast south of Keʻekū Heiau. There are probably burials as indicated by members of the Kahaluʻu community, but they have not been specifically identified. Tuggle (1990) lists the site as a "probable site."
6. Low-Walled Enclosure-LCA 5966 (SIHP # 50-10-37-12950). Walker and Rosendahl (1989) define the site as a "midden area and ʻiliʻili scatter" low-walled enclosure, representing the remains of kuleana parcel LCA 5966. The area measures 30 by 23 meters. Tuggle (1990) indicates that despite extensive disturbance and modern trash, further work is recommended. Midden and ʻiliʻili scatter in a roughly rectangular plan. It is bordered to the south and to the east by wall foundations. The south wall is collapsed and measures 0.5 to 0.6 meter wide and 0.2 to 0.3 meter high.
7. Well Complex (SIHP # 50-10-37-12951). Walker and Rosendahl (1989) define the site as a "midden area and ʻiliʻili scatter" low-walled enclosure, representing the remains of kuleana parcel LCA 5966. The site area measures approximately 30 meters by 23 meters. Tuggle (1990) indicates that despite extensive disturbance and modern trash, further work is recommended. Midden and ʻiliʻili scatter were observed in a roughly rectangular plan. The site is bordered to the south and to the east by wall foundations. The south wall is collapsed and measures approximately 0.5 to 0.6 meter wide and 0.2 to 0.3 meter high.
8. Aliʻi Residence - Poʻo Hawaiʻi Pond (SIHP # 50-10-37-12953). Poʻo Hawaiʻi Pond is a brackish water pond with a retaining rock wall along its perimeter, identified on current tax maps as LCA 6026:2. Reinecke (1930) and Kekahuna (1952) identify the area of this site as a residence for ancient royalty and as a bathing area for the aliʻi. The site area measures approximately 34 meters by 23 meters by 0.9 meter.
9. House Site/Wall-LCA 5632:1 (SIHP # 50-10-37-12955). The site contains two features originally recorded as two separate sites. Feature A is a wall mistakenly identified as the Great Wall of Kuakini by Emory et al (1971). Feature B is a house site that was left as a landscaped island when an adjacent parking lot was built; it measures approximately 26 meters by 16 meters by 0.2 meter. The west and south sides, 26 meters by 13 meters long, are well defined by a rock wall 20 centimeters high.
10. Low-Walled Enclosure-LCA 5693 (SIHP # 50-10-37-12957). This is a low-walled enclosure measuring 30 meters by 23 meters by 1 meter; bi-faced and core-filled on the east, south, and west sides. The retaining wall on the north end appears to be of recent construction. The wall is 0.6 to 1 meter high and has an average width of 0.9 meter. The site is the location of a kuleana parcel (LCA 5693). Tuggle (1990) indicated a high probability of encountering remnant deposits with further survey.
11. Rectangular Structure (SIHP # 50-10-37- Ha-D4-34). The rectangular structure is 80 by 70 centimeters, outlined by stones with three sides constructed of water worn stones; the fourth side is lined with ʻaʻā and filled with sand to the top of the sides.
12. Keawehala Pond (SIHP # 50-10-37- Ha-D4-52). Keawahala Pond is located at the limit of the high-tide zone between Keʻekū and Mākoleʻā Heiau. Roughly oval in shape, it measures approximately 20 by 30 meters. The wall has a 50 centimeters wide break on the west side. Wall width is 1.3 to 3.5 meters and height is 80 to 110 centimeters above the bottom of the pond.

13. Petroglyphs on Pāhoehoe (SIHP # 50-10-37- Ha-D4-53). Twenty petroglyphs are pecked into an area of exposed pāhoehoe, 19 by 20 meters. This site is in the wetland area between Hāpaiali‘i and Ke‘ekū Heiau.

3.11.3 Results of Fieldwork

CSH conducted fieldwork which included: 1) pedestrian survey and documentation of surface features; 2) a Ground Penetrating Radar (GPR) Survey; 3) layout, excavation and documentation of test trenches; 4) core sampling; and 5) observation of a geotechnical survey undertaken within the project area.

Eight previously identified historic properties were documented during the inventory survey investigation. No new historic properties were encountered. Two previously recorded sites within the project area were known to have been destroyed; 1) Keawehala Pond (SIHP # 50-10-37-Ha-D4-53) and 2) rectangular structure (SIHP # 50-10-37-Ha-D4-34).

The current survey also did not locate three previously recorded sites: 1) dune burials (SIHP # -12915); 2) low-walled enclosure (SIHP # -12950); and 3) petroglyphs (SIHP # -HaD4-53). The low-walled enclosure and petroglyphs were likely impacted by developments near the center of the project area. The dune burials are still believed to be present, but are buried.

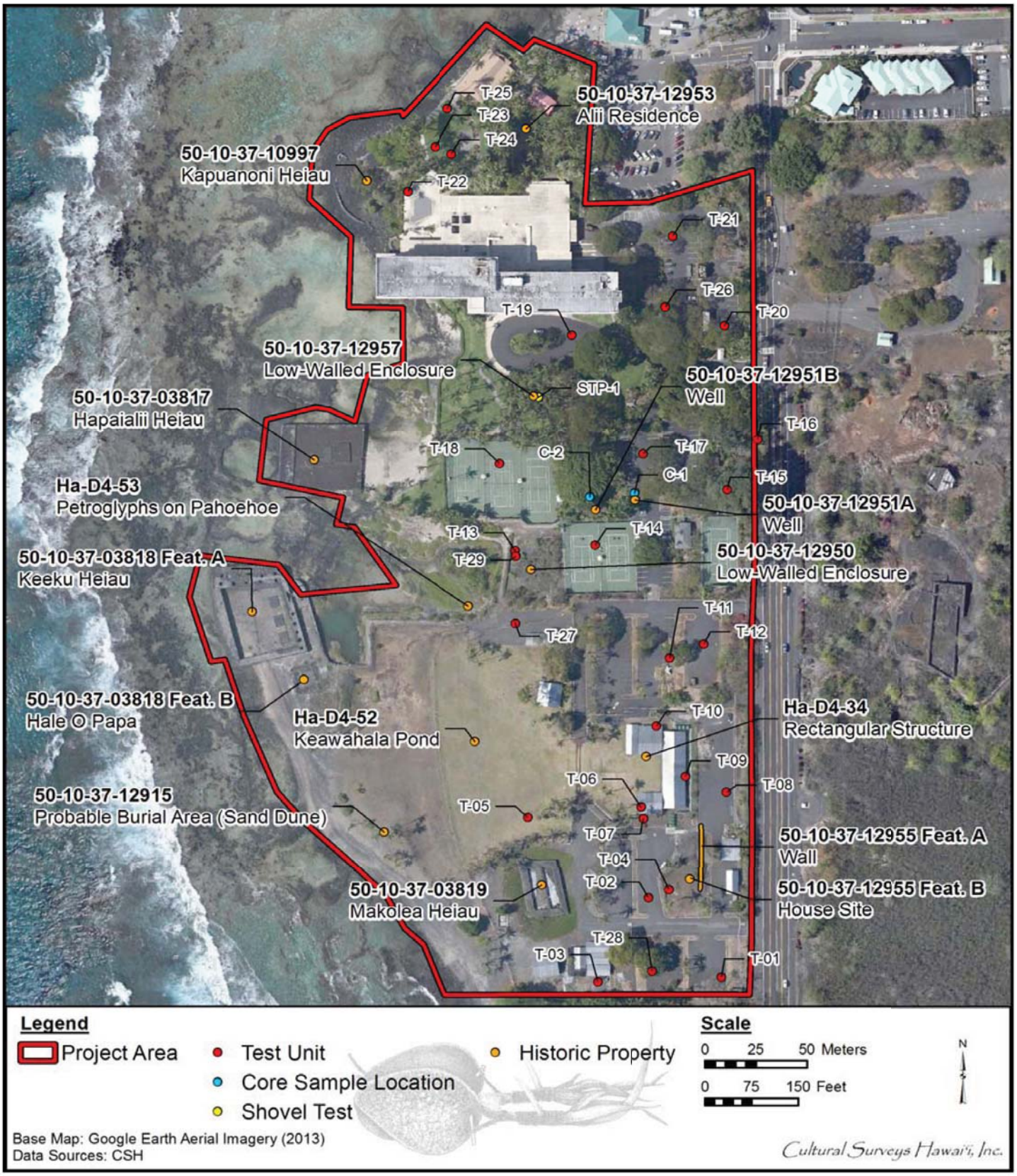
The current status of all the historic properties within the project area is summarized in Table 3.6. Figure 3.13 shows the locations of the eight confirmed historic properties within the project area, as well as the locations of the five unconfirmed historic properties previously documented in the project area. Also shown are the locations of the 29 test trenches (T-01 through T-29), shovel test (STP-1), and two core sampling areas (C-1 and C-2) investigated during the AIS.

Table 3.6 Historic Properties Assessed During Current AIS

SIHP Number	Other Site Number(s)	Site Name	Site Type	Site Function	Site Age	Status and Comment(s)
50-10-37-03817	50-Ha-D4-2, H-00165-25	Hāpaiali‘i Heiau	Heiau	Ceremonial, religious	Pre-Contact; built AD 1200s or 1300s-1400s	Confirmed as restored and documented during the current investigation
50-10-37-03818	50-HA-D4-3, H-00073-4, H-00165-24	Ke‘ekū Heiau + Hale O Papa	Heiau complex	Ceremonial, religious	Pre-Contact; built between AD 1200s to 1300s	Ke‘ekū confirmed as 90% restored and documented during the current investigation. However, previously restored Hale O Papa damaged by the 2011 tsunami and requires re-restoration; this feature fully mapped and documented
50-10-37-03819	50-Ha-D4-5, H-00073-6, H-00165-22	Mākole‘ā Heiau or Ke‘ekua-pua‘a Heiau	Heiau	Ceremonial, religious	Pre-Contact; likely post- AD 1550	Confirmed as restored and documented during the current investigation

Table 3.6 Historic Properties Assessed During Current AIS (continued)

SIHP Number	Other Site Number(s)	Site Name	Site Type	Site Function	Site Age	Status and Comment(s)
50-10-37-10997	H-00073-2, H-00165-41	Kapuanoni Heiau	Heiau	Ceremonial, religious	Pre-Contact	Confirmed and documented during the current investigation in anticipation of future restoration
50-10-37-12915	H-01426-AZK-7	Probable Burial Area (Sand Dune)	Sand dune	Probable burial	Unknown, likely pre-Contact	Not confirmed during the current investigation; believed to be present but buried
50-10-37-12950	PHRI 439-50, H00769, H01426	--	Complex	Habitation	Historic; dates from nineteenth century	Not confirmed during the current investigation; believed to be destroyed
50-10-37-12951	PHRI 439-51, PHRI 439-52, H-00769, H-1426	--	Faced well complex (Features A and B)	Habitation	Historic; dates from nineteenth century	Confirmed and documented during the current investigation
50-10-37-12953	PHRI 439-53, H-00165-43, H-00748-11881	Po‘o Hawai‘i	Complex including walled pond and adjacent habitation area	Habitation	Unknown (over 50 years)	Confirmed and documented during the current investigation in anticipation of future restoration
50-10-37-12955	PHRI 439-55, PHRI 439-56, 50-Ha-D4-47, 50-Ha-D4-49	--	Complex	Boundary, habitation	Historic; dates from early 1800s to the mid-1900s	Confirmed and documented during the current investigation in anticipation of future restoration
50-10-37-12957	PHRI 439-57	--	Complex	Habitation	Historic (probably dates from mid to late nineteenth century) and modern	Confirmed and documented during the current investigation
50-10-37- Ha-D4-34 / 50-10-37-01616	50-Ha-D4-34	--	Platform	Possible burial	Unknown	Not confirmed during the current investigation; believed to be destroyed
50-10-37- Ha-D4-52	50-Ha-D4-52	Keawehala Pond	Stone-lined pond	Bathing pool	Unknown; likely pre-Contact	Not confirmed during the current investigation; believed to be destroyed
50-10-37- Ha-D4-53	50-Ha-D4-53	--	Petroglyph field	Rock Art / communication	Unknown; likely pre-Contact	Not confirmed during the current investigation; believed to be destroyed



Source: Cultural Surveys Hawaii, Inc. (2014)

Kahalu'u Ma Kai

Figure 3.13 - Aerial Photo Showing Locations of Historic Sites, Test Trenches, Core Samples, and Shovel Test

Kahalu'u, Hawai'i

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Ground Penetrating Radar

A GPR survey was conducted within the project area prior to subsurface testing in an attempt to define the local stratigraphy and to prospect for buried cultural deposits. Seven discrete locations (Grids 01–07) within the project area were surveyed with GPR (see Exhibit 3.14).

Survey Grids 02 through 05 were located on the decks of the filled-in swimming pool within the northwestern portion of the former KBR building footprint. A primary objective of this survey was to use GPR analysis to look for evidence of intact stacked basalt walls associated with the Kapuanoni Heiau. No clear evidence for intact stacked basalt walls (Kapuanoni Heiau remnants) was identified within Survey Grids 02 through 05.

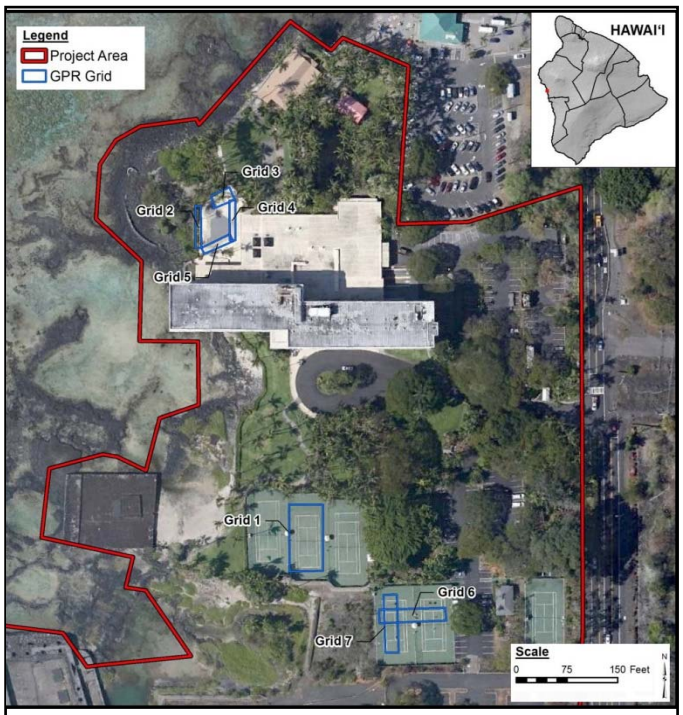


Exhibit 3.14 Photo Showing Location of GPR Grids

Survey Grids 06 and 07 were located in the mauka tennis court area near the central portion of the project area. One objective of this survey was to use GPR analysis to look for evidence of a potential post-Contact cemetery thought by some to be located beneath this tennis court bank (Grid 06). Another objective of this survey was to look for subsurface features that may be associated with LCA 5694 which encompassed the area that is currently the western half of the tennis court bank (Grid 07). The western half of Survey Grid 06 appeared to be pāhoehoe lava flows. The eastern half of Grid 06 was interpreted as clay or salt-rich fill material or possible salt-inundated sandy sediments. A set of linear anomalies was noted that may represent basalt rock deposits. A basalt rock deposit could include stacked walls, former foundations, or a type of marker. The low reflectivity soil coupled with the possible basaltic rock alignment in this area indicated an increased probability that this area may contain the conditions for human interment. Grid 07 GPR results were consistent with pāhoehoe lava flows.

Results of Exploratory Test Trenching

Subsurface testing was conducted within the project area to assess the stratigraphy and potential for subsurface historic properties. Three criteria considered in the selection of test trench locations were: 1) areas to be subjected to project-related ground disturbance; 2) areas thought to have the potential to contain cultural deposits based on background research; and 3) to provide general coverage of the overall project area. Details of the subsurface test results are discussed in the draft AIS report in Appendix G.

Four of the 29 total test trenches were excavated within the context of a known historic property (T-4, T-13, T-22, T-29) in an attempt to further clarify the nature or age of the existing historic site. The remaining 25 test trenches were excavated outside the context of any known historic property, and were therefore more exploratory in nature. While the exploratory testing did not identify any new archaeological or cultural features, it did provide valuable information about the nature of the sediments found throughout the project area.

The test results showed that the southern portion of the project area had been heavily impacted by the construction and subsequent demolition of the KLH. Some of the test trenches in this area included a fill layer of demolition debris. Throughout this portion of the project area, an upper red cinder fill layer was observed, likely indicating a major fill event after the KLH demolition was complete. Construction of the KLH caused the destruction of: 1) a rectangular structure (SIHP # -Ha-D4-34); and 2) Keawehala Pond (SIHP # - Ha-D4-52).

Testing at a former house site (SIHP # -12955 LCA 5632:1) identified this cinder fill over a disturbed cultural layer associated with usage of the site that appears to have extended well into the second half of the twentieth century. The present results of testing indicate this site has further research potential.

More recent developments on the property, particularly the construction of a sea wall and landscaped island near the center of the project area, appear to have destroyed the petroglyphs (SIHP #s -Ha-D4-53) and a low-walled enclosure-LCA 5966 (SIHP # -12950). Testing in the former location of the low-walled enclosure indicated fill layers associated with the developments in this area and a potential for disturbed cultural layers in the vicinity.

Testing within the more mauka central portion of the project area also indicated widespread disturbance and fill events, and yielded sediments containing cane slag. The sediments were likely sourced from outside the project area, as sugar cane was not grown commercially within the project area.

The northern portion of the project area, including the vicinity of KBR and the landscaped areas to the north, also indicate extensive disturbance and fill, although the sediments are typically deeper. Some of the fill sediments in this area also included significant amounts of cane slag. Evidence of an early, possibly pre-KBR beach layer was observed at some of the test trenches in this area.

Materials Collected During Subsurface Testing

Collection of artifacts and cultural materials for laboratory analysis was undertaken as part of the archaeological inventory survey investigation. No artifacts or other materials were collected from the ground surface. Marine shell midden was sorted down to the species level.

Artifact Analysis. Thirty-five artifacts were collected from the test trenches. Additionally, relatively large amounts of cane slag (calcium silicate) were observed and collected. Most of the fragmented materials included glass of various colors and ceramics, though a single piece of a possible basalt abrader was also recovered from T-17. This artifact is a small chunk of medium-grained basalt exhibiting a single worked side that is so flat it almost appears saw cut. Alternatively, this artifact may be a piece of demolition or construction-related debris.

The only items encountered during the testing program that were not fragmental were: 1) a medicine bottle (T-4); 2) two small buttons (one white plastic and one wooden, both from T-4); 3) a U.S. dime (T-24); 4) several metal items including an aluminum skewer (T-4); 5) iron nail (T-17); 6) iron spike (from STP-1); and 7) an iron cart wheel (from a possible disturbed cultural layer at T-26). With the exception of the items collected from T-23 and STP-1, the artifacts encountered during the test trenching were generally located within disturbed natural sediments and/or out-of-context materials mixed into fill sediments. No trash pits or undisturbed cultural layers were encountered.

Twelve of the 35 collected artifacts (34%) came from excavations at T-4 (SIHP # -12955 Feature B). Results of excavation at T-4 indicate continued usage into the latter half of the twentieth century, given the presence of the 1965 bottle, alkaline batteries, and aluminum skewer. The ashy layer containing these artifacts also yielded midden. No clear trash pit and no clear chronological substrata were observed. It is likely the layer in which these items were located, overlain by a cinder fill associated with the demolition of the KLH, represents a disturbed cultural layer.

A total of 429.5 grams of cane slag was collected from several trenches (T-15, T-16, T-17, T-21, T-23, and T-24). This material was used as a soil amendment for commercial sugar cane crops. Its substantial presence indicates importation of fill sediments into at least the central and northern portions of the project area. These fill layers were likely imported during or after the construction of KBR in 1968. In addition to cane slag, T-17 contained a fairly high concentration of other artifacts and midden, indicating the imported fill may have been mixed with sediments from a local cultural layer, or contained cultural materials from an outside location (possibly a dump).

Midden. A total of 767.6 grams of midden was recovered from nine of the 29 test trenches. Only four were in the context of an existing or destroyed historic property (SIHP #s -12950, -12955, and -12957). The vast majority of the collected midden was from T-4 at SIHP # -12955 Feature B, which yielded large amounts of both marine shell and non-marine shell midden. This layer does not appear to represent a formal trash pit but rather a disturbed cultural layer associated with former habitation at that location.

Midden found in T-13 and T-29 (SIHP # -12950) is not clearly in association with the habitation feature(s) once present there, as the material was collected from modern fill and/or a layer of naturally deposited sand. At STP-1 (SIHP # -12957 Feature B), a single cowrie shell fragment was observed within the shallow upper organic layer. This shell is interpreted as a modern deposition possibly related to the modern construction of the well or its subsequent use.

The remainder of the test trenches containing midden were excavated outside the context of a historic property. With the exception of T-17, these units (T-12, T-16, T-23, T-24) contain relatively small amounts of midden. The layers containing midden at T-12, T-16, and T-24 are fill layers. The layer at T-12 is interpreted as being imported sediments given the presence of cane slag. T-17 contained a much higher volume of midden (over 100 g). It is unclear what the layer there containing cultural materials represents, as it also included a substantial amount of cane slag. The midden from T-23 comes from two non-contiguous layers (Strata II and V). The upper layer is a construction-related fill, but the lower layer (Stratum V) appears to be a natural beach/shoreline layer, containing either naturally deposited midden or scattered materials from a disturbed cultural layer in the vicinity.

Marine shell midden accounted for 78 percent (599.6 grams) of the midden recovered from the project area excavations. Most of the shellfish species were likely obtained locally along the coastline, and are attributable to nearshore shellfish collection. The presence of marine midden recovered from the project area implies coastal resources were an important source of protein-related food for the residents of Kahalu‘u Ahupua‘a.

Faunal bone accounted for 20 percent (156.4 grams) of the midden recovered from the project area excavations. This bone material consisted of mostly (non-human) mammal bone, though small amounts of fish bone were also recovered from T-4 and T-29. These remains were also all likely obtained locally. The remaining 2 percent of collected midden comprises urchin and fish scale.

Results of Sediment Coring

The manual extraction of four sediment cores (C-1A, C-2A, C-2B, and C-2C) from two locations within the project area (C-1 and C-2), as shown on Figure 3.12, was conducted. The objective of obtaining sediment core samples was to generate data regarding the construction and use of the former water features and/or any climactic changes indicated within their sediments. Pollen/starch grain analysis was conducted on three samples collected that are summarized below:

1. Sample 1A1. This was collected from Core C-1A extracted from the open air well of SIHP # -12951A. Pollen/starch grain analysis showed that the sample was dominated by fern spores and foraminifera, indicative of a wet, possibly brackish water environment. Coconut and loulu (*Pritchardia spp.*) palm pollen, cheno-am pollen, and ilex species pollen were also identified. The ilex pollen documents the presence and growth of introduced holly or yerba mate. No starch grains were observed.
2. Sample 2C1 and 2C2. Sample 2C1 was collected from the upper boundary of Stratum II within the Core C-2C extracted from the open air well of SIHP # -12951B. Sample 2C2 was collected from the middle of Stratum II within Core C-2C. Pollen/starch grain analysis showed that the samples were dominated by fern spores and foraminifera that are indicative of a wet, possibly brackish water environment. Coconut and loulu palm pollen, Rhamnaceae and Straussia-type pollen, and Dodonses were also identified. No starch grains were observed.

The results show that while these wells are presently dry, the pollen analyses indicated a wet, possibly brackish water environment, which was to be expected. The local vegetation community, represented in all three samples, included both grasses and sedges as dominant elements, growing either in relatively wet areas or on local sediments. In addition, *alena* varied in quantity, being most abundant at the time represented by Sample 2C1. *Loulu hiwa* grew as part of the coastal vegetation. Shrubby vegetation included *'aheahea* and *a'ali'i* as the most abundant. The local wetland is represented by Typha pollen recovered in Sample 2C1. Monolete spores and a few Dicksoniaceae and trilete spores document local growth of ferns, and provide further evidence of relatively wet conditions. Recovery of foraminifera from all three samples indicates the presence of at least brackish water and growth of these organisms in sediments or substrate that was either occasionally inundated or perhaps was inundated at a later time.

Results of Radiocarbon Analysis

Radiocarbon analysis was conducted on three samples collected during sediment coring within the project area. Radiocarbon analysis of Sample 1A1 suggested two possible date ranges, AD 1680 to 1770 (29.8%) and AD 1800 to 1940 (65.6%), with the post-Contact date range (1800-1940) being the most probable. Radiocarbon analysis of Sample 2C1 suggested the subsample was modern. The analysis of Sample 2C2 suggested two possible date ranges; AD 1680 to 1730 (25.2%) and AD 1800 to 1930 (70.2%), with the post-Contact date range (1800-1930) being the most probable.

These results indicate that while there is a possibility of pre-Contact usage of SIHP # -12955, the site was well utilized throughout the historic era. A shovel test (STP-1) at nearby SIHP # -12957 Feature B (Low-Walled Enclosure-LCA 5693) did not yield evidence to counter Tuggle's (1990) prior study interpretation of this feature as a modern hotel landscaping construction.

Results of Geotechnical Survey Observations

The geotechnical survey conducted indicated the project area is underlain by layers of porous to dense basalt bedrock, which occasionally appears as a reddish cinder material. Extracted core samples indicated the upper limits of bedrock range from approximately 0.61 to 3.05 meter (1.0 to 10.0 feet) below surface in the tested areas. Consistent with CSH's subsurface testing program, areas with the deepest upper bedrock limits were at the KBR hotel or adjacent to KBR. The shallowest bedrock surfaces were encountered in the central and southern portions of the project area. No cultural materials were observed at any time in the sediments extracted during the geotechinal survey.

3.12 CULTURAL RESOURCES

A cultural impact assessment (CIA) study for the Kahaluʻu Ma Kai project was conducted by CSH. A copy of the report is included in Appendix H. Through document research and ongoing cultural consultation efforts, this report provides information pertinent to the assessment of the proposed project's impacts to cultural practices and resources.

The scope of work for this CIA consisted of the following:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities, and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation and interviews with knowledgeable parties regarding cultural and natural resources and practices at or near the parcel, present and past uses of the parcel, and/or other practices, uses, or traditions associated with the parcel and environs.

Background research for this study yielded results that were already discussed under Section 3.11 (Historic and Archaeological Resources). The project area is located within the Kahaluʻu Ahupuaʻa that was one of the most important places in all of the Hawaiian Islands. The project site, with its productive fishing grounds, access to the Kona field system and other resources, is home to four heiau (place of worship), all of highest spiritual importance, historically and in recent times, to Hawaiians.

Archaeological research shows the project area contains, although some are no longer present, numerous culturally and historically significant sites and features including heiau (Hāpaialiʻi Heiau, Keʻekū Heiau, Mākoleʻā Heiau, and Kapuanoni Heiau), Keawehala Pond, petroglyphs, fishponds, freshwater springs, and residential complex associated with aliʻi (Poʻo Hawaiʻi). The project area is also associated with a number of ruling chiefs who made Kahaluʻu their place of residence, including Lono-i-ka-makahiki, Alapaʻinui, Kalaniʻōpu'u, and Kamehameha as well as a famous and beautiful chiefess by the name of "Makolea."

3.12.1 Community Consultation

A combination of qualitative methods including purposive, snowball, and expert (or judgment) sampling, were used to identify and invite potential participants to the study. The sampling purpose is not to establish a representative or random sample, but to identify specific groups of people who either possess characteristics or live in circumstances relevant to the social phenomenon being studied. This approach allows the researcher deliberately to include a wide range of types of informants and also to select key informants with access to important sources of knowledge.

CSH began with purposive sampling informed by referrals from known specialists and relevant agencies. They contacted agencies such as SHPD, Office of Hawaiian Affairs, and community and cultural organizations in the North Kona District. CSH also worked with KS who had identified descendants connected genealogically to the project area. Based on their in-depth knowledge and experiences, these key respondents then referred additional potential participants who were added to the pool of invited participants.

Kamaʻāina and kūpuna with knowledge of the proposed project and study area were contacted to participate in semi-structured interviews. CSH contacted 26 individuals and organizations of which seven responded with a formal interview. Six of the seven interviews were organized with the assistance of Mr. Māhealani Pai, cultural resource specialist for KS KKEG.

Four lineal descendants from the project area were interviewed on site at Hale ʻIke, in Kahaluʻu, Hawaiʻi. Also present was Mr. Māhealani Pai of KS KKEG. The four interviewees included Uncle Mitchell Mikiʻala Fujisaka, Auntie Vel Konanui Kahulamu Alapai Kauahi, Auntie Elizabeth Kalaniola Kahulamu Kahinu Wilson Hamm, and Uncle Floyd Kahalioumi Sr. Interviews were also held with Mr. Ralph Alapai and Mr. Wayne Kahulamu at the project site in Kahaluʻu to discuss the cultural resources, beliefs, and practices of the project area and extending to the larger ahupuaʻa of Kahaluʻu. Ms. Nicole Kealohaokalanikeakaonaaliʻi Lui was also interviewed in Kona, Hawaiʻi to shared her interests and skills in the areas of history, moʻolelo, and genealogy. Information on these interviews are included in the CIA report in Appendix H.

3.12.2 Cultural Landscape

Discussions of specific aspects of traditional Hawaiian culture as they may relate to the project area are presented below. This section discusses cultural resources and practices identified within or in proximity to the project area in the broader context of the encompassing landscape of Kahaluʻu.

Hawaiian Habitation and Agriculture. Radiocarbon data suggest the earliest settlement in Kona began around AD 900. The earliest settlement most likely was located around Kahaluʻu Bay with all its marine resources. Archaeological evidence and community consultation also confirm the use of caves near the project area as a place of refuge and habitation during times of war and instability. As for agriculture, the beginning of the Kona Field System is believed to have taken place by the mid-1300s. It was a system of planting unique to Kona which involved cultivating crops such as sweet potatoes, breadfruit, and dryland taro in narrow fields that ran from near the sea to the uplands. In the project area, coconut trees and crops such as sweet potatoes were grown at higher elevations away from the shoreline were trees like maiʻa (bananas) and mango trees that gave both fruit and shade for travelers using the trails. Taro, plantains, sugar, and ʻulu also grew further upland.

Wahi Pana and Moʻolelo. Kahaluʻu, both the ahupuaʻa and particularly the project area, is part of a storied landscape teeming with natural and cultural resources which have been enjoyed by both the aliʻi and makaʻāinana, including the kamaʻāina and kūpuna of today. Beginning with numerous names for resources such as ponds, surf waves, caves and lava tubes, coastal points and hills, and

abundance of historic and cultural properties such as heiau and petroglyphs, Kahalu‘u is one of the most significant cultural places in all of Hawai‘i.

The project area is called Kahalu‘u according to Mr. Fujisaka, and he suggested the meaning of the name has to do with diving. The boundary between Kahalu‘u and Keauhou is Paniau, while the name Mākole‘ā refers to the heiau (south of Hale ‘Ike), as well as the whole beach. Place name research and community consultation reveal a profusion of names to describe the cultural landscape, with Mr. Fujisaka noting that the names for places have gotten lost through time and improper usage. Ke‘ali‘ali‘a once referred to a sandy pond, and Kilohana to a large pond that he and others regularly cleaned when called by Tūtū Naluahine. Mr. Fujisaka also shared that groves of ‘ōhai trees once existed, and one grove (located where there are condos now) was called Ulumoi, and in the lower end, where Tūtū Naluahine’s house was located, the grove of ‘ōhai there was called Umi.

Mo‘olelo about the project area include that of the mo‘o of Keawehala Pond, which Mrs. Kauahi shared was located in front of the current coconut trees seen from Hale ‘Ike. The pond was taken care of by Tūtū Naluahine and her father. The proper name for the wall in Kahalu‘u Bay is not Menehune wall, as it known today, but Kala‘auokali‘ikini, stated Mr. Fujisaka. Relating that he learned about the Menehune wall in school, he narrated the legend which involved the menehune abandoning their work which left the wall incomplete and enabled surf to come in. Other mo‘olelo associate the project area with the spirits of ali‘i who were there, such as sixteenth century Maui ruler Kamalālāwalu and his two faithful ‘ilio (dogs), Kapapako and Kauakahi‘oka‘oka. Mr. Fujisaka shared that Mrs. Kauahi’s father saw a “big man, standing on the heiau with a dog.”

Heiau. The number of heiau near and within the project area is indicative of the spiritual importance of this special place. Three of the four heiau have been restored. Another possible name for Hāpaiali‘i Heiau was “Kapaealii,” according to Ms. Nicole Lui who traced her genealogy to the Ma‘a line. Kahalu‘u makai was, and remains a sacred place, with each site having its own prayer. Mr. Fujisaka recalled that during the 1950s, when he assisted Henry Kekahuna, Theodore Kelsey, and Tūtū Naluahine with measuring the heiau, each time they measured a particular heiau, it had a different prayer. Places like the pond also had their own prayer. The majority of the community participants emphasized the sacred nature of the heiau and how they grew up being taught by their elders to respect the heiau, and that it was kapu or forbidden to step on it. They always had to go around and avoid the heiau, although they did not know until seeing Kekahuna’s map the full significance of the area. When Mr. Alapai and Mr. Kahulamu were growing up, only Hāpaiali‘i Heiau was intact.

Burials. Sand dunes in the project area may contain burials according to archaeological research and community consultation. Iwi were found in certain areas of the project area, especially around the sand dunes. After a storm or big waves, iwi would pop up in the sand and simply be put back where they came from, according to Mr. Fujisaka. When the Keauhou Golf Club was being built in 1966, lots of sand was taken from Kahalu‘u to be placed in the golf course, stated Mr. Kahalioumi. Bones were found in the sand that was hauled up by machines. He pointed out that burials in the sand were common, especially in Kona, where people buried wherever they could dig.

Caves, as well as lava tubes, were also utilized as burial sites because tools that can dig through stones were not available. No markers were used, and the grave location was committed to memory. There are three types of burials, sand, earth and cave, noted Mr. Fujisaka, and whatever was convenient determined the type of burial that occurred. Mr. Ralph Alapai and Mr. Wayne Kahulamu also described seeing iwi in the sand, especially when the surf was high, particularly in the sandy areas of the beach around Mākole‘ā. Before, there was a lot more sand along the shoreline and the cousins remembered the beach being about a 100 feet more than it is now. There was a grave pit in the area near the tennis courts of the Keauhou resort, according to Mr. Alapai.

Mrs. Hamm stressed that there is a family cemetery close to the project area that is still being maintained by the family. Mr. Fujisaka related that his father was trained to be the caretaker for the burial cave of the Kahalu‘u area when cave burials were still being done. The cultural practice of preparing the dead included washing the body with ashes and salt, and then wrapping it with cloth or tapa to be tied to carrying poles. Only a designated group of family members, no more than eight, were chosen to accompany the body along the trail to be buried in the cave. Other family members stayed behind to mourn the deceased. Mrs. Hamm confirmed the training of the designated members to take care of the deceased, and that the ceremonies of carefully cleaning the dead and preparing them for burial was part of honoring the physical body of individuals, which was valued by Hawaiians along with the spiritual and mental bodies.

Caves. Near the project area are a number of caves that were used for refuge and/or habitation purposes during times of instability, as well as for burials. Archaeological studies, place name research, and community consultation confirm the presence of caves including the well-studied ‘Ōhi‘a Cave. There are no caves in the project area itself, according to Mr. Fujisaka. But, there are many along the hillside near the project area. Both Mr. Alapai and Mr. Kahulamu shared that there are many caves in Kahalu‘u which were used as burials and also for shelter. Some of the caves also had many fishbone hooks and poi pounders that were taken by collectors.

Marine and Freshwater Resources. Kahalu‘u was teeming with abundant water resources, brackish as well as fresh. The water came from underground and would bubble to the surface, shared Mr. Fujisaka. Study participants knew ponds that could be used for bathing and for drinking purposes. There were also ponds that were off limits and reserved for ali‘i, such as Po‘o Hawai‘i. As for daily drinking water, study participants used freshwater catchment; water for the cisterns came from rain. Mrs. Hamm related that they would minimize using the water from their cisterns as much as possible by taking baths and washing their laundry at the beach. Mr. Kahalamu and Mr. Alapai had a catchment tank for their needs but they needed to supplement by hauling water from a brackish pond near their house as well as several freshwater ponds.

Anchialine ponds teeming with ‘ōpae ‘ula were, and still are, in the project area, and Mr. Fujisaka recalled a big pond in particular called Kilohana, which he and others cleaned whenever Tūtū Naluahine called for the overgrown ēkoa bush to be cut back. The cleaning of invasive plants like ēkoa is still an ongoing cultural practice. ‘Ōpae ‘ula was used as bait for ‘ōpelu fishing. Mr. Fujisaka

described the ʻōpae ʻula as hardy survivors who find a way to live no matter where they may be, while Mr. Alapai explained that the little red shrimp filtered the water and kept the pond clean.

Because the project area was primarily a fishing area, just about every fish variety associated with the shoreline could be found, including manini,ʻūʻū, and hinalea, to name just a few. There was abundant limu of all kinds, including limu eleʻele, limu waina, limu lipoa (for use with ʻōpihi), and limu kala. There was no limu kohu in the Kahaluʻu makai area, so those who lived in Kahaluʻu would ask permission from the residents of Keauhou to pick limu kohu there. Limu kala was used for medicinal purposes as well.

Fishing Practices. Kahaluʻu Bay was teeming with all kinds of fish. Mr. Fujisaka recalled being taken by his elders around the bay to learn all the locations of kuʻuna, or places where and how to set net. The kuʻuna were in shallow waters and had their own names such as Koʻomea or Pokowaʻa, which had big flat boulders on the bottom close to where the net is set. Cousins Mr. Alapai and Mr. Kahulamu noted there were at least 30 kuʻuna in the bay, and they shared their method of cross netting. Once it was time to bring in the fish, one simply walked up to the shallow area, grabbed the lead, and brought the net together to catch the fish, which Mr. Alapai noted as tasting better back then because of all the limu that the fish ate. Even the guts of manini would be eaten, when now it is not advisable, and little fish like that would be roasted or pulehu. Limu is not as available now as it was before, which limits the amount fish can eat, thereby changing its taste.

Each family also had a specific kind of fish that was kapu for them to eat. For Mr. Kahalioumi, a little dark fish that was used for medicine by his family was forbidden to be eaten. For Mr. Fujisaka, the fish that was kapu was the one that was used to lure others. There was ʻōpelu fishing outside Keauhou, and there was also ʻōpelu caught outside of Laʻaloa. Heʻe (octopus) also used to be abundant in Kahaluʻu Bay.

Limu Gathering. According to Mrs. Hamm, women were the limu gatherers, while men were the fishermen. The women from her ʻohana frequented special places to gather limu, and she learned to do it by watching her mother who also fished in the water for small fish using her muʻumuʻu. She also gathered limpets or ʻōpihi. Mr. Alapai described the different kinds of limu, such as ogo, limu kala, and cabbage limu.

Salt Gathering. Salt was found and gathered all along the shoreline of the project area. It was used to dry fish that would then be left out on the black lava rocks or placed on top of coconut leaves on the rocks. Mr. Alapai noted that there were plenty of small salt water ponds that were dried by the sun, leaving salt. However, the salt is not so clean now as before due to the ocean being used as a bathroom, according to Mr. Kahalamū.

Trails. There were four main trails that went mauka-makai in Kahaluʻu, according to Mr. Fujisaka. Those trails were Paniau, Mākoleʻā, Kaholele, and Kapaʻalaʻalaia. Other nearby trails include Kahaluʻu, Laʻaloa, Pāhoehoe which was a flat trail, Hōlualoa, Kamalumalu (a big trail), Judd trail, and Puapuaʻa. In addition, there were smaller trails that interconnected with the larger ones.

One travelled up and down the trails on old kēkake, or donkeys, that were used to carry packs and wooden saddles, related Mrs. Hamm who described riding on the hard wooden saddles. All along the trail, she and her family would visit other families and pay their respects along the way to their destination. The main road that is now known as Ali‘i Drive was a trail before; residents referred to the trail as either going to Kailua or Keauhou, described Mr. Fujisaka.

Surfing. Ku‘emanu Heiau was a surfing heiau attesting to the ancient practice of surfing enjoyed by ali‘i. Near Ku‘emanu Heiau were specific wave breaks called Kehau and Kapua, with Kapua being inside and Kehau located outside according to Mr. Mitchell Fujisaka. There was also a third surf wave there. Pu‘u Pu‘u was the surf by Ohi‘o, because it was the highest peak.

Mr. Fujisaka described surfing the way it was practiced in the 1950s, stating it was he and others in his group who started so-called "modern surfing." He used a "big, hollow paddle board" that was about 13 feet long, and knew all the surf spots and their names before they were called the names that are currently being used. The names were sometimes related to the people who lived nearby including Tommy Whites and Hinds (before it was known as Banyan's). Other spots were Moa, Kamoamoa, and Kahalu‘u.

Educational and Cultural Programs. The project area is currently being used for educational purposes by the KKEG that teaches students using place-based learning. Students are brought on-site to learn topics such as plane table mapping techniques and math, which is being used in the restoration of the heiau located in the project area. Mrs. Hamm pointed to the use of genealogy to teach history to the children. Her grandchildren along with Mr. Kahalioumi's grandchildren and those of Mrs. Vel Kauahi are already benefitting from the program, which teaches them important aspects of Hawaiian culture including chants and ceremonies.

3.13 SOCIAL AND ECONOMIC FACTORS

3.13.1 Population and Housing

Information on the existing social characteristics of the project area was obtained from the U.S. Census Bureau's Census 2010 data. The Kahaluʻu Ma Kai project site is located within the Kahaluʻu-Keauhou Census Designated Place (CDP) identified as census tract number 215.09. Demographic characteristics from the 2010 Census assembled of the Kahaluʻu-Keauhou CDP in comparison with the Hawaiʻi County CDP are shown on Table 3.7.

Population

The resident population in West Hawaiʻi, and particularly in the North Kona District, has grown rapidly over the last few decades as compared to population growth over the entire County. As shown below, the district has increased in population by 784 percent between 1970 and 2010 as compared to only 287 percent for the entire County.

Area	Resident Population by Year					Total Percentage Growth
	1970	1980	1990	2000	2010	
North Kona District	4,832	13,898	22,284	28,543	37,875	784%
County of Hawaiʻi	64,468	92,053	120,317	148,677	185,079	287%

Source: Hawaiʻi State DBEDT: *Hawaiʻi State Data Book*

The high growth rate over the decades has resulted in a steady stream of new residents to the district, lured by Kona's attractions, employment, and entrepreneurial opportunities associated with the tourism industry. Many residents of the district are relative newcomers to the island, particularly from the U.S. mainland, who are often retired and more affluent. The growth of tourism has also contributed to a number of visitors vacationing in the area increasing the district's de facto population (those actually present on any given day).

Census data for 2010 indicates that the Island of Hawaiʻi had a population of 185,079 persons, and the Kahaluʻu-Keauhou CDP a population of 3,549 persons, or 1.92 percent of the island total. Within this CDP population, 16.2 percent (575 persons) were of age 17 and younger, 24.3 percent (862 persons) were 65 years and older, and 59.5 percent (2,112) were between the ages of 18 and 64 years old. In comparison, the Island of Hawaiʻi had a significant higher percentage of persons age 17 and younger (22.8%) and significantly lower percentage of persons 65 years and older (14.5%). The median age for Kahaluʻu-Keauhou CDP of 52.8 years is also considerably older than the County's median age of 40.9 years.

Table 3.7
Summary of U.S. Census Demographic Data (2010 and 2000)

Description of Demographic Data	Kahalu‘u-Keauhou CDP		Hawai‘i County CDP	
	Number	Percent	Number	Percent
POPULATION (2010)	**3,549**		**185,079**	
AGE				
Under 5 years	196	5.5	11,845	6.4
5 to 17 years	379	10.7	30,435	16.4
18 to 64 years	2,112	59.5	115,965	62.7
65 years and older	862	24.3	26,834	14.5
Median age	52.8		40.9	
RACE				
White	2,252	63.5	62,348	33.7
Black or African American	23	0.6	1,020	0.6
American Indian and Alaska Native	14	0.4	869	0.5
Asian	363	10.2	41,050	22.2
Native Hawaiian or Other Pacific Islander	312	8.8	22,389	12.1
Some other race	92	2.6	2,868	1.5
Two or more races	493	13.9	54,535	29.5
HOUSEHOLDS	**1,456**		**67,096**	
Family households	957	65.7	44,407	66.2
Non-family households	499	34.3	22,268	33.8
Households with individuals under 18 years	292	20.1	21,340	31.8
Households with individuals 65 years and over	550	37.8	19,541	29.1
Average household size	2.37		2.70	
Average family size	2.75		3.22	
HOUSING OCCUPANCY AND TENURE				
Total housing units	2,715		82,324	
Occupied housing units	1,456	53.6	67,096	81.5
Vacant housing units	1,259	46.4	15,228	18.5
Occupied housing units	1,456		67,096	
Owner-occupied housing units	947	65.0	44,271	66.0
Renter-occupied housing units	509	35.0	22,825	34.0
EMPLOYMENT STATUS (2000 Census)				
Population 16 years and older	2,088		114,647	
In labor force	1,071	51.3	70,791	61.7
Not in labor force	1,017	49.9	43,856	38.3
INCOME (in 1999) (2000 Census)				
Households	1,045		52,945	
Less than $10,000	105	10.0	6,135	11.6
$10,000 to $49,999	394	37.7	25,989	49.1
$50,000 to $99,999	346	33.1	15,257	28.8
$100,000 or more	200	19.2	5,564	10.5
Median household income	$52,522		$39,805	

Source: U.S. Census Bureau, Census 2010 and Census 2000

The resident population in Kahalu‘u-Keauhou is also quite different from the County with 63.5 percent being White as compared to the island's 33.7 percent (almost double). The percentage of Asian in the district is also less than half of the County (10.2% compared to 22.2%) as shown on the table. The district also has a lower percentage of Native Hawaiian or other Pacific Islander, and less than half of the residents of the Two or More Races category than the County. This data supports the trend over the decades of many residents in the district consisting of newcomers to the island, such as from the U.S. mainland, who are often retired and choosing to live in the area.

Housing

The 2010 census data showed that the number of households on the island was 67,096 and the Kahalu‘u-Keauhou CDP had 1,456, or 2.17 percent of the island total. The average household size for this CDP was 2.37 persons and the average family size was 2.75 persons. The average household and family size for the Kahalu‘u-Keauhou CDP were both lower than the island's average of 2.70 and 3.22 persons, respectively. The percentage of households with individuals 65 years and older (37.8%) was also notably higher than the County's (29.1) reflecting the migration of many retirees to the area.

The visitor-oriented characteristic of the Keauhou Resort area likely contributes to the lower household size numbers as compared to the overall island. This is reflected in the area having a high percentage of vacant housing units (46.4%) in comparison to the County (18.5%).

The project site currently does not have any residential homes on the property. With the closure of the Keauhou Beach Resort, the hotel units associated with the resort are no longer operational. As a result, there are no residents or visitors residing on the property temporarily or permanently.

3.13.2 Employment and Household Income

The County of Hawai‘i had the second largest number of people in the labor force by County in the State with 119,897 people employed (between the ages of 16 to 64 years old) in 2011. The City and County of Honolulu was first with 622,297 persons and the County of Maui was third with 102,429 persons. Based upon the census data, the Kahalu‘u-Keauhou CDP (51.3%) had a lower percentage of the population in the labor force compared to the island's percentage (61.7%). This reflects the larger number of retirees living in the CDP as compared to the island.

The County of Hawai‘i had the third largest number of annual average jobs in the State with an annual average of 63,350 jobs in 2011. This total was behind the City and County of Honolulu, and close to the County of Maui's total of 67,400 jobs. The County's total number of jobs represented about 10.5 percent of the State's total. The County also had the highest unemployment rate of 9.9 percent compared to the other counties. The average annual wage in the year 2011 (including government) for the Island of Hawai‘i was $36,566 compared to the State's average of $42,454.

The closure of the Keauhou Beach Resort resulted in the elimination or displacement of several jobs associated with the Outrigger Hotels and Resorts Company. This involved jobs in the areas of hotel management, housekeeping, security, and maintenance. Smaller businesses operating within the resort also needed to close or relocate elsewhere.

3.13.3 Character of Community

The project site is situated within the Keauhou Resort area that encompasses an area of about 2,400 acres generally extending from the shoreline inland up to Kuakini Highway. Keauhou Resort is a fully integrated destination resort community located about five miles south of the primary West Hawai‘i resort area of Kailua-Kona. As a result, many of the characteristics associated with this community are visitor-oriented.

Such resort-oriented developments include the Sheraton Kona Resort and Spa at Keauhou Bay, the Keauhou Shopping Center, Kona Country Club, and various timeshare, residential and resort condominiums, and single-family residences predominantly situated along the coastline. The former KLH (previously demolished) and KBR on the project site similarly represented the resort character of the area. This resort character of the community also extends further north with several visitor timeshare, residential condominiums, and single-family residences developed along the shoreline.

This coastline is also known for its numerous historic sites and natural and cultural resources. Many of the resort uses have incorporated these historic and cultural sites into their operations or design themes. As a result, these sites generate much interest from visitors staying in the region or elsewhere. The Kahalu’u Ma Kai property is an example of this pattern of development and by emphasizing the five heiau present, generated much interest by both residents and visitors. Even with the closing of the KBR, there continues to be many visitors to the site on a daily basis to inquire about the historic and cultural sites.

Inland areas located above (mauka) Kuakini Highway have a distinctly different character which is rural residential. These areas consist of predominantly low-density single-family residences spread out over large areas and connected by rural roadways. Owners of these residences are predominantly island residents.

3.14 INFRASTRUCTURE FACILITIES

A preliminary engineering report was prepared by Belt Collins Hawai‘i, LLC (BCH) that covered water, wastewater, drainage, and electrical and communication facilities. This report is included in Appendix I of this document. A traffic impact analysis was prepared by Austin, Tsutsumi and Associates, Inc., and this report is included in Appendix J of this document. Information from these reports was used to address existing infrastructure facilities.

3.14.1 Water Facilities

Potable water service to the project area is provided by the County Department of Water Supply (DWS) from its 324.5-foot elevation Keauhou system served by the Keauhou Reservoir located makai of Kamehameha III Road. A 12-inch diameter water line transports water down (makai) from this reservoir, along Makolea Street, and then along Ali‘i Drive.

The water system providing service to the project site is associated with existing infrastructure that previously served the KLH and KBR. Water meters and service laterals currently serve the northern and southern halves of the property that was formerly used by the two resorts.

Domestic water service to the KBR portion of the project site is provided by a 6-inch by 4-inch Hersey compound meter located near the site’s main entrance off of Ali‘i Drive. A 4-inch diameter water line extends from this meter to the KBR hotel. Smaller service laterals extend from the hotel to the tennis center building (located in the middle of the project site) and Kalani Kai structure situated along the shoreline. Irrigation lines serving the KBR section of the property are also tapped off the 4-inch diameter water line. Domestic water and fire protection services to the former KLH area of the property are provided by a 4-inch Hersey compound meter and 6-inch Hersey detector check meter. These water meters are located within the property near the Ali‘i Drive shoulder area. The DWS indicated that as-built drawings of the water system for this southern half of the property were not available.

Fire protection service to the former KBR is provided by a 6-inch Hersey detector check meter. Building fire protection is provided by a 4-way Siamese wet standpipe connection located in front of the hotel and a 2-way Siamese dry standpipe connection located near the southeast corner of the building. There are no on-site fire hydrants in the KBR building area, or in the former KLH portion of the property.

Existing Water Demand

The existing water system serving the former KBR was sized to accommodate 317 hotel rooms plus accessory facilities. Average daily water usage at KBR, based upon DWS monthly water usage data from November 2011 to November 2012, was approximately 46,000 gallons per day (gpd). Monthly water usage data from January 2013 to July 2013 (after closure of KBR) indicated an average daily demand on the order of 20,000 gpd. Therefore, a 56 percent reduction in water usage is generally

occurring on the KBR portion of the project site with the closure of the resort operations. Current water usage is predominantly associated with landscape irrigation.

The existing water system serving the former KLH was sized to accommodate 462 hotel rooms. Average daily water usage at the KLH, based upon DWS monthly water usage data from October 1997 to October 1981, was approximately 94,000 gpd. Monthly water usage data from December 2012 to August 2013 indicated an average daily demand of about 4,000 gpd, or less than 95-percent of the previous demand of the KLH.

Therefore, the total water usage currently being generated from the entire project site is about 24,000 gpd. Prior water usage with both the KBR and KLH resorts in operation was about 140,000 gpd. This reflects a decrease of about 83 percent in total water usage for the property. Based on an October 2011water agreement, the KLH parcel has an allocation from DWS of 235 equivalent units of water. Each equivalent unit is equal to 600 gallons per maximum day. As a result, the available maximum daily usage for this southern half of the project site is 141,000 gpd.

3.14.2 Wastewater Facilities

The County DEM, Wastewater Division provides wastewater collection and treatment for most of the island. A County wastewater system consisting of gravity and force mains connecting to the Kealakehe Wastewater Treatment Plant serves areas of the North Kona district. However, this wastewater collection system stops at a residential subdivision located north of the project site.

Wastewater collection and treatment in the Keauhou area is by a privately operated company. This sewer system consists of gravity lines, force mains, pumping facilities and the He‘eia Wastewater Treatment Plant (WWTP) located within the Kona Country Club Golf Course near He‘eia Bay about 0.6 miles to the south.. The He‘eia WWTP was expanded from its previous capacity of 0.75 million gallons per day (mgd) to a current capacity of 1.8 mgd. The treatment facility can be further expanded to an ultimate size of 3.6 mgd (LUC August 2005). Wastewater at the treatment plant receives pretreatment followed by primary and secondary treatment. The wastewater is treated to R-2 quality with approximately 0.5 mgd of reclaimed water produced.

Sewerage Pump Stations

There are four sewage pump stations (SPSs) located within the project site consisting of three small SPSs serving the former KBR site, and the Kahalu‘u SPS located on the southern half of the project site. The Kahalu‘u SPS is located in the VE flood zone near the southwestern corner of the property and adjacent to the Mākole‘ā Heiau.

The Kahalu‘u SPS is owned by the Applicant (KS), but is operated and maintained by a private firm. The original pumping facilities consisted of a dry well and wet well. However, in 2005 the SPS was modified with the demolition of the dry well, and addition of two submersible pumps in the wet well. Each submersible pump is rated to operate at 1,037 gallons per minute (gpm) or about 1.5 mgd. With two pumps in operation, the Kahalu‘u SPS capacity is about 3 mgd. Exhibit 3.15 shows a photo of this SPS.

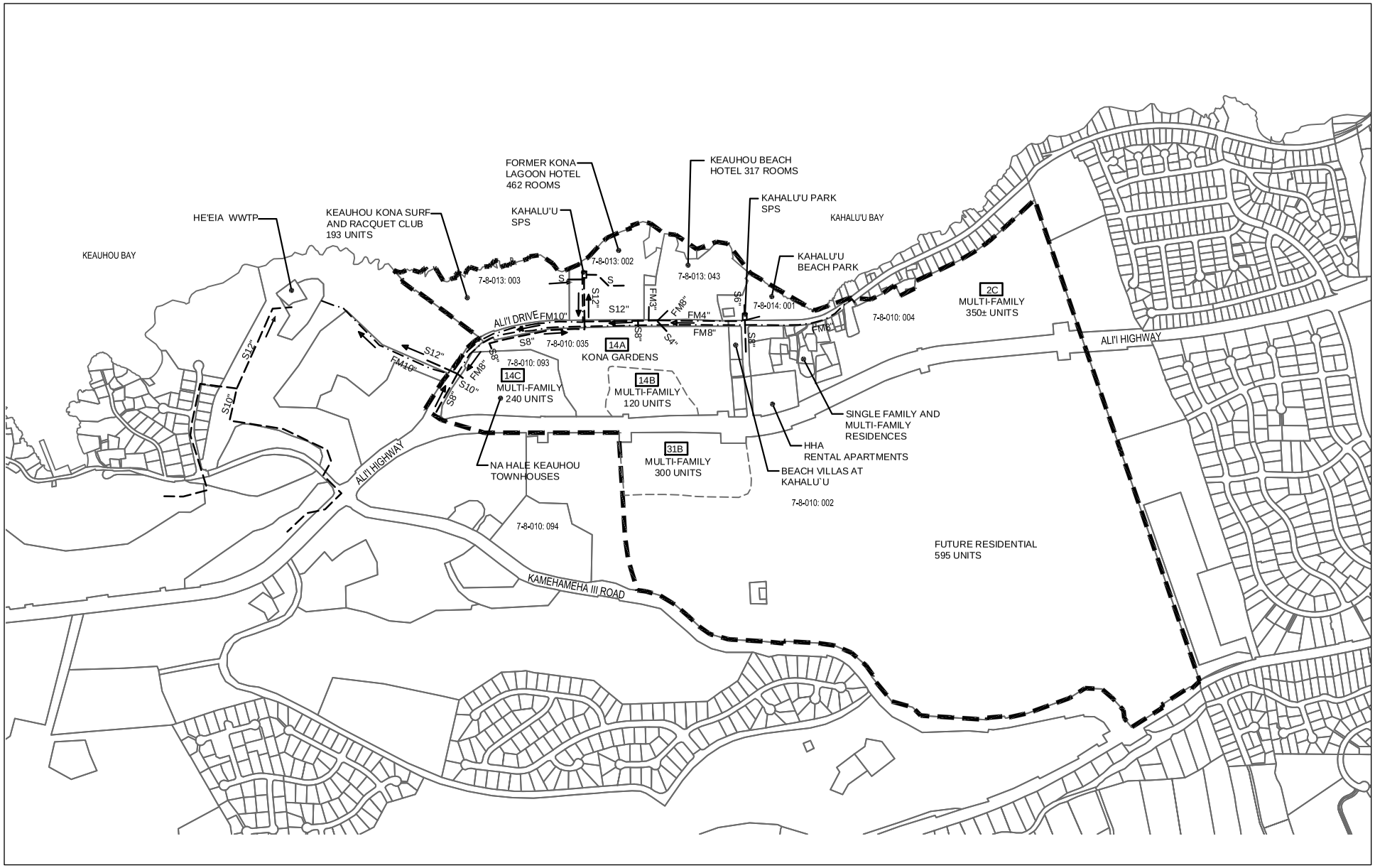
Exhibit 3.15 Photo of Kahalu‘u SPS

This Kahalu‘u SPS appears to be well maintained and in satisfactory condition. The pump controls and emergency generator were installed separately from the Kahalu‘u SPS, and are located along Ali‘i Drive in the southeastern corner of the property, and outside the flood zone. The circuit breakers of the pumps trip periodically due to the long distance from the pump controls.

Wastewater at the northern half of the project site (former KBR area) is currently collected in three small SPSs. A SPS located in the basement of the existing KBR hotel conveys wastewater to a SPS located adjacent to the hotel on the southeast side. The other SPS is at the existing Tennis Center Building. Force mains from the SPSs convey wastewater collected to an existing 12-inch diameter sewer main within the Ali‘i Drive right-of-way. This 12-inch diameter sewer main then conveys wastewater from the project site along with nearby properties by gravity along Ali‘i Drive southbound, and is then routed makai to the existing Kahalu‘u SPS. Wastewater from the Kahalu‘u SPS is then pumped mauka (inland) back to Ali‘i Drive where a 10-inch diameter force main conveys wastewater along this roadway to the south toward the He‘eia WWTP.

Existing Tributary Area and Wastewater Design Flows

The wastewater tributary area of the Kahalu‘u SPS is approximately 400 acres, and includes existing developed areas and future planned developments within this Keauhou Resort area. A general site map showing the tributary area for the Kahalu‘u SPS is shown on Figure 3.14. As shown on this figure, the Kahalu‘u SPS receives flows generated from the former KBR area which are the hotel, tennis center building, and Kalani Kai Grill.



Source: BELT COLLINS

LEGEND:

- TRIBUTARY AREA
- GRAVITY SEWER
- FORCE MAIN SEWER
- FLOW DIRECTION

KAHALU'U MA KAI

Figure 3.14 - Kahalu'u Sewer Pump Station Tributary Area

Kahalu'u, Hawai'i

0 200 400 800

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This tributary area includes the following surrounding properties: the Keauhou Kona Surf and Racquet Club, HHA Rental Apartments, Na Hale Keauhou Townhouses located mauka of the racquet club, Kahalu‘u Beach Park SPS, Beach Villas at Kahalu‘u, and several single-family and multi-family residences. In addition to these properties, the tributary area also includes the southern half of the project site (former KLH) and large undeveloped areas planned for future residential and multi-family development.

Wastewater from the racquet club and mauka townhouses is conveyed to the Kahalu‘u SPS via a gravity line directly from the racquet club property. A 4-inch diameter force main from the Kahalu‘u Beach Park SPS conveys wastewater to the 12-inch diameter gravity sewer main within the Ali‘i Drive right- of-way.

Preliminary wastewater flow calculations based on the tributary area and land uses identified are provided in Table A-1 of Appendix J (BCH Preliminary Engineering Report). The wastewater flows were estimated based on the methodology in the *Design Standards of the Department of Wastewater Management* (City 1993). The results of the preliminary wastewater flow design calculations for this tributary area to the Kahalu‘u SPS are provided along with estimated flows under existing conditions. Existing conditions reflect the closure of the KBR.

Wastewater Flow Estimates		Design Conditions	Existing Conditions
a.	Design Average Flow:	0.81 mgd	0.16 mgd
b.	Design Maximum Flow:	3.59 mgd	0.77 mgd
c.	Design Peak Flow:	4.14 mgd	0.86 mgd

Based on the existing developments discharging wastewater to the SPS, the existing pumps are oversized for the flows received. Existing average flows are estimated to be only 0.16 mgd while the Kahalu‘u SPS design flows can process 0.81 mgd (20% of capacity).

3.14.3 Drainage Facilities

The project site is located makai of Ali‘i Drive and borders the shoreline, therefore, storm water runoff generated on the site generally sheet flows to lower lying areas, infiltrates into the ground in some locations, and eventually discharges into the ocean at the shoreline. As previously discussed in Section 3.1, the topography associated with most of the project site is generally level, and gently slopes from Ali‘i Drive toward the shoreline in a westerly direction. Much of the area has been previously modified as part of the development of the KBR and KLH. The property generally slopes towards the ocean at a grade of between 4.0 to 4.4 percent. There are no perennial or intermittent streams or large drainageways routed through the site.

Three existing drain inlets and a 16-inch diameter drain line collect storm water runoff from portions of the KBR parking lot and cul-de-sac located adjacent to the hotel. The drain line discharges into a seepage pit located within a landscape area south of the hotel and adjacent to the

tennis courts. Existing drainage conditions showing general flow patterns on the property, drainage areas within the property, and estimated runoff quantities are shown on Figure 3.15.

As shown on Figure 3.15, there are 11 drainage areas identified on the property with the largest being the southern half of the site (11.11 acres). The next largest is the middle section of the property that includes the tennis courts, tennis building, and nearby parking area (3.56 acres). The northern portion of the property associated with the former KBR is divided into the remaining nine drainage areas. Existing storm water runoff from the project site totals 52.2 cubic feet per second (cfs).

3.14.4 Solid Waste Facilities

The County Department of Environmental Management, Solid Waste Division operates the County's solid waste facilities that consist of transfer stations and landfill sites. Solid waste generated in West Hawai‘i is disposed of at the West Hawai‘i Sanitary Landfill in Pu‘uanahulu in the North Kona District of the island. The Keauhou Transfer Station is the closest transfer station to the project site located on the mauka side of Kuakini Highway.

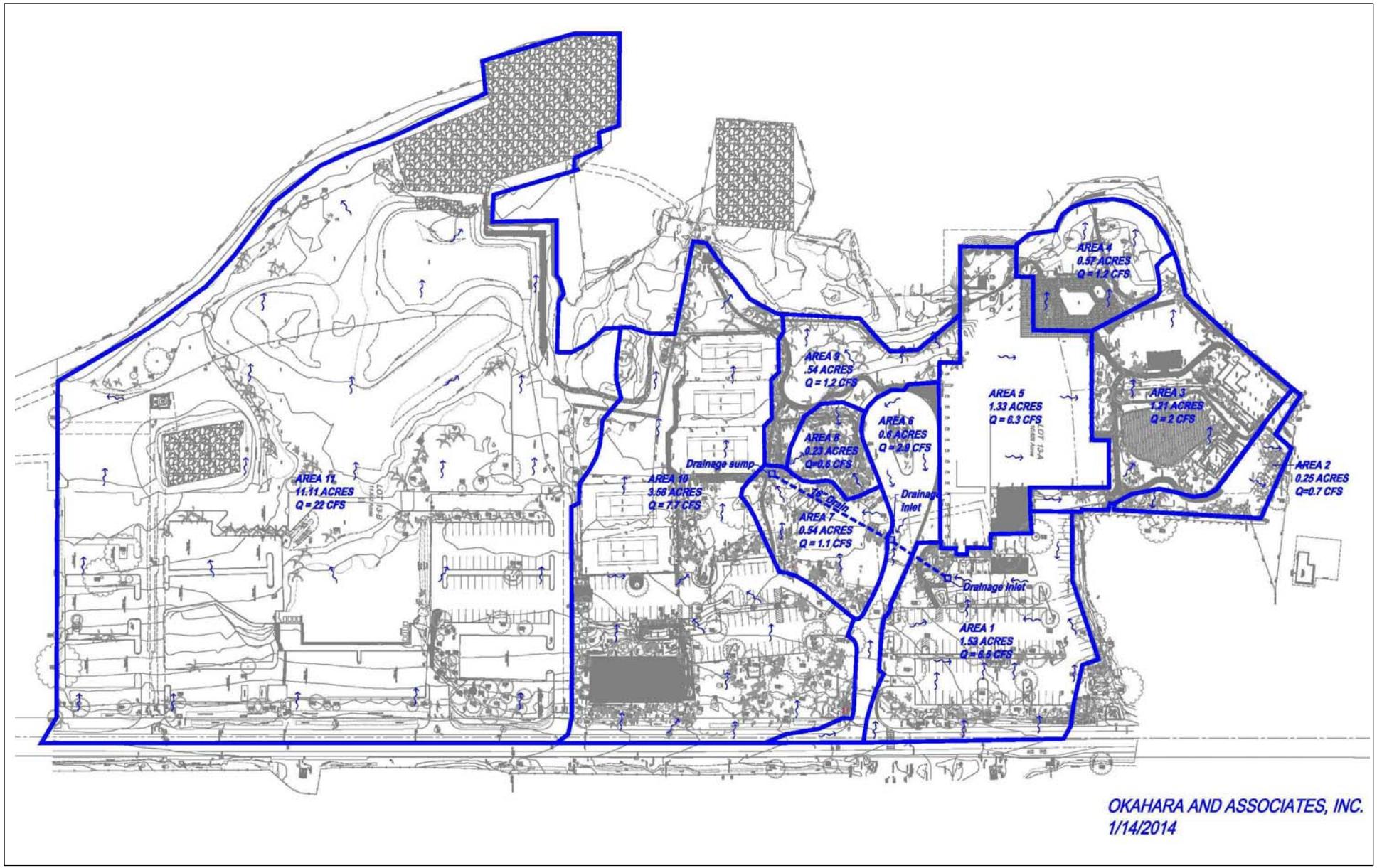
Solid waste generated from the project site is currently serviced by a private solid waste collector who disposes of waste at either the transfer station or West Hawai‘i Sanitary Landfill.

3.14.5 Transportation Facilities

Austin Tsutsumi and Associates, Inc. conducted a traffic impact analysis study for this project, and this report is included in Appendix J of this document. Traffic counts were taken at selected study intersections to determine existing traffic operations during the weekday morning and afternoon peak hours of traffic. Future traffic projections without the project and with the project were generated for the study year 2023, and analysis of traffic conditions performed. The study intersections include the following:

1. Ali‘i Drive with Project Main Driveway (unsignalized).
2. Ali‘i Drive with Ali‘i Highway and Keauhou Shopping Center Driveway (signalized).
3. Ali‘i Drive with Kamehameha III Road (signalized).
4. Kamehameha III Road with Keauhou Shopping Center Driveway (signalized).

The methods for calculating volume to capacity ratios and delays prescribed under *The Highway Capacity Manual; Special Report 209* (HCM, 2000) was used. The analysis methodology also used Level of Service (LOS) as a qualitative measure to describe traffic flow conditions at study intersections. LOS values range from free-flow conditions (LOS A) to congested conditions (LOS F).



Source: BELT COLLINS

Kahalu'u Ma Kai

Figure 3.15 - Existing Drainage Conditions Plan

Kahalu'u, Hawai'i

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Existing Roadway System

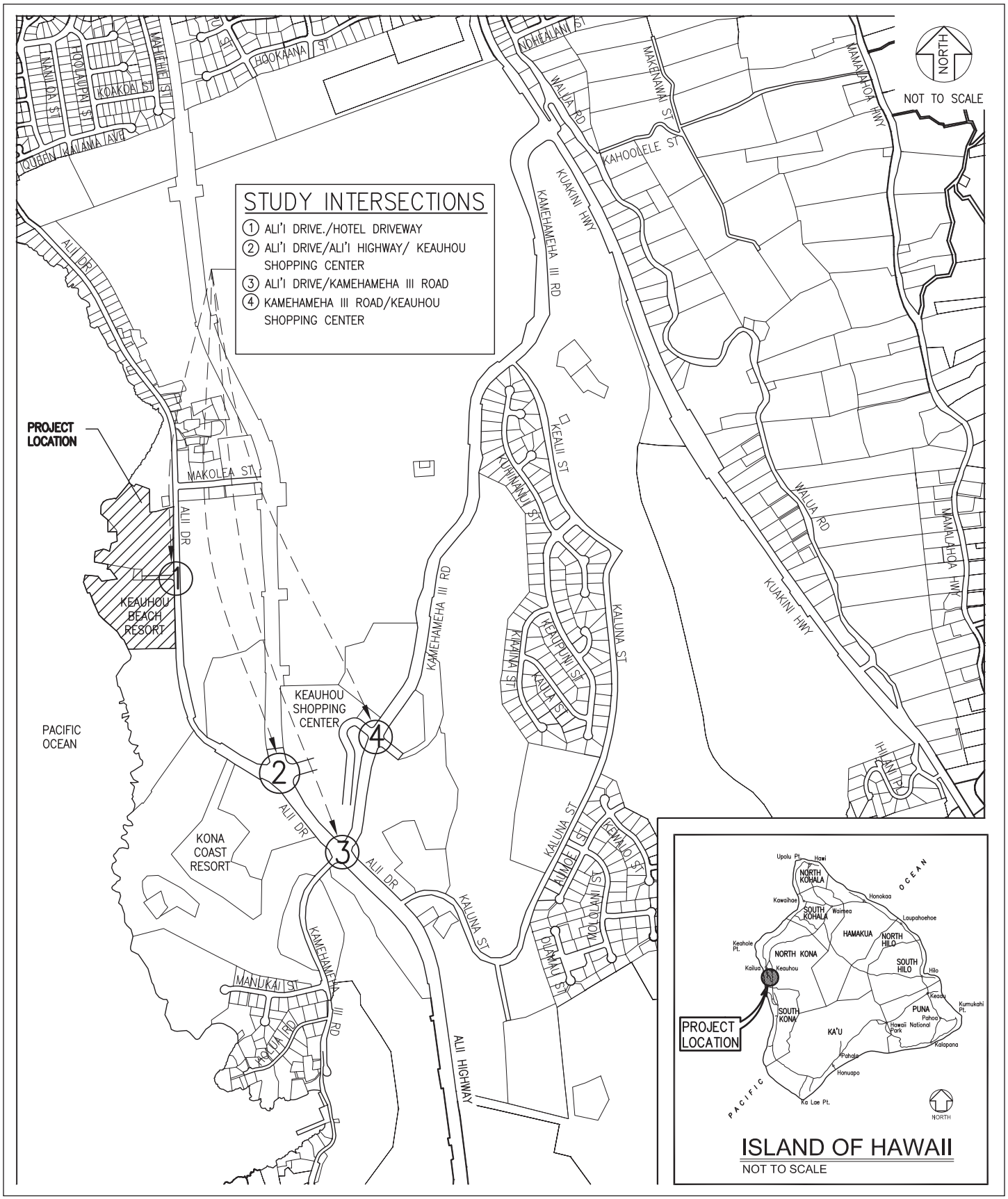
The roadway system in the project area consists of the State Department of Transportation's Kuakini Highway and the County's Ali'i Drive both of which generally provide north-south vehicular access through this vicinity from other communities. Ali'i Drive is a County collector roadway generally routed along the coastline while Kuakini Highway is located well inland. Ali'i Highway provides north-south vehicular access south of the project toward Kealakekua. Kamehameha III Road is a County road generally routed in an east-west direction connecting Ali'i Drive with Kuakini Highway. Figure 3.16 shows the roadway network in the project area, and identifies the four study intersections.

The State's Kuakini Highway is a two-lane, two-way undivided State highway that is part of the Hawai'i Belt Road (SR-11). This highway begins at the Old Kona Airport State Recreation Area north of downtown Kailua-Kona, travels southbound past Keauhou, and merges with Mamalahoa Highway further south in the town of Honalo. Within the vicinity of the project, the posted speed limit is 45 miles per hour (mph) to the north of Kamehameha III Road, and 55 mph to the south.

Ali'i Drive is a two-lane, undivided two-way County collector roadway. This roadway begins in downtown Kailua-Kona, travels southbound along the coastline, and terminates over a mile south of the project site at its intersection with Ali'i Highway. The posted speed limit is 30 mph along the project site. Pedestrian crosswalks and numerous all-way stop-controlled intersections are provided along Ali'i Drive.

Ali'i Highway is a two-lane, two-way undivided County roadway, also referred to as County Highway 187. This roadway begins at its intersection with Ali'i Drive (south of the project site), and proceeds south beyond Keauhou to its intersection with Mamalahoa Bypass Road. Ali'i Highway has a posted speed limit of 35 mph. This roadway is planned to be extended beyond Ali'i Drive for approximately 4.5 miles into downtown Kailua-Kona (see Figure 3.16), but no specific start date for construction has been set.

Kamehameha III Road is a two-lane, two-way undivided County roadway that connects Ali'i Drive with Kuakini Highway. This roadway begins at Keauhou Bay and travels inland in a northeast direction with a posted speed limit of 25 mph until its intersection with Ali'i Drive. After its intersection with Ali'i Drive, the roadway continues mauka past the Keauhou Shopping Center with a posted speed limit of 35 mph. Kamehameha III Road terminates at its signalized intersection with Kuakini Highway.



Source:

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
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Kahalu'u Ma Kai

Figure 3.16 - Existing Roadway Network and Study Intersections

Kahalu'u, Hawai'i

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Existing Traffic Volumes and Level-of-Service

Weekday morning and afternoon peak hour turning movement data was collected on Tuesday, October 1, 2013. Based on this traffic count data, the morning peak hour of traffic was determined to occur from 7:15 a.m. to 8:15 a.m., and the afternoon peak hour of traffic was determined to occur from 3:30 p.m. to 4:30p.m. The traffic count data is graphically shown on Figure 3.17.

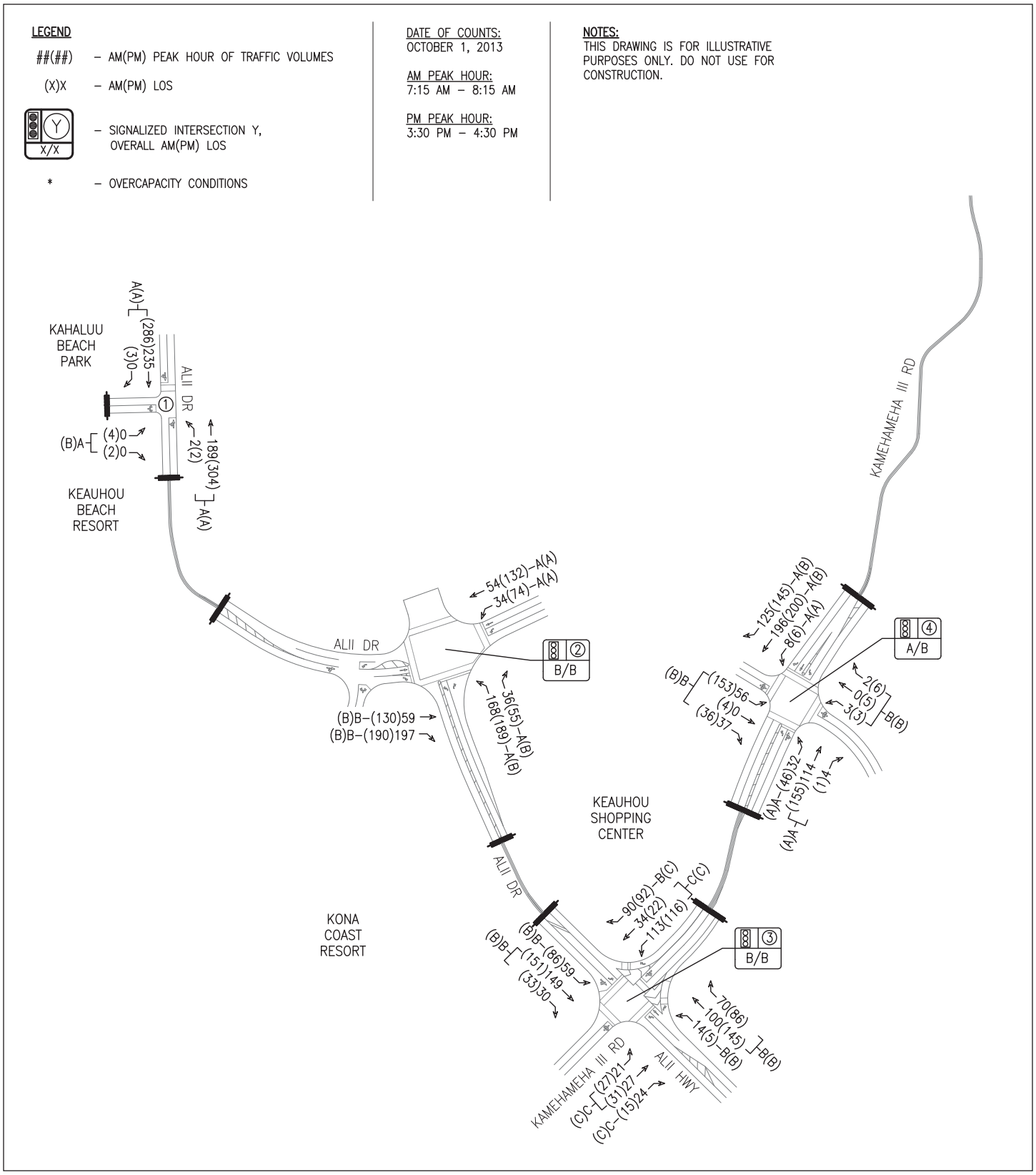
Analysis of the study intersections were conducted for existing conditions based upon the traffic data collected. Table 3.8 shows these results, and a summary is provided.

1. Ali'i Drive and Project Driveway. The existing two-way, stop-controlled Ali'i Drive and Project Driveway (KBR main driveway) intersection provides single-lane approaches and a marked crosswalk on the north leg. All approaches currently operate at LOS B or better during the morning and afternoon peak hours of traffic.
2. Ali'i Drive and Keauhou Shopping Center Driveway. The Ali'i Drive with Keauhou Shopping Center Driveway signalized "T"-intersection operates at LOS B or better for all approaches during both the morning and afternoon peak hours of traffic.
3. Ali'i Drive and Kamehameha III Road. The Ali'i Highway with Kamehameha III Road signalized intersection was observed to operate at LOS C or better for all approaches during both the morning and afternoon peak hours of traffic.
4. Kamehameha III Road and Keauhou Shopping Center Driveway. The Kamehameha III Road and Keauhou Shopping Center Driveway signalized intersection was observed to operate at LOS B or better for all approaches during both the morning and afternoon peak hours of traffic.

3.14.6 Electrical and Communication Facilities

Electrical power service to this area is provided by the Hawai'i Electric Light Company (HELCO), a privately owned utility company regulated by the State Public Utilities Commission, via distribution lines routed primarily along major roadways. HELCO's Keāhole generating plant, along with generating facilities in East Hawai'i, provides electrical capacity to West Hawai'i (LUC August 2005). North of the project site, overhead sub-transmission lines located on utility poles are routed along Ali'i Drive. At the project site and south into the Keauhou Resort area, utility lines are distributed underground.

Hawaiian Telephone Company (HTC) provides telephone and other telecommunications services to Keauhou as well as to the rest of the island. HTC provides telephone service for the region from their switching facilities in Kailua-Kona (LUC August 2005). Oceanic Time Warner Cable (OTWC) provides CATV, voice and other telecommunication services to Keauhou as well as to the rest of the island.



Source:

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Kahalu'u Manowai

Figure 3.17 - Existing Traffic Volumes and Level-of-Service

Kahalu'u, Hawai'i

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Table 3.8
Existing 2013 Levels-of-Service Analysis Results

Study Intersection	Existing Conditions					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1. Ali‘i Drive & Project Driveway						
Eastbound Left-Turn/Right-Turn	0.0	0.00	A	12.6	0.01	B
Northbound Left-Turn/Through	0.1	0.00	A	0.6	0.02	A
Southbound Through/Right-Turn	0.0	0.15	A	0.0	0.18	A
2. Ali‘i Drive/Keauhou Shopping Ctr.						
Eastbound Through	11.3	0.19	B	12.7	0.36	B
Eastbound Right-Turn	11.2	0.14	B	12.3	0.24	B
Westbound Left-Turn	8.0	0.13	A	7.6	0.20	A
Westbound Through	7.8	0.10	A	7.5	0.20	A
Northbound Left-Turn	9.9	0.38	A	12.1	0.46	B
Northbound Right-Turn	8.8	0.03	A	10.6	0.04	B
Overall	10.1	0.30	B	10.9	0.40	B
3. Ali‘i Drive & Kamehameha III Road						
Eastbound Left-Turn/Through	24.3	0.33	C	26.9	0.39	C
Eastbound Right-Turn	23.3	0.02	C	25.5	0.01	C
Westbound Left-Turn/Through	20.7	0.48	C	22.8	0.46	C
Westbound Right-Turn	18.7	0.06	B	20.8	0.07	C
Northbound Left-Turn	14.8	0.05	B	14.9	0.01	B
Northbound Through/Right-Turn	17.1	0.38	B	18.0	0.47	B
Southbound Left-Turn	10.8	0.15	B	10.7	0.21	B
Southbound Through/Right-Turn	14.5	0.33	B	14.2	0.30	B
Overall	17.5	0.38	B	18.3	0.43	B
4. Private Driveway/Keauhou SC & Kamehameha III Road						
Eastbound Left-Turn	6.1	0.07	A	7.6	0.11	A
Eastbound Through/Right-Turn	6.8	0.17	A	9.8	0.26	A
Westbound Left-Turn	5.8	0.02	A	9.6	0.02	A
Westbound Through	7.0	0.27	A	11.4	0.37	B
Westbound Right-Turn	6.4	0.09	A	10.3	0.10	B
Northbound Left-Turn/Through/Right-Turn	13.7	0.00	B	11.8	0.02	B
Southbound Left-Turn/Through/Right-Turn	14.5	0.28	B	15.2	0.57	B
Overall	8.0	0.27	A	11.6	0.43	B

3.15 PUBLIC FACILITIES

3.15.1 Recreational Facilities

Parks and recreational facilities within a three-mile radius of the project site consist of public parks and associated facilities, and private recreational facilities associated with the Keauhou Resort area. County recreational facilities include the Harold H. Higashihara Park in Honalo, Magic Sands/La‘aloa Beach Park and Pāhoehoe Beach Park in Kona, and Kahalu‘u Beach Park to the immediate north of the project site.

The Keauhou Boat Harbor is located approximately 1.2 miles south of the project site in a protected cove next to the Sheraton Kona Resort & Spa at Keauhou Bay. Operated by the State DLNR, Division of Boating and Ocean Recreation (DOBOR), the boat harbor consists of a boat launch ramp and pier, washdown facility and moorings for 12 vessels, and is a popular launch site for kayak rentals, boating tours and dive charters. The Keauhou Canoe Club is also located at Keauhou Bay on land leased from KS. Kailiilinehe Park is a privately-owned beach park next to the Boat Harbor, and has restrooms and picnic areas.

Other recreational facilities within three miles of the project site consist primarily of resort amenities such as golf courses, walking/biking paths and tennis courts. Golf courses include the Kukio Makai Beach Golf Club and Hokulia Golf Club, which are private clubs exclusively for members, and the Kona County Club, which is open to the public.

Kahalu‘u Beach Park

Kahalu‘u Beach Park is a 4.2-acre shoreline park with restrooms and showers, a covered pavilion, lifeguard tower and small parking lot. It is a popular recreational area known for snorkeling, swimming, sunbathing and surfing, with an estimated 400,000 users a year.

In an effort to protect and enhance the reef ecosystems and marine life fronting Kahalu‘u Beach Park, the County has partnered with a non-profit organization that teaches visitors and residents about marine life and reef protection. The Kahalu‘u Bay Education Center currently operates its educational and snorkel rental programs out of a portable facility, with long-term plans to construct a permanent visitor center and other park improvements identified in the Kahalu‘u Beach Park Master Plan (Kohala Center, 2008).

Recreational Activities Within Project Site

Within the project site, recreational activities occur along the shoreline fronting the property. Such activities include fishing from the shoreline and tidal pools, shoreline hiking/walking, and swimming and sunbathing at the small sandy beach at the southern end of the project site (Mākole‘ā Cove). The shoreline is also used to access the historic and cultural sites (i.e., restored heiau).

The County identifies a public shoreline access way through the former KBR, with parking at Kahalu‘u Beach Park (no on-site public parking) and 24-hour/daily access through the resort grounds to the shoreline. However, with the closing of the KBR, this public shoreline access has been changed, and is currently managed by KS and open during daylight hours. As discussed in Chapter 2, visitors check in at the security gate from the main driveway entrance, receive a brochure informing them of the property and cultural resources, and can then visit designated areas of the property to view cultural sites.

A second public shoreline access way that provides access to the sandy beach (Mākole‘ā Cove) at the southern end of the project site is available through the neighboring Keauhou-Kona Surf and Racquet Club property between the hours of 6:00 a.m. and 8:00 p.m. Limited parking for this access way is available along Ali‘i Drive.

3.15.2 Medical Facilities

The closest major medical facility to the project site is the Kona Community Hospital in Kealakekua, located nearly eight miles to the south. Kona Community Hospital is a full service, 94-bed long-term care hospital that provides acute and psychiatric care services, including inpatient medical and surgical care, obstetrics, intensive care, outpatient and long-term care services, as well as 24-hour emergency response care. The hospital, which is part of the State's Hawai‘i Health Systems Corporation network of hospitals and clinics, is the primary health care facility serving West Hawai‘i.

The Keauhou Rehabilitation and Healthcare Center (Keauhou RHC) is located along Kamehameha III Road. Keauhou RHC is an extended-stay nursing care center for seniors with varying levels of disabilities. Other facilities in the vicinity of the project site that offer medical care for minor emergencies include the Keauhou Urgent Care Center on Ali‘i Drive about 0.5 mile south of the project site and the Hualālai Urgent Care Center located approximately 3.0 miles to the north, along with a host of other private medical providers.

Emergency medical service and ambulance response is provided by the County's Fire Department via the Keauhou Fire Station Number 12. The county's ambulance based at the Keauhou Fire Station is the first response unit for the county. Private ambulance service is also available.

3.15.3 Educational Facilities

The project site is situated within the northern portion of the State Department of Education's (DOE) Konawaena Complex, which is part of the larger Hawai‘i District, Honoka‘a-Kealakehe-Kohala-Konawaena Complex Area. The Konawaena Complex consists of six public schools and one charter school, including Honaunau, Ho‘okena and Konawaena Elementary Schools, Konawaena Middle and High Schools, Ke Kula ‘o ‘Ehunuikaimalino (Hawaiian language immersion school serving grades K-12), and Kona Pacific Public Charter School, all of which are located to the south of the project site.

There are also a number of public schools to the north within 15 miles of the project site, including Kahakai, Hōlualoa and Kealekehe Elementary Schools, Kealekehe Intermediate and High Schools, Innovations Public Charter School and West Hawai‘i Explorations Public Charter School. Kahakai Elementary School, which is about 2.5 miles north of the project site, is the closest public school to the site.

Private schools that serve the West Hawai‘i region include Kona Christian Academy (K-7), Kona Adventist Christian School (K-8), and Makua Lani Christian School (Grades 8-12).

KS's Community-Based Early Childhood Education Program operates three preschool sites in West Hawaiʻi, with locations in Kona, Kailua-Kona, and Hōnaunau. KS's Hawaiʻi Campus is located in Keaʻau, roughly seven miles south of Hilo. This 300-acre campus accommodates an elementary school, middle school, and high school, with a current enrollment of approximately 1,100 students.

3.15.4 Police and Fire Protection

Police Protection

The County of Hawaiʻi Police Department (HPD) provides police protection services to the Kona District through the Area II Operations Bureau. The Area II Operations Bureau encompasses the western half of the island, including the districts of North Kohala, South Kohala, Kona and Kaʻū. HPD's Kona District occupies the area between Waikoloa and Kaulanamauna in the Kaʻū District. The main station in the district (i.e., the Kona District Station) is located to the north of the project site in Kealakehe. HPD operates substations in Captain Cook and Keauhou, and mini-stations at Kailua Village and Hale Halawai Park.

Fire Protection

Fire protection service is provided by the County of Hawaiʻi Fire Department (HFD). The closest fire station to the project site is the Keauhou Fire Station No. 12, which is located about five miles to the south of the project site along Kuakini Highway in Honalo. The Kailua-Kona Station No. 7 is almost six miles north of the project site, near the entrance to Kailua-Kona town.

CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

This chapter discusses the environmental consequences associated with implementing the Kahaluʻu Ma Kai project. Discussion of probable impacts is provided and mitigative measures are proposed, if necessary.

4.1 GEOGRAPHY, TOPOGRAPHY AND SOILS

The project would not have a significant long-term or short-term impact on the existing geography associated with the property. New facilities would be constructed over previously developed areas associated with the former KLH and KBR, and would not involve substantial changes to the existing geography. No major cut or fill activities are planned that would significantly alter present geologic land forms. Demolition of the KBR hotel would involve implementing several best management practices to minimize effects on the tide pools and inland area. The existing underground garage of the hotel would also be renovated for similar use as an underground parking area with storage support and thus not significantly alter that site condition.

Redevelopment of the project site after demolition of the KBR hotel, hotel amenities, and remnants of the KLH would not significantly alter the existing topography of the property. The multi-purpose building, hālau, and parking would utilize the former KBR hotel location. As a result, no large cut or fill activities would be required in that area. The heritage center, Hale Hoʻomaha and other facilities planned on the southern area of the property would utilize existing parking areas and not require major changes to the existing topography. The Hale Waʻa and Hale Kiʻi would similarly be structures constructed where similar activities currently occur. Therefore, minimal grading and only minor excavations for building foundations and utilities are anticipated.

The project would also have a beneficial long-term effect by removing several existing impervious surfaces (e.g. paved parking areas), and restoring these paved areas with landscaping (e.g. grass). These improvements would reduce the amount of storm water runoff generated on the site, and thereby reduce potential soil erosion. Restoring landscaped areas on the site would also not significantly alter existing topographic conditions. Therefore, effects on topography and soils would primarily be associated with short-term construction effects that are discussed in the following section.

Short-Term Construction Effects

Construction of the project would inevitably involve temporary land-disturbing activities that cause minor short-term effects and nuisances. Such effects may be associated with some soil erosion during periods of heavy rainfall or high winds. Soils on the project site are Punaluʻu, extremely rocky peat (rPYD) and Pāhoehoe (rLW). Punaluʻu soil has rapid permeability and only slight erosion hazard, and Pāhoehoe lava typically has no soil covering. Redevelopment of the property

for previous resort use likely involved importation of soils for grounds and landscaping. Nevertheless, construction activities should not result in considerable soil runoff, and would not have a significant impact on the environment given the property's existing soil conditions.

Various mitigation measures using standard construction best management practices will be incorporated into the project's design to minimize potential short-term erosion impacts. Such measures will be instituted following site-specific assessments during the project's design phase, and incorporate structural and non-structural best management practices (BMPs), as deemed appropriate. BMPs being considered include the following measures:

- Installing a perimeter construction fence.
- Using controlled watering to allay dust during the demolition work.
- Collecting and placing building debris, as it is created, into roll-off bins or trucks for hauling and removal from the site.
- Installing silt fences, snake bags or other means to mitigate silt laden runoff from leaving the site.
- Installing netting or another form of barrier along the exterior of the KBR hotel to prevent debris from falling down from the upper floors.
- Installing stabilized construction entrances, tire wash areas, and concrete washout areas.
- Use of temporary sprinklers in non-active construction areas and stationing water trucks nearby during construction to provide sprinkling in active areas.
- Thorough watering of disturbed areas after construction activity has ceased for the day.

The actual measures implemented will be developed during the final design of this project, and would comply with the County's erosion and sedimentation control regulations. Design plans will be submitted to pertinent County agencies for ministerial review and approval. A State Department of Health (DOH) National Pollutant Discharge Elimination System (NPDES) permit for construction activities would be obtained.

4.2 NATURAL HAZARDS

The project will not significantly increase the risk of human health or property due to exposure to natural hazards, and discussion of the project's effects and susceptibility to natural hazards is provided.

4.2.1 Earthquake Hazards

The Island of Hawai'i experiences many earthquakes each year predominantly due to volcanism. However, most are so small that they can only be detected by instruments. A few earthquakes may cause minor to moderate damage. Larger damaging earthquakes (magnitude 6 or greater) have generally occurred on the southern half of the island primarily on the eastern end.

The Seismic Probability Rating for the entire Island of Hawai`i is Zone 4, and these areas are at risk from major earthquake damage, especially to poorly designed and/or built structures. However, earthquakes cannot be avoided or predicted with any degree of certainty, and an earthquake of sufficient magnitude (greater than 5 on the Richter Scale) may cause structural or other damage to the project improvements. Building improvements would be structurally designed and constructed in accordance with the County's building code, which will help mitigate effects from an earthquake. Therefore, the susceptibility of being damaged from an earthquake would be no different from other structures or buildings present in the surrounding Kahalu‘u and Keauhou area.

4.2.2 Lava Flow Hazards

The project site has a lava flow hazard rating of Zone 4, which are areas that have experienced 1 to 5 percent lava coverage since 1800 and less than 15 percent coverage in the last 750 years. It includes all of Hualālai, where the frequency of eruptions is lower than Kīlauea and Mauna Loa. The project would not be subject to additional risk than other surrounding developments in the Kahalu‘u and Keauhou areas.

4.2.3 Hurricane Hazards

The three major elements making a hurricane hazardous are: 1) strong winds and gusts; 2) large waves and storm surge; and 3) heavy rainfall (FEMA, 1993). Impacts from hurricanes can thus be severe and lead to beach erosion, large waves, high winds, and marine over-wash despite the fact that the hurricane may have missed a particular island (USGS, 2002). Study of the aftermath of Hurricane Iniki found that a significant threat related to hurricane overwash along the coastline in the Hawaiian Islands is due to water-level rise from wave forces rather than wind forces.

A hurricane of significant strength and high winds passing directly over or close to the Island of Hawai‘i could cause damage to project improvements, existing heiau along the shoreline, and other existing uses in the surrounding area. Some elements of a hurricane that may cause damages to project improvements are strong winds and gusts. The project site is also situated along the shoreline making it susceptible to damage from large wave forces from a hurricane of significant strength. Heavy rainfall from a hurricane could also affect project improvements because a portion of the site is located within a flood area.

The existing heiau located along the shoreline could receive some damage to walls predominantly from wave forces, and Hale O Papa Heiau has incurred some damage from the 2011 Japan Tsunami. The potential for damages to the heiau has existed since their establishment and this situation should not have a significant impact on the surrounding environment or users and activities on the property. Damage to the heiau are repaired by KS per SHPD approved preservation plans, and some of the restoration work has been incorporated into educational programming. Thus, the project provides the classroom and foundation to help the next generation of caretakers (‘ohana members with ties to the Kahalu'u area) embrace the knowledge and kuleana of maintaining the heiau if, and when, they incur damage.

To minimize potential hurricane damages to facilities associated with the property's redevelopment, new buildings and structures would be designed and constructed in conformance to applicable building codes. In addition, the buildings have been set back from shoreline, which further mitigates damage from hurricanes. Therefore, the risk of potential damage from high winds, large waves, and storm surge should be minimized. Therefore, the property should be at no greater risk of damage than other residential, commercial, and resort buildings in the Kahalu‘u and Keauhou areas.

4.2.4 Tsunami and Flooding Hazards

The coastline between Kailua-Kona and Kealakekua Bay has recorded tsunami run-up heights from a low of 2 feet (1952) up to 16 feet (1960) (USGS, 2002). Recorded tsunami run-up heights at Keauhou Bay from a March 2011 tsunami generated off of Japan ranged from about 2.0 to 3.5 feet in height (NOAA, 2014). Being located along the shoreline, the property would be subject to hazards from a tsunami with high run-up heights.

The tsunami evacuation zone designated at the project site extends to the area slightly inland (mauka) of Ali‘i Drive. Ground elevations along Ali‘i Drive range from about 15 feet AMSL near Kahalu‘u Beach Park, and increase to about 25 to 27 feet AMSL toward the southern end of the project site. The moderately rising elevation proceeding inland of the project site also creates safer areas higher up for evacuation such as at the Keauhou Shopping Center. Written procedures could also be developed addressing evacuation procedures for the project to further increase personal safety for persons using or visiting the site. To minimize potential damages from a tsunami, new buildings and structures would be designed and constructed in conformance to applicable building codes. Therefore, the property should be at no greater risk of damage than other residential, commercial, and resort buildings in the Kahalu‘u and Keauhou areas.

Flood Hazards

Annual rainfall along this coastline is fairly low (highest monthly average of 3.02 inches in July) reducing the potential for flooding from surface runoff. However, the project site is subject to flooding hazards associated with wave action (Zone VE) which covers large portions of the property on the northern and southern ends based upon the FIRM from the State's flood hazard assessment tool. The center of the property is generally subject to the 100-year flood (Zone AE). Figure 4.1 shows the designated flood hazard areas in relation to proposed redevelopment improvements.

Based upon these designated flood areas, Hale Wa‘a and Hale Ki‘i are within Zone VE on the southern end. The Hālau, most of the Multi-Purpose Center, and Kalani Kai structure (existing) are located within Zone VE on the northern end. A portion of the comfort station and Heritage Center are situated within the 100-year flood (Zone AE). Hale Ho‘omaha (camping) is located outside the flood zone. It should be noted that the flood hazard lines do not match the contours of the property's actual ground conditions based upon a topographic survey conducted. Actual site conditions reflect elevations that could reduce the extent of the flood hazard areas shown for the site by the FIRM.

LEGEND

12 Base Flood Elevation

Zone VE: Coastal Flood Zone with Velocity Hazard

Zone AE: 100-Year Flood with Base Flood Elevations Determined

Zone X: Areas Outside the 500-Year Flood Zone

KAHALUʻU MA KAI

Figure 4.1 - Flood Zone Overlay with Project Site Plan

Kahaluʻu, Hawaiʻi

0 90 180 270 FEET

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New construction and substantial site improvements will require compliance with the County's floodplain management regulations (Section 27 of the County Code). Coordination with the County to interpret the specific boundaries of flood hazard areas under Section 27-16(c) of the Hawaiʻi County Code would be conducted during the project's design phase to determine compliance with applicable requirements. Therefore, the risk of potential damage from these flood hazards should be minimized by compliance with County requirements.

4.2.5 Sea-Level Rise Hazards

With its location along the shoreline, the project site will be exposed to the impacts of a rising sea level. The Sea Level Rise and Coastal Land Use Policy Toolkit published by the University of Hawaiʻi Sea Grant College Program suggests using sea level rise planning benchmarks of 1-foot-by-2050 and 3-feet-by-2100. Based on the project site topography and NOAA's Sea Level Rise and Coastal Flooding Impact Viewer[2], at the 1-foot-by-2050 benchmark, impacts will likely be limited to the inundation of coastal tide pools, coastal erosion, and an increased exposure to coastal flooding, tsunami, and storm surge. At the 3-foot-by-2100 benchmark, the low-lying land areas adjacent to the tide pools fronting the KBR hotel (Kealiʻaiʻa Lagoon) and between Keʻekū Heiau and Hāpaialiʻi Heiau will likely experience intermittent if not permanent inundation especially during periods of high wave run-up. This area includes some inland portions of the site of the existing KBR.

The proposed project does not include building any new structures directly along the coastline, but instead replaces the existing development (KBR hotel) with open space. One existing building (Kalani Kai) adjacent to the coastline will be maintained. The existing Kalani Kai structure is located at approximately 7 feet of elevation, and it is protected from the shoreline by a rock retaining wall. As sea levels rise, the building site may be subject to coastal erosion, deterioration of the retaining wall, and increased wave run-up from tsunami and storm surge. However, the open-air layout of the building and its proposed use as a staging area for ocean-based activities will help to minimize potential damages.

The proposed project is not expected to significantly impact the surrounding environment or increase the surrounding areas' vulnerability to sea level rise. Instead, it will enhance the site's resilience to sea level rise by creating an open-space buffer between the shoreline and the built environment. Overall, the project land uses and conceptual site plan illustrate a retreat from the coastline, which is in accordance with best practices for climate change adaptation.

[2] NOAA Sea Level Rise and Coastal Flooding Impact Viewer, V2.0 http://csc.noaa.gov/slr/viewer/

4.3 HAZARDOUS MATERIALS

A hazardous material inspection conducted for the KBR hotel determined the presence of some hazardous materials that need to be properly removed before demolition of the hotel commences. Consequently, the project and environment should not have a significant impact from hazardous materials as implementation of necessary procedures would mitigate potential impacts during the hotel's demolition. The materials identified needing to be properly treated consist of the following:

1. Asbestos. Due to the likelihood of disturbance during demolition activities, the asbestos containing materials must be removed prior to demolition activity. All removal must be completed by a certified asbestos abatement contractor under controlled conditions in accordance with Federal EPA and State DOH regulations. Work should also be monitored by an independent industrial hygiene professional.
2. Lead. The EPA does not require that lead paint/coatings/materials be removed prior to demolition activity. However, the requirements of the Occupational Safety and Health Administration (OSHA) and Hawai'i Division of Occupational Safety and Health (HIOSH) would apply in regards to worker exposure. The contractor's employees removing or disturbing the painted material must be informed that it contains lead and must have received prior training under OSHA 29 CFR 1926.62 Lead and HIOSH 12-148.1.
3. Polychlorinated Biphenyls Ballasts (PCB). If light ballasts are identified without the "NO PCB" or missing a label, the ballast should be assumed to contain PCBs. The light fixtures should be removed and disposed of at an EPA approved waste disposal facility. The fluorescent light tubes are known to contain measurable amounts of mercury and should also be collected and recycled.
4. Underground Storage Tanks (USTs). There was an out of use UST identified as being located in the northeast corner of the property. Further research will be conducted during the project's design to verify if the tank was properly removed and closed. If necessary, the UST will be properly removed in conformance to State requirements prior to redevelopment activities in this area.
5. Smoke Detectors. Smoke detectors would be collected and recycled or disposed of in accordance with state and federal guidelines.

4.4 BOTANICAL RESOURCES

In general, existing vegetation within the project site is not sensitive from a conservation biology perspective, as the property's landscape material is predominantly comprised of non-native ornamental plants that have mainly aesthetic value. The property's landscape planting theme is generally typical of resort hotels in the Kona area with little native plant material present on site. With the exception of the endangered loulu palms (*Pritchardia maideniana*), there were no other endemic species (found in Hawai'i and nowhere else) identified on the project site. No existing or proposed federally designated critical habitat is present on the property, and no other threatened or endangered species was observed on the property.

Exhibit 4.1 Photo of Endangered Loulu Palm *(Pritchardia Maideniana)* Near Hotel Building

Redevelopment of the property would not impact existing endangered loulu palms because all facilities are located away from these palms. There is one loulu palm located close to the KBR hotel as shown on Exhibit 4.1, and demolition activities could damage this tree. Therefore, this palm is planned to be relocated to another area of the property prior to hotel demolition. An experienced landscape contractor with an arborist would be used to ensure the tree is removed and relocated properly. Other loulu palms are located next to the existing tennis courts; however, demolition of the courts should not negatively impact these palms, and the contractor would be informed to ensure proper management practices are implemented during construction activities.

The strand vegetation located along the beach on the south end of the property would not be affected by redevelopment activities. That area would remain as present and should not be disturbed by construction activity. A delineation of the wetland present within the center of the property would establish its boundaries so that demolition and redevelopment construction activities can be conducted to avoid disturbing this area. A wetland delineation is being conducted and will be coordinated with the U.S. Department of Army, Corps of Engineers.

KS plans to implement landscape restoration within the property as part of educational programming and cultural restoration. This would include removal of non-native and invasive plants and trees along with diseased trees. Native plants and trees would be used as part of restoration improvements implemented supporting both educational and cultural practitioner activities. The existing endangered loulu palms on the property could also represent a seed source for recovery actions for the species, particularly if any of them are determined to be wild individuals, as part of educational programming implemented. Restoration efforts under this project would therefore have a beneficial effect on botanical resources.

4.5 AVIFAUNAL AND FAUNAL RESOURCES

4.5.1 Avifaunal Resources

The findings from the avian survey conducted were consistent with the location of the site, and the habitats present on it. Two of the species detected were native species to the Hawaiian Islands, and consisted of: 1) Pacific Golden-Plover (*Pluvialis fulva*), and 2) Wandering Tattler (*Tringa inacana*). Both are indigenous migratory shorebird species that nest in the high Arctic during the late spring and summer months, returning to Hawai‘i and the Tropical Pacific each year to spend the fall and winter months. They usually leave Hawai‘i for their trip back to the Arctic each year in late April or early May.

Other species recorded were alien to the Hawaiian Islands. No avian species currently protected or proposed for protection under either the federal or State of Hawai‘i endangered species programs were detected during the course of this survey. There is no federally delineated critical habitat present on or adjacent to the project site. Thus, the project will not impact any federally designated critical habitat.

Although no seabirds were detected during this survey, it is probable that both the endangered Hawaiian Petrel (*Pterodroma sandwichensis*), and the threatened endemic sub-species of the Newell's Shearwater (*Puffinus auricularis newelli*), overfly the project area in small numbers between April and the middle of December each year. Both of these pelagic seabird species nest high in the mountains in burrows excavated under thick vegetation, especially ‘uluhe (*Dicranopteris linerais*) fern. There is no suitable nesting habitat for either of these seabird species on, or close to the project site. It is also possible that several non-listed indigenous seabird species overfly the site on a seasonal and temporal basis as well.

The primary cause of mortality in the two listed seabird species is thought to be predation by alien mammalian species at the nesting colonies. Collision with man-made structures is considered to be the second most significant cause of mortality of these seabird species in Hawai‘i. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals.

The principal potential impact the project poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with facilities during the nesting season. Outdoor lighting could pose a threat to these nocturnally flying seabirds by the following: 1) conducting nighttime construction activities; and 2) operation of streetlights and security lighting during the seabird nesting season.

Nighttime construction activities are not planned for this project, therefore, the only potential outdoor lighting source would be driveway or building security lighting. Demolition of the KBR hotel will likely reduce the amount of nocturnal lighting present on the property, thus reducing potential impacts to seabird species from the current level. The following recommendation is proposed to mitigate lighting impacts on protected seabirds, and this measure will be incorporated into the project's design of facilities and other site improvements.

- Any driveway lighting or facility security lighting that may be required for public safety reasons shall be shielded. This measure would minimize the threat of disorientation and downing of Hawaiian Petrels and Newell's Shearwaters. It would also comply with the Hawai'i County Code (§14-50) that requires the shielding of exterior lights to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

4.5.2 Mammalian Resources

The findings of the mammalian survey were consistent with the location of the site, and the habitat present on it. All of the terrestrial mammalian species recorded during the survey were alien to the Hawaiian Islands.

Although no rodents were detected, it is probable that the four established *muridae* known from the Island of Hawai'i use resources within the project site and general project area on a seasonal or temporal basis. These four rodents are: 1) European house mouse (*Mus musculus domesticus*); 2) roof rat (*Rattus rattus*); 3) brown rat (*Rattus norvegicus*); and 4) possibly the black rat (*Rattus exulans hawaiiensis*). All of these introduced rodents are deleterious to native ecosystems and the native faunal species that are dependent on them.

Hawaiian Hoary Bats

Although no Hawaiian hoary bats were recorded during the survey, this species is regularly seen foraging over the nearshore areas of the property on a seasonal basis. This species is found in almost all areas in the mid-to-low elevation areas on the island that still maintain dense tree cover.

The principal potential impact that construction and operation of the project poses to bats is during the clearing and grubbing phase of construction activity. The trimming or removal of foliage and/or trees may temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, female carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they themselves forage. Thus, very small pups may be unable to flee a tree that is being felled.

The following measures are recommended to mitigate potential impacts to Hawaiian hoary bats. These measures will be incorporated into the project's design and coordinated with the contractor for implementation.

1. Disturbance to bats would be avoided or minimized by not clearing woody vegetation taller than 15 feet between June 1st and September 15th, which is the period when bats are potentially at risk from vegetation clearing.
2. Where appropriate and practicable, native plant species should be considered for landscaping efforts. This is ecologically prudent, and will likely save maintenance and water costs over the long term if appropriate plants are used.

4.6 AIR QUALITY

Existing air quality in the project area is impacted by emissions from the ongoing eruption of the Kilauea Volcano. Fine particulate measurements indicated that the national standards for both the 24-hour and the annual averaging periods may be exceeded and attributed to this eruption. While this phase of Kilauea's eruption has been occurring for more than 25 years, and it is unknown when it will end, fine particulate concentrations will decrease significantly when it does. Other air quality parameters are probably within standards in the project area. A discussion of short- and long-term effects from the project is provided.

Short-Term Effects on Air Quality

Short-term direct and indirect impacts on air quality could potentially occur due to project demolition and construction activities. There are two types of air pollution emissions that could directly result in short-term air quality impacts: 1) fugitive dust from vehicle movement, soil excavation and demolition activities; and 2) exhaust emissions from on-site construction equipment. There could also be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting construction workers and from the disruption of normal traffic flow caused by roadway lane closures, if required. With best management practices and compliance with State regulations implemented by the contractor, short-term effects should not have a significant impact on air quality in the project area.

Fugitive dust emissions would likely arise from demolition work for the hotel building, accessory facilities, and from grading activities associated with site clearing and preparation work for the redevelopment phase. The rate for fugitive dust emissions from these activities is difficult to estimate accurately because it depends upon soil type, amount and type of activity, moisture content of exposed soil in work areas, and wind speed. However, the EPA has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity. Emissions from site preparation work should likely be less due to the existing Punalu'u series and Pahoehoe lava present on the property.

The State's Air Pollution Control Regulations under Chapter 11-60, HAR prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project demolition and construction phases is essential, and such a plan will be incorporated into design plans for implementation by the contractor.

Preliminary plans call for the KBR hotel structure to be demolished in a controlled manner from the top down. A form of "soft demolition" of the interior would first be initiated to remove all wood, plaster, glass, drywall, etc.; leaving only the building's exterior walls and structural members for larger scale demolition. Debris would be deposited in an enclosed chute directly discharging into a roll-off bin. After the interior demolition work is completed, the exterior building shell would then be removed by a large crushing machine working from the exterior inward. Heavy equipment would be used to load the crushed material into trucks for offsite disposal. Controlled watering would be used to reduce dust emissions during the crushing and removing of the building shell. These measures should be substantially effective in controlling dust emissions during the demolition phase.

During the redevelopment phase of the project, adequate fugitive dust control would be implemented by the establishment of a frequent watering program to keep bare-dirt surfaces from becoming significant sources of dust. Other control measures such as limiting the area disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens could be implemented, as necessary. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible would also lower the potential for fugitive dust emissions.

During both demolition and redevelopment phases of the project, control regulations stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Therefore, the contractor will implement a program of driveway cleaning or tire washing, as appropriate.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxide emissions from diesel engines can be relatively high compared to gasoline- powered equipment, but the annual standard for nitrogen dioxide is not likely to be violated by short-term construction equipment emissions. Also, the new short-term (1-hour) standard for nitrogen dioxide is based on a three-year average. Thus, it is unlikely that relatively short-term construction emissions would exceed the standard. Carbon monoxide emissions from diesel engines are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project demolition and construction activities could obstruct the normal flow of traffic for short periods of times, such that overall vehicular emissions in the project area could temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from the project site during periods of low traffic volume. Design plans would be coordinated with the contractor to ensure the movement of heavy equipment does not occur during peak traffic hours.

Long-Term Effects on Air Quality

After redevelopment is completed, vehicular traffic will access the project site on a long-term basis. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide, and they also emit nitrogen oxides and other contaminants. However, redevelopment of the project site would result in lower traffic volumes accessing the site compared to when the site was in resort use. Thus, long-term impacts from project-related motor vehicle traffic compared to when the site was in resort use should be positive and beneficial to the environment. Long-term impacts on air quality in the project area due to project related emissions should thus be negligible.

4.7 NOISE

4.7.1 Short-Term Construction Noise Effects

Demolition of the existing KBR and construction of the educational complex will involve several stages which utilize various types of construction equipment. The actual sound levels that will be experienced in the vicinity of the project site will vary greatly during the project and are a function of the distance from the noise source, the duration of the construction activities, and the number of pieces of equipment used.

The various stages of construction and the type of equipment that would likely be utilized are described in Table 4.1 below. The noise levels represent the maximum A-weighted sound pressure levels (L_{max}) measured at a distance of 50 feet from the construction equipment. The estimated duration for each stage is included; however, these estimations are based on the contractor's ability to work with minimal interruptions. The actual noise levels produced during construction of the project will be a function of the methods employed during each stage of the construction process. Although the specific equipment and quantity that will be used has not been finalized, the equipment described below represents a reasonable approximation of what will be used.

Daytime and maximum construction noise levels for each stage of construction were calculated at five noise receptor locations in the vicinity of the project site: 1) the Keauhou-Kona Surf and Racquet Club; 2) Na Hale Keauhou to the south; 3) Kahalu'u Beach Park; 4) Beach Villas at Kahalu'u; and 5) Kahalu'u Bay Villas to the north. It is not expected that the equipment will be used continuously for extended periods. Therefore, daytime equivalent construction noise sound levels (L_{eq}) were calculated and take into account usage factor based on an 11-hour work day (7:00 am to 6:00 pm, Monday through Friday). Worst-case conditions were assumed for each stage (e.g. all equipment operating simultaneously at full power near the project site boundary closest to the sensitive receptors).

Table 4.1
General Construction Stages and Anticipated Equipment

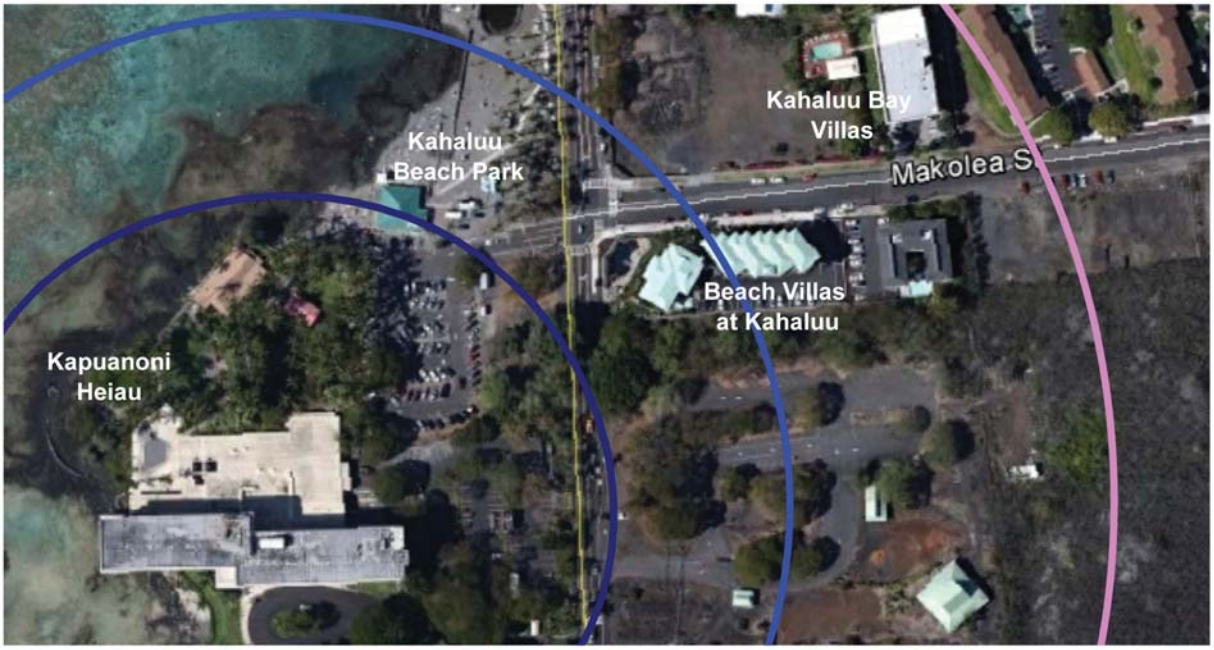
Construction Stage (Duration)	Expected Equipment	Acoustical Use Factor (%)[N1]	L_{max} at 50 feet (dBA)	Impact Device[N2]
A Mobilization and Best Management Practices (5 weeks)	Backhoe	40	80	No
	Front Loader	40	80	No
	Dump Truck	40	84	No
B Abatement (16 weeks)	Dump Truck	40	84	No
	Trash Container	N/A	N/A	No
	Boom Lift	20	85	No
C Building Demolition (17 weeks)	Crane	16	85	No
	Excavator	40	85	No
	Front Loader	40	80	No
	Dump Truck	40	84	No
	Concrete Saw	20	90	No
	Jack Hammer	20	85	Yes
	Chipping Gun	20	85	Yes
D Site Demolition (3 weeks)	Excavator	40	85	No
	Front Loader	40	80	No
	Dump Truck	40	84	No
	Grader	40	85	No
	Dozer	40	85	No

Notes:
N1. The acoustical usage factor is an estimate of the fraction of time each piece of construction equipment is operating at full power (i.e., the equipment will be operating in its loudest condition).
N2. Impact equipment is equipment that generates an impulsive noise produced by the periodic impact of a mass on a surface which is of short duration and high intensity, characterized by abrupt onset and rapid decay, and often rapidly changing spectral composition.

Table 4.2 summarizes the results of the construction noise analysis. Figures 4.2 and 4.3 illustrate the projected maximum sound level contours due to the hotel building and site demolition stages of construction at both the north and south ends of the project site.

Table 4.2
Construction Noise Analysis Results

ID	Noise Receptor	Distance to Building/ Site (ft)	Existing Ambient Noise (dBA)	Maximum Predicted Construction Noise per Stage[N3] (L_{max} dBA)				Hourly Equivalent Predicted Construction Noise per Stage[N4] ($L_{eq\ (11hr)}$ dBA)			
				A	B	C	D	A	B	C	D
R1	Kahalu'u Beach Park	250/100	49-60	64	70	70	73	59	65	64	69
R2	Kahalu'u Bay Villas	800/650	48-54	54	53	61	60	50	48	55	56
R3	Beach Villas at Kahalu'u	425/300	54-60	60	59	67	67	56	54	61	63
R4	Keauhou-Kona Surf & Racquet Club	1200/50	51-57	51	47	58	77	47	41	52	74
R5	Na Hale Keauhou	1400/450	48-54	49	45	56	60	45	40	50	56



LEGEND

- = 40 dBA
- = 45 dBA
- = 50 dBA
- = 55 dBA
- = 60 dBA
- = 65 dBA
- = 70 dBA

Source:

D. L. ADAMS ASSOCIATES
acoustics | performing arts | technology

Kahalu'u Ma Kai

Figure 4.2 - Projected Maximum Sound Level Contours for Hotel Demolition

Kahalu'u, Hawai'i

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LEGEND

- = 40 dBA
- = 45 dBA
- = 50 dBA
- = 55 dBA
- = 60 dBA
- = 65 dBA
- = 70 dBA

Source:

D. L. ADAMS ASSOCIATES
acoustics | performing arts | technology

Kahalu'u Ma Kai

Figure 4.3 - Projected Maximum Sound Level Contours for Site Demolition

Kahalu'u, Hawai'i

NOT TO SCALE

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The analysis results show that construction noise levels at all noise receptor locations are expected to be below the FTA's noise impact threshold of 80 dBA for residential land uses. Nevertheless, it is anticipated that construction noise levels will exceed the existing ambient noise level at the receptor locations closest to the site. Intermittent construction noises will be clearly audible, especially during the hotel building and site demolition stages.

None of the intruding noise would be high enough to cause hearing loss for nearby residents or park users. However, people may need to raise their voice or reduce the talker-to-listener distance in order to communicate effectively. The severity of the speech interference will depend on how close the residents or park users are to the project site as well as the location of the construction activities. Although this noise disruption would likely occur over the duration of the project, the impact of these disruptions are minor and of a short-term duration.

Therefore, demolition activities would inevitably result in short-term, but insignificant noise impacts. The extent of these impacts at any of the receptor locations will vary depending on the stage of construction, specific equipment being used, distance to the receptor, and the duration of each activity. Therefore, the ability to control construction noise levels relates primarily to the duration and time of construction activity in any one day. Since construction noise levels will exceed maximum permissible noise limits specified in the Community Noise Rule, a permit must be obtained from the State DOH to allow the operation of construction equipment. The permit allows the operation of construction equipment but it is limited to daylight hours.

Transportation of Waste

Dump trucks used for transporting waste material off site are a further potential source of noise. It is anticipated that traffic noise could potentially increase for residents adjacent to the haul route due to individual truck pass-bys. But, the truck traffic volume is expected to be low on an hourly basis so an overall traffic noise impact is not expected.

Construction Noise vs. Vibration

Construction activities generate not only audible airborne sounds, but can also result in varying degrees of ground vibration depending on the equipment and methods employed. Vibration induced by the specific construction equipment utilized would not usually result in adverse effects on people or structures. Jack hammering is the greatest source of vibration associated with the demolition of the buildings; however, these impact activities will be located a significant distance away from the nearest receiver. During site demolition, noise from the earth-moving construction equipment will likely be more noticeable than any perceived vibration due to the close proximity of the construction site to the adjacent park and condominiums. Furthermore, ground vibration from construction activities would be temporary, and thus not have a significant impact.

Noise Impact Mitigation

In cases where construction noise exceeds, or is expected to exceed the State's "maximum permissible" property line noise levels, a permit must be obtained from the State DOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit such noise levels. Prior to issuing the noise permit, DOH may require the contractor to incorporate noise mitigation into the construction plan, or require the contractor to conduct noise monitoring or community meetings to discuss construction noise. The DOH noise permit does not limit the noise level generated at the construction site, but rather the times at which noisy construction can take place. Specific permit restrictions for construction activities are:

1. No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 AM and after 6:00 PM of the same day, Monday through Friday.
2. No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 AM and after 6:00 PM on Saturday.
3. No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays.

In general, a majority of the construction noise mitigation is in the form of scheduling to limit the construction hours to the timeframe specified by the State DOH. The contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. However, DOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities. Source control methods listed in Table 4.3 below can be applied to most construction equipment.

Table 4.3
Construction Noise Source Control Methods

Scheduling	Limit activities that generate the most noise to less sensitive time periods (e.g. daytime hours).
Substitution	Use quieter methods/equipment when possible (e.g. low noise generators, smaller excavators, etc.).
Exhaust Mufflers	Install quality mufflers on equipment.
Reduced Power Options	Use smallest size and/or lowest power as required.
Quieter Backup Alarms	Install manual adjustable or ambient sensitive alarms. Do not use backup alarms during night work.
Motors	Insulate or enclose motors
Equipment Selection	Electric equipment is quieter than pneumatic equipment
Equipment Retrofit	Rubber chucks in jackhammers
Equipment Maintenance	Sharpen and balance tools, repair silencing equipment, replace worn parts and open airways
Staging Area	Maximize the distance between the construction staging areas and nearby receptors to the greatest extent possible

When source control measures are not sufficient to avoid a noise impact, path control measures could be considered. Non-permanent noise barriers or curtains and equipment enclosures could be installed at the construction site to reduce construction noise in noise sensitive locations. The general contractor could also conduct noise monitoring of construction during noisy or extensive activities at locations close to residential properties.

4.7.2 Long-Term Noise Effects

The project should not generate significant long-term noise impacts on the surrounding environment. Noise-generating sources would primarily be human voices resulting from activities being conducted at the project site. Vehicles entering and exiting the property would generate some noise; but, the projected number of vehicles occurring throughout the day would be relatively low in comparison to other surrounding uses such as Kahalu'u Beach Park, Keauhou Shopping Center, residential developments.

Educational activities would be typically occur during normal weekday school hours of which other business and recreational activities are similarly occurring in the surrounding vicinity. Camping taking place periodically at the site would generate some noise during the evening hours; however, such activities should cease by early evening.

4.8 HYDROLOGY

4.8.1 Hydrogeological Resources

Redevelopment of the project site should have a beneficial effect on the underlying Keauhou Aquifer System and larger Hualālai Aquifer Sector even though the property is located along the shoreline and thus within a less sensitive ground recharging area as compared to forest areas at higher elevations. Redevelopment of the property along with landscape restoration improvements implemented would reduce the present amount of impervious surfaces (e.g. paved parking lots) by creating more green space consisting of grassed and landscaped areas. New facilities constructed would implement low impact design (LID) measures such as greywater gardens, bioswales, rain gardens, bioretention areas, and rain catchment systems. These measures would further reduce runoff, improve water quality, and thus have a beneficial effect on the underlying aquifer system.

Redevelopment of the property with proposed facilities would also reduce the amount of daily potable water demand required from the County's water system. Section 4.13 in this chapter provides more details on this decrease on water system infrastructure. Therefore, the project's decreased potable water demand will have a beneficial effect on the aquifers sustainable yield.

4.8.2 Surface Waters

The project should have a beneficial effect on surface waters present within and along the property. Redevelopment of the property would result in a less intense land use than the prior resort use. Improvements would not impact Wai‘aha Stream which is the area's only perennial stream located in Holualoa over 4 miles to the north.

Redevelopment of the property would reduce the present amount of impervious surfaces (e.g. paved parking lots) by creating more green space consisting of grassed and landscaped areas. Implementing LID measures (e.g. greywater gardens, bioswales, rain gardens) would further reduce storm water runoff and improve water quality within the tide pools and ocean. Landscape restoration activities implemented on the property as part of educational programs, activities and cultural practices would support management and preservation of surface water features such as Po‘o Hawai‘i and the wetland area situated inland from the tide pools located between Ke‘ekū and Hāpaiali‘i Heiau. These activities would all contribute to positive effects on existing surface waters.

4.9 MARINE RESOURCES AND WATER QUALITY

Overall, results of the water chemistry and biotic community analyses indicate that the project area is not presently affected to a significant extent by existing land uses. The redevelopment plan will result in lower production of wastewater than with the KBR operations. In addition, all wastewater and greywater will be reused through use of constructed wetlands and absorption beds planted with native Hawaiian plant species. Demolition and construction of buildings located over and adjacent to the marine tide pools will employ a variety of BMPs to ensure that no materials from these activities enter the ocean. Based on these measures, the project should not cause changes to water quality or the biotic composition of the offshore marine area to any discernible extent.

The proposed project does not include plans for any direct alteration of the shoreline or offshore areas. Therefore, potential impacts to the marine environment considered are: 1) demolition of existing structures and construction of new structures; and 2) delivery of materials (primarily fresh water and nutrients) to the ocean through infiltration into groundwater with subsequent discharge to the ocean; and through surface runoff.

Impacts from Short-Term Construction Activities

During demolition of the KBR and KLH remnant facilities and redevelopment of the project site, BMPs would be utilized for both land based areas and areas within the tide pools. Specific procedures and BMP details will be determined and refined during the project's design phase. Some BMPs that are being considered for implementation include: 1) for the landside work, install or deploy silt fences, snake bags or other measures to mitigate silt laden runoff from leaving the site; 2) for work over the tide pools, utilize a floating boom outside of the "fall zone" for dust and particle control; and 3) for work in the ocean, deploy floating booms and silt curtains. Section 4.14 discusses project effects on drainage facilities and these measures in more detail.

The implementation of these BMP's should limit or eliminate introduction of materials originating from construction activities into the marine environment. Potential mitigative measures may include time-course monitoring during the demolition and construction activity, so that the results can validate the effectiveness of the BMP's implemented. If monitoring results indicate that there are detectable changes to conditions of the marine setting owing to construction activities, alterations can be made to BMP's to alleviate the problem. The need for such monitoring would be determined by pertinent agencies as part of the project's design phase which includes plan review and obtaining ministerial permits.

Impacts from Redevelopment

Wastewater generated from the project would be treated by an on-site wastewater system with the intent to reuse all wastewater resulting in a net zero discharge. Primary effluent will flow underground into wetland cells with native Hawaiian plants treating the primary effluent. Secondary treatment would be accomplished with a subsurface-flow constructed wetland. Discharge from the wetland cells would then receive treatment consisting of cartridge filters and UV disinfection. As the plants in the wetland cells will likely take up most or all of the effluent, there is little potential for large changes in nutrient loading to the ocean from wastewater generated by the project. Greywater from outdoor showers will be treated with shallow absorption beds planted with native Hawaiian plants before ground infiltration.

Redevelopment under this project will result in lower wastewater design flows than what was previously generated by the former KBR and KLH. Reduced wastewater coupled with treatment using these low impact design measures will result in improved wastewater treatment efficiency that will lower potential impact to the tide pools and ocean.

Storm water runoff generated on-site will decrease with the reduction of impervious surfaces related to the KBR and former KLH (existing paved areas, removal of the KBR hotel and associated areas, and other support buildings. The project will also increase the amount of green space over the entire project site and implement LID elements such as greywater gardens, bioswales, rain gardens, and bioretention areas. Section 4.14 discusses drainage facilities and their effects in more detail. The results show that redevelopment of the project site would result in a large decrease in storm water runoff from 52.2 cfs currently to 4.1 cfs at build-out (a 92% reduction). This would have a positive and beneficial effect on shoreline conditions and water quality.

Based on the demolition activities and redevelopment of the project site using LID concepts, there is no reason to expect significant impacts to groundwater, surface water, and the marine environment.

Results of the marine survey indicate that there are currently only slight detectable changes to marine ecosystems that can be attributable to human activities. While slight subsidies of nitrate nitrogen can be detected, the levels of such subsidies are well within the envelope of natural variability found on the west coast of Hawai'i. Overall, all indications demonstrate a positive impact as a result of

activities associated with the demolition of the KBR and KLH remnant facilities and the project site's re-development. All of these considerations suggest that the proposed project should not have any significant negative effect on water quality, and the biotic community structure in the tide pools and nearshore environment.

4.10 VISUAL RESOURCES

The concepts established in characterizing visual quality from a *Coastal View Study* (Chu 1987) were used to assess the visual impacts resulting from this project. Visual qualities associated with scenic resources were evaluated using three factors that were: 1) visual vividness, 2) unity, and 3) intactness. These criteria are briefly described below:

1. Visual Vividness. The memorability of a landscape is derived from contrasting landscape components as they combine to create striking and distinctive visual patterns, taking into account form, line, texture and color.
2. Visual Unity. The degree to which the visual resources of a landscape scene join together to form a coherent, harmonious and visual pattern; a balanced composition between manmade and natural elements.
3. Visual Intactness. The extent to which the landscape is free from visually encroaching features (Chu 1987).

Using these criteria, the visual impact of the project was evaluated based upon the degree of change to an existing view or alteration of a scenic resource. Three visual resources were identified and shown on Figure 3.9 which are: 1) Kahalu'u Beach Park along Ali'i Drive; 2) views of heiau within the property; and 3) a scenic viewing point of the coastline from Kamehameha III Road. Overall, the project would have a beneficial effect by improving views of these scenic resources. This improvement is primarily due to the removal of the KBR hotel structure which would increase the general visual unity of the coastal landscape scene, improve the visual intactness from the encroaching building, and increase the vividness and memorability of the view.

Views of Kahalu'u Beach Park from Ali'i Drive have high visual vividness with the park contrasting with the ocean and sandy beach, which isn't common along this coastline, to create a distinctive visual pattern and color. The south view of the beach park from Ali'i Drive has a contrasting but distinctive view with the seven story tall KBR hotel framing the background. Existing beach structures (e.g. pavilion) coupled with the natural shoreline at the beach park also create a balanced visual pattern, although the existing hotel somewhat alters the visual intactness of the landscape.

With demolition of the hotel and redevelopment of the project site, the visual intactness would be improved due to removal of the large hotel structure creating a more natural landscape pattern for the shoreline and beach. The visual unity would also be improved without the hotel as new structures constructed on the project site would be much lower in height, taking advantage of site topography and reflecting a Hawaiian cultural design. The visual vividness of the beach park would

be changed in a positive manner without the contrasting hotel structure, and should result in a more memorable landscape visual pattern.

Views of Hāpaiali‘i, Ke‘ekū, and Mākole‘ā Heiau all have high visual vividness, unity, and intactness viewed from within the project site. The size of the restored Hāpaiali‘i and Ke‘ekū Heiau coupled with their unique location along the shoreline with tide pools create a memorable landscape pattern and distinctively striking view. There are no encroaching features disrupting the makai view of these heiau, and together they form a harmonious pattern between the man-made cultural structures and ocean background.

With implementation of the project, these views would not change and would retain their high visual vividness, unity, and intactness. Demolition of the KBR hotel would open up more of the project area but have no significant effect on these makai views. The public is currently allowed to view the heiau from designated areas respecting the cultural sensitivity, and this condition would continue with the project.

The panoramic coastline view from the scenic lookout along Kamehameha III Road generally has high visual vividness, unity, and intactness. The visual landscape of this area has a striking visual pattern with the natural ocean backdrop, generally low-scale development along the shoreline, and undeveloped terrain proceeding inland. The tide pools, heiau, and extensive vegetation on the project site contribute to the uniqueness and vividness of the view. The hotel is somewhat distinctive due to its size and height along the shoreline, but it also conflicts with the low scale developments of surrounding uses along the coastline. This somewhat affects the visual intactness of panoramic coastline view in that particular area.

With demolition of the KBR hotel, the visual intactness of the panoramic coastline would be improved since the seven-story structure would be replaced with new structures (multi-purpose building, hālau, etc.) similar in height and scale to other surrounding uses. The somewhat encroaching view of the hotel would be removed, opening up more views of the ocean, heiau, and tide pools in the project area. The visual vividness would also be improved with new appropriately designed structures on the property to complement the surrounding cultural landscape form and enhance the memorability of the view. Visual unity would be improved by having more balanced and harmonious manmade structures in relation to natural elements of the project site.

4.11 HISTORIC AND ARCHAEOLOGICAL RESOURCES

The findings of the AIS study conducted were as anticipated through current consultation and background research of the project area. This locale has been used continuously from early pre-Contact to modern times for habitation, ceremony, resource procurement, and recreation. Hotel development beginning in the 1960s has significantly altered the landscape and has caused the destruction of some known historic properties, and likely many more features that were never documented. Although the current testing program did not identify any new historic properties, there remains a strong potential for additional subsurface features within the project area, including burials. This very significant area remains an archaeologically and culturally rich location that will continue to educate generations to come.

4.11.1 Significance Assessments

The current investigation confirmed the presence of eight historic properties within the project area (SIHP #s -03817, -03818, -03819, -10997, -12951, -12953, -12955, and -12957). These historic properties were all previously identified through prior studies, and were evaluated under an investigation approved by SHPD at that time. However, their significance was evaluated at that time using now obsolete criteria, and they have now been re-evaluated under this current AIS based on the updated findings presented.

An additional previously identified historic property was not confirmed, but is considered to still be present, but buried within the project area (Probable Sand Dune Burial, SIHP # -12915). For this reason, the eligibility of this site for the Hawai'i Register of Historic Places (HRHP) could not be evaluated.

The eight historic properties confirmed by the current study were evaluated for significance according to the following five broad criteria used by the Hawai'i State Register of Historic Places (HAR §13-284-6). The criteria are the following identified below, and Table 4.4 identifies these sites, the significance criterion, and recommendations.

1. Criterion "a." Associated with events that have made an important contribution to the broad patterns of our history;
2. Criterion "b." Associated with the lives of persons important in our past;
3. Criterion "c." Embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possesses high artistic value;
4. Criterion "d." Have yielded, or is likely to yield information important for research on prehistory or history;
5. Criterion "e." Have an important value to the Native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property, or due to associations with traditional beliefs, events or oral history accounts; these associations being important to the group's history and cultural identity.

Table 4.4 Historic Property Significance Criteria and Recommended Treatment

SIHP # (50-10-37)	Temporary Site #(s)	Function	Probable Age	Significance Criteria	Recommendations
-03817	50-Ha-D4-2, H-00165-25 (Hāpaialiʻi)	Ceremonial, religious	Pre-Contact; AD 1200s or 1300-1400s	b, c, d, e	Preservation
-03818	50-HA-D4-3, H-00073-4, H-00165-24 (Keʻekū + Hale O Papa)	Ceremonial, religious	Pre-Contact; AD 1200-1300s	b, c, d, e	Preservation and repair of Hale O Papa
-03819	50-Ha-D4-5, H-00073-6, H-00165-22 (Mākoleʻā)	Ceremonial, religious	Pre-Contact	b, d, e	Preservation
-10997	H-00073-2, H-00165-41 (Kapuanoni)	Ceremonial, religious	Pre-Contact	b, d, e	Preservation
-12951	PHRI 439-51, PHRI 439-52, H-00769, H-01426	Habitation	Historic; nineteenth century	d	No further work
-12953	PHRI 439-53, H-00165-43, H-00748-11881,	Habitation	Unknown (over 50 years)	b, d	Preservation and restoration
-12955	PHRI 439-55, PHRI 439-56, 50-Ha-D4-47, 50-Ha-D4-49,	Boundary, habitation	Historic; early 1800s to mid-1900s	d	Preservation and restoration
-12957	PHRI 439-57	Habitation	Historic (mid to late 1800s) and modern	d	Avoidance

All eight historic properties confirmed and documented within the project area are assessed as significant under Criterion "d." The sites have yielded information important for understanding late pre-Contact to historic land use in the project area.

SIHP #s -03818, -03819, -10997, and -12953 are also recommended significant under Criterion "b" for their associations with the lives of persons of importance in the past. Background research indicates these sites are commonly associated with some of the most well-known aliʻi in Hawaiian history. SIHP # -03818 (Keʻekū Heiau) is associated with Lono-i-ka-makahiki, who resided in the area and by some accounts sacrificed the Maui chief Kamalalawalu there; and with Kamehameha I. SIHP # -03819 (Mākoleʻā Heiau) is also associated with Lono-i-ka-makahiki, as is SIHP # -10997 (Kapuanoni Heiau). Oral histories also indicate Kapuanoni was associated with Kalaniʻōpuʻu and was the residence of Alapaʻinui. Finally, SIHP # -12953 is a former aliʻi residence associated with such important figures as Keʻeaumoku, Governor John Adams Kuakini, and the chiefess Kekāuluohi.

For their distinctive construction, SIHP #s -03817 and -03818 are recommended significant under Criterion "c." While these sites have been restored (or in the case of Keʻekū Heiau, 90% restored), this work was informed by a combination of archaeological study and background research, and it is believed they are fairly accurate representations of the pre-Contact heiau.

Finally, SIHP #s -03817, -03818, -03819, and -10997 are assessed as significant under Criterion "e" for their important value to the Hawaiian people as ceremonial sites.

4.11.2 Project Effect and Mitigation

CSH's project specific effect recommendation is "effect, with agreed upon mitigation measures." The project has the potential to impact historic properties in the project area. The recommended mitigation measures (see Table 4.4) will reduce the project's potential adverse effect on significant historic properties.

Mitigation Recommendations

It is recommended that of the nine (9) extant historic properties within the project area, six (6) sites be preserved. Furthermore, two sites that will not be affected by the present project are recommended for preservation in the form of avoidance. The remaining historic property is not recommended for further archaeological research.

Historic Properties for Which Sufficient Data Has Been Recovered

No further historic preservation work is recommended for one historic property that was confirmed within the project area. SIHP # -12951 is a nineteenth century well complex that has been impacted by modern developments. Sufficient information regarding the location, function, age, and construction methods of these features have been generated by the current AIS investigation to mitigate any adverse effect caused by proposed development activities (though none is presently anticipated). Furthermore, these wells no longer provide any resources to the community (i.e., water or aquatic flora or fauna).

Preservation

Six historic properties are recommended for preservation under a plan in accordance with HAR §13-277-3. Five historic properties have existing, site-specific preservation plans in place (SIHP #s -03817, -03818 Feature A, -03819, -10997, and -12953). While the repair of Hale O Papa (SIHP # -03818 Feature B) and the restoration of the Keikihoʻokama House Site (SIHP # -12955) are not presently specified as part of the Kahaluʻu Ma Kai project, these future undertakings would likely require eventual preparation of a preservation plan.

It is therefore recommended that a single, project area-wide preservation plan be developed to address SIHP #s -03818 Feature B and -12955 and to update the existing preservation plans, which were developed prior to restoration work that has already occurred. Aside from addressing buffer zones and protective measures for all historic properties recommended for preservation within the project area, this preservation plan would include detailed maps of the restored heiau sites. In consultation with KS, it is proposed that this mapping should be completed as part of school year 2014 to 2015 ʻāina-based education activities.

Additionally, preservation by avoidance is recommended for two historic properties: SIHP #s -12915 and -12957. Project plans presently do not indicate ground disturbing activities at these sites.

No ground disturbing activities should be undertaken at any time within the backshore sand dune area at SIHP # -12915. It is recommended that after storms or other events of high seas, the vicinity be inspected by KS staff for any exposed remains. If at any time human remains are exposed in this area, development of a burial treatment plan will be required in accordance with HRS §6E-43 and HAR §13-300. If in the future, any projects are proposed with potential to impact SIHP # -12957, it is recommended the site first be subjected to a program of data recovery. If required, work should proceed in accordance with a data recovery plan pursuant to HAR §13-278.

Archaeological Monitoring

Due to the potential for additional surface and subsurface historic properties, including human burials, it is recommended that development (including the KBR demolition) within the project area be attended by an archaeological monitoring program. The monitoring program will begin with the production of an archaeological monitoring plan for the review and approval of SHPD prior to the beginning of construction. Field monitoring should be carried out in accordance with the plan. An archaeological monitoring report should be submitted for review and approval by SHPD following the completion of all monitoring activities related to project development.

4.12 CULTURAL RESOURCES

The results of the community consultation conducted under the CIA study identified several important factors related to the cultural landscape. These factors are identified below, and the project should not have an adverse on them.

1. The project area and its environs, from mauka-to-makai (upland to the sea) has a long history of use by ali‘i and Kānaka Maoli (Native Hawaiians) for a variety of past and present cultural activities and gathering practices including fishing, limu (seaweed) gathering, and spiritual worship. Community participants stress the sacred nature of the place, and convey their deep aloha for the project area’s cultural and natural resources.
2. Participants discussed natural and cultural resources including freshwater springs and anchialine ponds teeming with ‘ōpae ‘ula (small endemic shrimp) which were used as bait; the existence of at least 30 ku‘una (place where a net is set in sea) in shallow waters; and ‘ōpelu ko‘a (Decapterus macarellus, mackerel scad fishing grounds) in deep water. They gathered marine resources such as ‘opihi (limpets), and a large variety of limu (seaweed, algae) used for subsistence as well as medicinal purposes and also gathered salt used to dry fish. Community interviewees shared the traditional manner of handling the dead and other burial customs, the protocol and respect accorded to heiau in the project area, and gender-based cultural beliefs associated with fishing and gathering. They shared place names for cultural and natural resources including Kilohana for a large pond which once existed, place names for each cove along the shoreline such as Imo‘ōhua, where small manini or ‘ōhua were caught, and told mo‘olelo about surfing in the 1950s, and what it was like to grow up in an area with heiau of extreme importance.

3. All of the community participants expressed their support for the proposed project and the importance of cultural education for the younger generation, with Mrs. Hamm suggesting that all children, not just Hawaiian children, should be able to take advantage of this learning opportunity.
4. They approved the restoration of the heiau and stressed the continuing need to teach visitors the right protocol and proper respect in approaching the heiau. They called for proper signage that can teach the history of the site as well as communicate the need for respecting the area.
5. The majority of the study participants agreed to limiting public access, and called for customary fishing rights to be part of the practice of the heritage center. Those living outside the ahupua‘a must first ask for permission to fish, and the same should be done for use of the project area for funeral services.
6. The study participants would like to continue to participate in maintaining the heiau and expressed their willingness to be involved in future operation of the heritage center; emphasizing their aloha for the place and their desire to perpetuate Native Hawaiian culture.

Recommendations

The following recommendations are based on a synthesis of all the information gathered during preparation of the CIA. Efforts to develop appropriate measures to address these concerns will help mitigate adverse impacts of the project on Hawaiian cultural beliefs, practices, and resources.

In light of statements made by the majority of the participants in this study that there may be burial sites or iwi kūpuna (ancestral remains) in the makai (seaward) portion of the project area, it is recommended that:

1. Lineal and cultural descendants will be identified and consulted in accordance with applicable laws.
   a.. Personnel involved in development activities in the project area should be informed of the possibility of inadvertent cultural finds, including human remains.
   b.. Any development of the makai area should be limited, and the sand dunes and beach area should be left alone.
   c.. Any potential development should be limited to minimally invasive infrastructure.
   d. Should cultural or burial sites be identified during ground disturbance, all work should immediately cease, and the appropriate agencies notified pursuant to applicable law.
2. Community members affiliated with the area both genealogically and culturally should be consulted regarding the preservation, restoration, and interpretation of cultural resources including archaeological sites, caves, petroglyphs, trails, possible burials, and other features.
3. As part of active management, visitor/resident education should be provided to encourage proper behavior and protocol to assist in the protection, appreciation, and enjoyment of natural and cultural features.

4.13 SOCIAL AND ECONOMIC FACTORS

4.13.1 Population and Housing

The project would not change the existing number of housing units in the Kahalu‘u-Keauhou area and surrounding West Hawai‘i communities because no residential housing units are included under this project. Although overnight camping will occur as part of student educational programs and activities, no residential units would result or be needed to support these activities.

Closure of the KBR and demolition of this building would result in a decrease of 311 visitor units. The Island of Hawai‘i had a total inventory of 11,113 visitor units in 2011, prior to the KBR closure. Visitor units include hotels, condo/hotels, timeshare, and other visitor related types of units. This decrease represents 2.8 percent of the total island inventory. Although this change decreases available visitor units in West Hawai‘i, it should support occupancy rates with other existing visitor units making them more competitive and profitable. The KBR had not been profitable for several years, and substantial capital was needed to address years of deferred maintenance. Outdated facilities thus contributed to the resort’s operational losses, as it was not able to compete with larger and more contemporary resort destinations.

Project improvements are not expected to generate in-migration of individuals to the island. Construction jobs are anticipated to be filled by workers on island. Participants in educational programs, cultural activities, and other activities would come from existing schools and community organizations. Therefore, this project should not impact the existing resident population or the existing population characteristics of the West Hawai‘i district.

4.13.2 Economic and Fiscal Factors

This section discusses the effects of project improvements on both the County’s and State’s economic and fiscal factors. Demolition of the KBR hotel and other remnant facilities along with construction of new facilities under this project will have different effects in relation to the County and the State of Hawai‘i’s finances.

Short-Term Construction Related Jobs

The estimated construction cost for this project of about $34.3 million would create several short-term construction jobs during the duration of demolition and construction activities, as well as support industries that service construction activities directly and indirectly. Three broad types of jobs are distinguished below:

- Direct jobs are immediately involved with construction of a project or with its operations.
- Indirect jobs are created as businesses directly involved with a project purchase goods and services in the local economy.
- Induced jobs are created as workers spend their income for goods and services.

Direct construction jobs would typically consist of on-site laborers, landscapers, tradesmen, mechanical operators, supervisors, etc. These new jobs created would also generate additional personal income for construction workers that are the wages paid directly to them or operational employees associated with project improvements. Direct construction jobs created would also stimulate indirect and induced employment and spending of wages within other industries located in the West Hawai'i region and on the island such as retail, restaurants, material distributors, and other related businesses supporting the construction industry. These construction jobs would likely be filled by residents from the Island of Hawai'i employed within the construction industry.

The project could generate a total of about 160 to 220 new direct construction jobs over the course of the entire demolition and redevelopment. This would generate another approximately 150 to 200 indirect and induced jobs over the entire construction period. Therefore, a total employment impact of about 310 to 420 jobs (direct, indirect, induced) could be generated by this project over the entire implementation period. These jobs would create a small but positive impact in employment for the island.

Construction of the project would be implemented in phases over a 10-year period starting with demolition of the KBR hotel. Therefore, the number of construction jobs would not be evenly spread out over this entire implementation period. The majority of construction jobs created would occur during the first two to three years with future jobs spread out over remaining years as other components of the site's redevelopment are implemented.

Demolition of the hotel is estimated to cost about $11.5 million (about 1/3 of total cost), and would initially generate about 50 to 70 new direct construction jobs and about 100 to 140 total jobs (direct, indirect, induced) during the first year. Construction of the Multi-Purpose Building, Hālau, and infrastructure improvements would then be promptly started which will create several construction jobs over the next 2 years of work. During the remaining years, the number of construction jobs would depend upon the timing of components implemented, but should not be as high as during the initial hotel demolition.

These new construction jobs would generate additional personal income for construction workers totaling about $13.0 million over the entire project. Indirect and induced income would also be generated on the order of $11.0 million over the entire project. This additional income of about $24 million would have a positive impact to residents on Hawai'i. The potential additional jobs created from construction activities would provide additional personal income to individuals that would also support indirect and induced employment within the County from the spending of these wages. These indirect and induced effects would be somewhat minor in comparison to the entire County, but would nevertheless result in a positive effect on the local economy.

Fiscal impacts would primarily involve additional tax revenue generated to the State from construction of this project. Tax revenue sources for State government are composed primarily of general excise taxes (GET) on development costs and construction materials, along with corporate income tax, and personal income tax from construction workers. The $34.3 million total project

construction budget expended is estimated to generate about $5.58 million in tax revenue to the State over the 10-year implementation period. These construction related tax revenues would have a minor positive effect on the State's fiscal condition because of the short-term increase in revenue associated with construction activities.

Long-Term Fiscal Effects

Personal income generated by jobs creates additional revenue to the State in the form of income tax and GET from expenditures. Closure of the KBR resulted in the displacement of about 115 employees, most of which were full-time jobs. The project will generate up to 24 new permanent full-time jobs consisting of staff to manage the Heritage Center, security personnel, maintenance (landscaping and facilities) staff, and administrative personnel. As a result, a net decrease of about 90 full-time jobs would result with the project, compared to the operation of the KBR hotel. The net result would be a decrease in State revenue from income tax and GET having a minor impact relative to statewide revenues received.

County revenues generated are primarily limited to tax revenues on privately-owned property and improvements, and to a lesser extent fees charged for various activities such as water, sewer, permits, etc. The three parcels making up the project site are privately owned by KS and subject to property tax. The easement associated with the State-owned parcel (TMK 7-8-013: 042) in the tide pool created for a portion of the hotel would be terminated with the hotel's demolition.

County tax revenue generated from the project site was about $33,700 in 2013 primarily associated with the KBR parcel (Parcel 043), and reflects the closure of the KBR. Prior to the hotel's closing, over $201,000 in revenue was collected from that parcel in 2012. Therefore, County property tax revenue has decreased over $167,000. With redevelopment of the site under the project, further changes to the amount of property tax generated may occur depending upon the County's valuation of site and facility improvements. Therefore, the project would have minor fiscal impact relative to current County revenue generated island wide.

4.13.3 Character of Community

Redevelopment of the property to serve as an educational complex would change the existing character of the property which is currently resort use associated with the former KBR. Demolition of the hotel, associated resort facilities (e.g. tennis complex), and other remnants of the KLH would eliminate the main features contributing to the property's resort character. Construction of new educational facilities, the expansion of educational programs at the property, and increased cultural practices would change the character of the site. However, these changes should not have a significant impact on the overall character of the community and Kahalu‘u-Keauhou area which is still predominantly visitor oriented.

Existing cultural resources on the property would remain and continue to serve as a point of interest for visitors to the area. The Heritage Center is intended to serve this function to manage visitation of the heiau and property in a culturally sensitive manner, while also supporting education of these resources for visitors. Therefore, the project site would continue to serve as an attraction for visitors complementing other natural resources (e.g. Kahalu‘u Beach Park), recreational amenities (Kona Country Club), and shopping opportunities provided in this region.

4.14 INFRASTRUCTURE FACILITIES

4.14.1 Water Facilities

Based on the domestic consumption guidelines provided in the DWS *Water System Standards*, the average daily demand for school and park areas is 4,000 gallons per acre. Assuming similar water demands for the educational complex, the projected average daily demand for the 22.6 acre parcel is 90,400 gpd. Maximum daily demand is anticipated to be about 135,600 gpd, which is less than the 141,000 gpd per the County DWS's water agreement for the KLH portion of the property.

Projected water demands for the project were also developed as part of the evaluation of the proposed on-site wastewater system conceptual design. The average daily wastewater demand was anticipated to be about 5,450 gpd. Additional reductions in water demand are also expected with the project's use of reclaimed water. Due to the project's planned implementation of sustainable water management practices, water usage is expected to be closer to this projected water demand than that using the DWS system standards.

Based on the water agreement and projected water demands, adequate water service is available for the Project. BCH's consultation with the DWS indicated that the agency was not aware of any issues with the existing 12-inch diameter water line in Ali‘i Drive, and water line improvements or upgrades are not planned in the near future.

Therefore, the project should have a beneficial effect on the County's water system and average daily water demands. The project would result in a large decrease in water use from about 140,000 gpd that occurred when both the KLH and KBR were operational. Even with just the KBR operating, prior water usage was about 46,000 gpd. The project would have a beneficial effect on the County's existing water system serving the project site, and will not require any expansion improvements.

The project's design for the on-site water system will include down-sizing the service meters and installing new laterals off of the 12-inch diameter water line in Ali‘i Drive. Fire protection services will also be designed for the project in accordance with applicable building and fire codes. Design plans would be submitted to the County DWS for review and approval during the project's design phase.

4.14.2 Wastewater Facilities

The projected wastewater flow from new facilities is based on the State DOH's Chapter 11-62, Wastewater Systems, HAR. The population contributing to wastewater generation at the project site will vary daily, and would consist of students, day visitors (tourists), campers related to educational activities, lineal and cultural descendents, and facility personnel. Based on these uses, the average daily wastewater flow is projected to be 5,450 gpd (refer to Appendix I Preliminary Engineering Report).

The estimated wastewater flow rate for occasional larger events held (e.g. life celebrations, makahiki, hōʻike, seasonal ceremonies) will be determined during the project's design phase. However, for preliminary engineering purposes, the average daily wastewater flow was estimated to be 5,000 gpd based on 1,000 visitors at 5 gallons per person per day using the State DOH's Chapter 11-62, Wastewater Systems, HAR.

Proposed Wastewater System

New facilities planned under the project's redevelopment will utilize an on-site wastewater collection and treatment system and greywater gardens. The on-site wastewater system will consist of septic tanks, pump stations, equalization tanks, small diameter collection pipe, a constructed wetland, turbidity filters, and an ultraviolet (UV) disinfection system. The treatment system will produce R-2 water for irrigation at the project site. The intent of the proposed treatment system is to reuse all wastewater on-site with zero discharge of wastewater. Further information on the on-site wastewater system and greywater gardens is provided in a separate engineering report prepared by Roth Ecological Design International (REDI), and included in the BCH Preliminary Engineering Report (Appendix I).

The on-site wastewater system will not be designed to treat wastewater during occasional events due to the large number of visitors. During these events, wastewater from the septic tanks will discharge from the on-site wastewater system to the existing 12-inch diameter gravity main within the Aliʻi Drive right-of-way, which will then discharge to the Kahaluʻu SPS.

Primary treatment tanks with a total capacity of 13,000 gallons will be located near individual buildings or groups of buildings. The septic tank system will provide primary treatment of the raw wastewater and consist of two chambers. The first chamber will provide solids and floatables separation. The second chamber will include a duplex pump system and effluent filters to pump the septic tank effluent to the constructed wetland. Equalization tanks with a total capacity of 6,500 gallons will be installed downstream of the septic tanks and upstream of the constructed wetland to dampen peak flows. The locations and total number of equalization tanks and septic tanks would be determined as part of the design phase.

Secondary treatment of the primary effluent will be accomplished with a subsurface-flow constructed wetland. Primary effluent will flow beneath the ground surface into wetland cells with native Hawaiian plants treating the primary effluent. Discharge from the wetland cells or secondary effluent will then flow to treatment using cartridge filters and UV disinfection. The filtration and disinfection unit processes will produce R-2 water for on-site landscape irrigation reuse.

Greywater from outdoor showers will be treated with planted, shallow absorption beds before ground infiltration. The beds will be planted with native Hawaiian plants. The greywater gardens will be sized to accommodate up to 100 visitors per day or 500 gpd based on the requirements of Chapter 11-62, HAR. The locations of the showers would be determined during the design phase. Existing sewer lines would be demolished and removed or abandoned in place, and backfilled with grout. New sewer lines connecting to the Kahaluʻu SPS and existing 12- inch diameter sewer line in Aliʻi Drive would be incorporated into the project to provide service to Kalani Kai Grill as well as to accommodate occasional events, such as life celebrations, makahiki, and hōʻike.

Probable Impacts

Preliminary wastewater flow calculations for the Kahaluʻu SPS tributary area for future conditions are shown below.

Wastewater Flow Estimates		Projected Flows
a.	Design Average Flow:	0.53 mgd
b.	Design Maximum Flow:	2.43 mgd
c.	Design Peak Flow:	2.98 mgd

Of these totals, the project would generate an average design flow of 0.016 mgd, maximum design flow of 0.077 mgd, and peak design flow of 0.105 mgd. These flows would be considerably lower (over 90% reduction) than when the KLH and KBR hotels were in operation, which had an average design flow of 0.290 mgd and peak design flow of 1.267 mgd.

Therefore, redevelopment of the property under the proposed project will have a beneficial effect associated with the considerable reduction in the wastewater generated compared to when both the KBR and KLH were in operation. Construction of an on-site wastewater system will further decrease flows to the Heʻeia WWTP by treating wastewater on the property.

The property is located in the critical wastewater disposal area as determined by the Hawaiʻi County Wastewater Advisory Committee. However, there is no existing public sanitary sewer connection available. The on-site wastewater system will be designed, constructed, operated, and maintained in accordance with Chapter 11-62, HAR. The existing privately owned regional wastewater system serving this property will also provide 100 percent backup capacity.

The Kahalu'u SPS is located in the flood zone (Zone VE) and experiences limited flooding during high tide or high surf conditions. This flood zone is a coastal high hazard area subject to a one percent or greater annual chance of flooding in any given year that includes additional hazards associated with high velocity waves, including tsunamis. Potential impacts to this sewer pump station from flooding and water infiltration have been reduced with the following measures:

- Upgrades made to the SPS in 2005, including the demolition of the dry well and addition of two submersible pumps in the wet well.
- Low lying concrete rubble masonry (CRM) wall surrounding the SPS.
- Solid manhole covers located over the SPS.

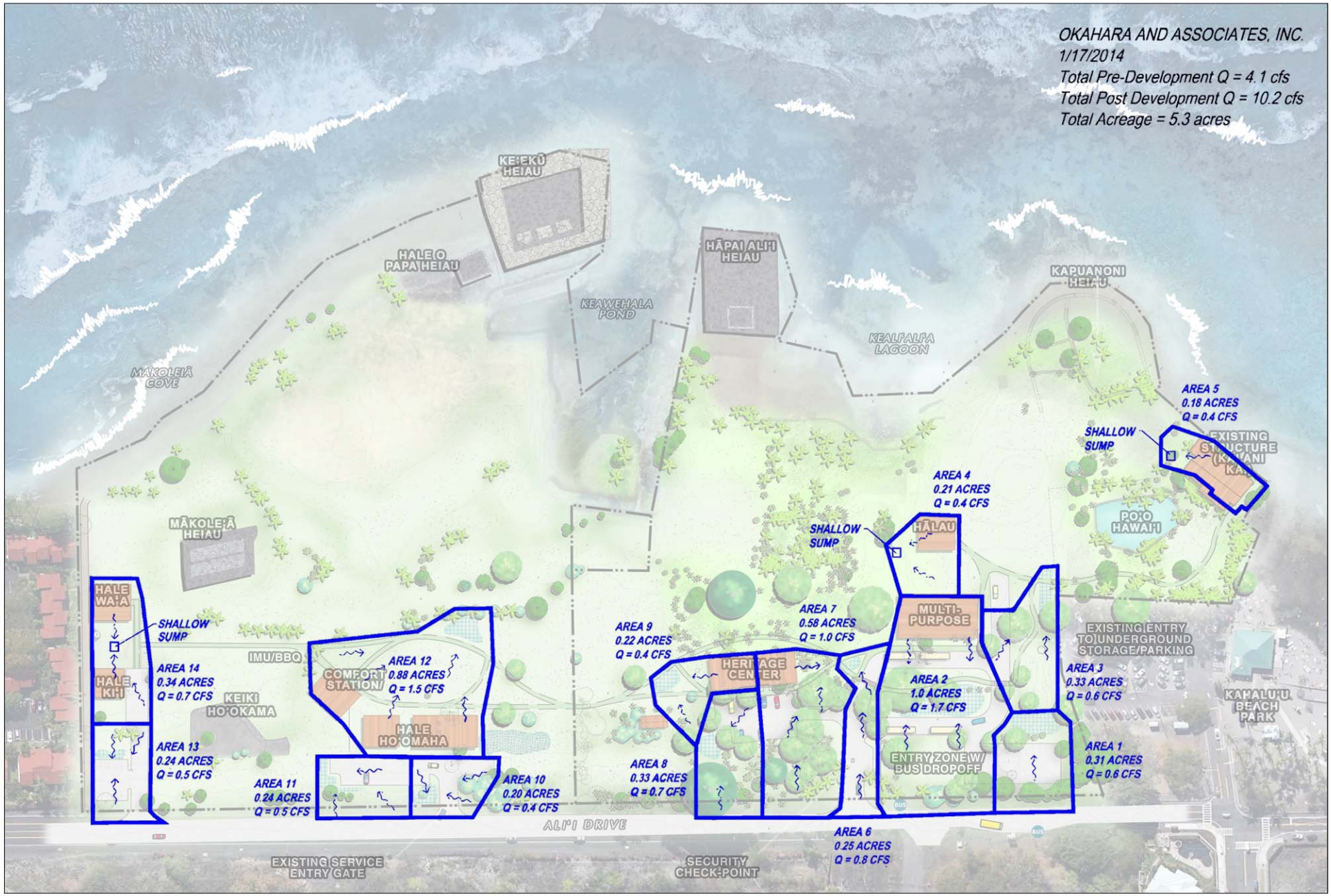
4.14.3 Drainage Facilities

Storm water runoff design criteria is based on the County DPW's, *Storm Drainage Standard*. However, input from the County DPW during the project's conceptual design phase requested that storm water runoff for redeveloped conditions with the project be reduced to pre-developed conditions (i.e., prior to the development of the existing hotels and parking areas) for the entire property. Existing storm water runoff from the property totals 52.2 cfs, and pre-developed conditions were estimated to have a runoff quantity of 4.1 cfs.

Storm water runoff generated on-site will decrease with the project's redevelopment because it would decrease the amount of existing paved parking areas, remove the KBR hotel and associated areas (e.g. pool), and other support buildings. The project will increase the amount of green space over the entire property and also implement LID elements such as greywater gardens, bioswales, rain gardens, and bioretention areas. The total area developed with the project amounts to 5.3 acres, and this area was estimated to generate 10.2 cfs of runoff. Figure 4.4 shows the drainage areas and quantities of storm water runoff generated. Although the project's developed condition reflects a considerable decrease from current conditions (52.2 cfs or 80%), it would still need to reduce runoff by 6.1 cfs to meet pre-developed conditions as requested by the County DPW.

To accommodate the necessary reduction in storm water runoff, LID concepts are planned for the project. The following provides a summary of the proposed LID concepts that would be utilized.

1. Seepage Pits (Shallow Sumps). Seepage pits will be incorporated to infiltrate excess storm water runoff into the ground. The infiltration rate of the seepage pits will be determined during the design phase with percolation tests. However, it is anticipated that each seepage pit will have a capacity of one to two cfs.
2. Rain Gardens. Rain gardens, also referred as bioretention basins, are engineered shallow depressions that collect and filter storm water runoff using vegetation and conditioned planting soil beds. The filtered runoff gradually infiltrates through the basin and into the soil.



Source: KYA Design Group

Kahalu'u Ma Kai

Figure 4.4

Proposed Drainage Basins and Stormwater Runoff Quantities

Kahalu'u, Hawai'i

Not to scale

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3. Bioretention Swales. Bioretention swales are shallow linear channels with a planting bed and covered with turf or other surface material (other than mulch or plants). Runoff filters through the planting bed, is collected in an underdrain system and discharged at the downstream end of the swale.
4. Rainwater Harvesting. Rainwater harvesting is the collection and temporary storage of roof runoff in rain barrels or cisterns for subsequent landscape irrigation. Rainwater harvesting will be utilized at the Multi-Purpose Building, Heritage Center, Hale Ho'omaha, and comfort station.

Infiltration facilities, such as the seepage pits and rain gardens, are highly susceptible to clogging and premature failure from sediment, trash, and other materials. To extend the service life of the infiltration facilities, pretreatment using vegetated swales, filter strips, sedimentation basins, and manufactured treatment devices may also be included in the project's design.

Proposed drainage improvements would not significantly alter the existing topography of the site. However, some grading would be required to provide level building pad areas. Additionally, the site will be graded so that surface storm water runoff is directed into rain gardens, bioretention areas, bioretention swales, and grass swales.

With these drainage improvements and redevelopment of the property, the project would reduce the existing amount of surface runoff from 52.2 cfs to 4.1 cfs (92% reduction). This would have a positive and beneficial effect on shoreline conditions and water quality.

Short-Term Construction Activities

During demolition of the KBR hotel and construction of new facilities and other site development activities, BMPs would be utilized for both land based areas and areas within the tide pools. Specific procedures and BMP details will be determined during the project's design phase. Thus, the short-term construction activities should not have a significant impact on existing drainage conditions and impacts on tide pools and water quality. Some of the BMPs that could be implemented include the following.

1. BMPs for the landside work:
   - Installing a perimeter construction fence.
   - Using controlled watering to allay dust during the demolition work.
   - Collecting and placing building debris, as it is created, into roll-off bins or trucks for hauling and removal from the site.
   - Installing silt fences, snake bags or other means to mitigate silt laden runoff from leaving the site.
   - Installing netting or another form of barrier along the exterior of the KBR Hotel to prevent debris from falling down from the upper floors (BMPs will be needed for protection of Po'o Hawai'i and shoreline areas).

- Installing stabilized construction entrances, tire wash areas, and concrete washout areas.

2. BMPs for work over the tide pools:
   - Installing a floating boom outside of the "fall zone" for dust and particle control.
   - Installing silt curtains in the tide pools as needed.
   - Installing a platform that serves as a debris catchment system; plywood, or netting with a filter cloth beneath the work area.
3. Procedures for work in the ocean:
   - Install floating booms and silt curtains as needed.
   - Large debris will be removed as soon as possible.
   - Waste hauling will follow the shortest and most direct path to the shoreline.
   - Water contaminated with fine particles will be removed by bailing within the work area barrier and disposed in an area similar to a construction site concrete washout area.

4.14.4 Solid Waste Facilities

Demolition of the existing KBR hotel and remnant facilities of the KLH along with the proposed redevelopment will generate solid waste that is typical of construction-related activities. Construction waste generated will have a short-term impact, and consist primarily of vegetation, rocks, concrete, and other debris created from building demolition, clearing, excavation, and building construction activities.

Certain hazardous materials present within the KBR hotel will need to be properly removed by the contractor before demolition of the KBR hotel commences. Removal of such material will be conducted and disposed of in conformance with applicable State and Federal requirements. As an example, PCB light ballasts would be placed in 55-gallon drums, incinerated, and disposed of at the West Hawai'i Sanitary Landfill site.

Other materials from demolition activities such as scrap iron and steel and asphalt pavement would be taken for recycling at the landfill by the contractor. Concrete material, after being crushed on site, would be reused as fill material within the project site where appropriate. The remaining material will be disposed of at the landfill. Vegetation such as trees, palms, and other plants would be taken to the Kealakehe (Kailua-Kona) Greenwaste Facility for recycling. Therefore, the proper processing and disposal of materials should not have a significant impact on those facilities

Redevelopment of the property as an education complex will result in activities that continue to generate solid waste at the project site. However, the amount of solid waste generated on a daily basis would be considerably less due to the lower intensity and density of from education activities as compared to the former resort use.

Typical residential solid waste consisting of organics (food), paper, and plastics, would be generated by this project. Solid waste generated predominantly from educational activities would continue to

be collected by a private company for disposal. Therefore, the project should have a positive long-term effect on solid waste facilities due to reduced amounts of waste being generated from educational activities compared to the former resort use.

4.14.5 Transportation Facilities

The year 2023 was used as the study year reflecting the projected completion of the project which includes demolition of the hotel and redevelopment of facilities. Future conditions without the project were first projected. Changes with the project could then be assessed to determine project related impacts.

Future Conditions Without Project

A defacto growth rate was used to take into account other island-wide developments, and generate additional vehicles distributed on the study roadway network for the study year. It is noted that the most recent traffic counts indicated a reduction in vehicle traffic during the weekday morning and afternoon peak hours.

Other known developments in the area that are reasonably anticipated to have a direct transportation impact on the study intersections were also considered. A residential project (Parcel 26 at Kahalu'u for Towne Development of Hawai'i) was identified less than a mile north of the project site. This development would consist of 321 multi-family time-share units and 17 single-family detached units located on the mauka side of Ali'i Drive. A traffic impact assessment report prepared for this development was used to determine the number of vehicular trips generated and applied to the background projections of the roadway network.

Projected traffic volumes without the Kahalu‘u Ma Kai project are shown on Figure 4 of the traffic impact study in Appendix J of this document. A summary of the results for study intersections is provided in Table 4.5 and discussed below.

1. Ali'i Drive and Main Project Driveway. This two-way stop-controlled intersection is forecast to operate at LOS C or better for all approaches during both weekday morning and afternoon peak hours of traffic.
2. Ali'i Driveway and Keauhou Shopping Center Driveway. This signalized "T"-intersection is forecast to operate at LOS B or better for all approaches during both weekday morning and afternoon peak hours of traffic.
3. Ali'i Highway and Kamehameha III Road. This signalized intersection is forecast to operate at LOS D or better for all approaches during both weekday morning and afternoon peak hours of traffic.
4. Kamehameha III Road and Keauhou Shopping Center Driveway. This signalized intersection is forecast to operate at LOS B or better for all approaches during both weekday morning and afternoon peak hours of traffic.

Table 4.5
Future 2023 Levels-of-Service Analysis Results Without the Project

Study Intersection	Future 2023 Conditions Without Project					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1. Ali‘i Drive & Project Driveway						
Eastbound Left-Turn/Right-Turn	0.0	0.00	A	18.1	0.04	C
Northbound Left-Turn/Through	0.2	0.01	A	0.2	0.01	A
Southbound Through/Right-Turn	0.0	0.33	A	0.0	0.38	A
2. Ali‘i Drive/Keauhou Shopping Ctr.						
Eastbound Through	13.4	0.21	B	16.2	0.33	B
Eastbound Right-Turn	13.8	0.31	B	18.7	0.58	B
Westbound Left-Turn	9.2	0.13	A	9.7	0.19	A
Westbound Through	9.0	0.10	A	9.8	0.21	A
Northbound Left-Turn	12.4	0.60	B	17.1	0.64	B
Northbound Right-Turn	9.1	0.04	A	12.3	0.08	B
Overall	12.6	0.47	B	15.9	0.57	B
3. Ali‘i Drive & Kamehameha III Road						
Eastbound Left-Turn/Through	33.8	0.66	C	35.6	0.70	D
Eastbound Right-Turn	26.9	0.05	C	26.9	0.04	C
Westbound Left-Turn/Through	32.0	0.70	C	34.4	0.70	C
Westbound Right-Turn	23.7	0.10	C	25.9	0.10	C
Northbound Left-Turn	20.0	0.22	C	19.8	0.13	B
Northbound Through/Right-Turn	24.4	0.49	C	26.3	0.58	C
Southbound Left-Turn	17.4	0.31	B	16.1	0.42	B
Southbound Through/Right-Turn	29.9	0.75	C	26.1	0.70	C
Overall	28.0	0.70	C	27.8	0.70	C
4. Private Driveway/Keauhou SC & Kamehameha III Road						
Eastbound Left-Turn	6.9	0.10	A	9.6	0.16	A
Eastbound Through/Right-Turn	9.1	0.39	A	13.4	0.52	B
Westbound Left-Turn	6.5	0.05	A	10.5	0.06	B
Westbound Through	9.5	0.51	A	14.8	0.57	B
Westbound Right-Turn	7.7	0.11	A	11.8	0.12	B
Northbound Left-Turn/Through/Right-Turn	14.1	0.02	B	12.8	0.06	B
Southbound Left-Turn/Through/Right-Turn	15.2	0.33	B	17.4	0.62	B
Overall	9.7	0.44	A	14.1	0.57	B

Future Conditions With Project

Vehicular trips generated by the project were estimated using the Institute of Transportation Engineers’ *Trip Generation Manual, 9th Edition*. These trip rates and their associated directional distributions were used to estimate the increase in the number of vehicular trips generated by the project and distribution to the roadway network.

The volume of trips generated by the project is projected to be less than the former operation of the KBR when it was in use. Based upon the projected number of students and staff conducting activities on a daily basis at the project site, the following project-related vehicular trips was estimated as shown on Table 4.6. As shown on this table, the project would reduce total trips from the property by 100 vehicles and 70 vehicles during the weekday morning and afternoon peak hours, respectively.

Table 4.6
Project Generated Traffic Comparison

Land Use Designation	Independent Variable	AM Peak Hour			PM Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
PREVIOUS LAND USE (Keauhou Beach Resort)							
Hotel (310)	Rooms	9	67	164	95	91	186
	Total Prior Trips	**97**	**67**	**164**	**95**	**91**	**186**
PROPOSED LAND USE (Kahalu'u Ma Kai)							
Campground (416)	125 Students/Staff	5	5	10	5	5	10
Educational Facilities	125 Students/Staff	5	5	10	5	5	10
Shoreline Access	10 Stalls	10	10	20	10	10	20
Ground Staff	10 Staff	10	10	20	10	10	20
Museum (580)	7,200 SF	3	1	4	27	29	56
	Total Project Generated Trips	**33**	**31**	**64**	**57**	**59**	**116**
	Reduction in Trips with Project	**[64]**	**[36]**	**[100]**	**[38]**	**[32]**	**[70]**

As shown on this table, the ITE Code 580 – Museum, was used to generate trips for the project's heritage center. It is also planned that students and teachers would be shuttled to and from the site via bus. About five (5) buses in and out during the weekday morning and afternoon peak hours of traffic would be shuttling students for the daytime educational programs and five (5) other buses would be shuttling campsite users. Ten (10) trips during the peak hours of traffic were anticipated to account for the staff needed to manage and maintain all project facilities. Ten (10) trips were also assumed to account for people using the public parking lot to access the beach at Mākole'ā Cove located at the south end of the property.

Projected traffic from the project was then added to the roadway network and distributed based on the historical traffic data. Figure 4.5 shows the future (year 2023) traffic volumes at study intersections with the project. Table 4.7 shows the resulting LOS analysis results.

LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

(X)X – AM(PM) LOS

Y – SIGNALIZED INTERSECTION Y, OVERALL AM(PM) LOS (X/X)

* – OVERCAPACITY CONDITIONS

NOTES:
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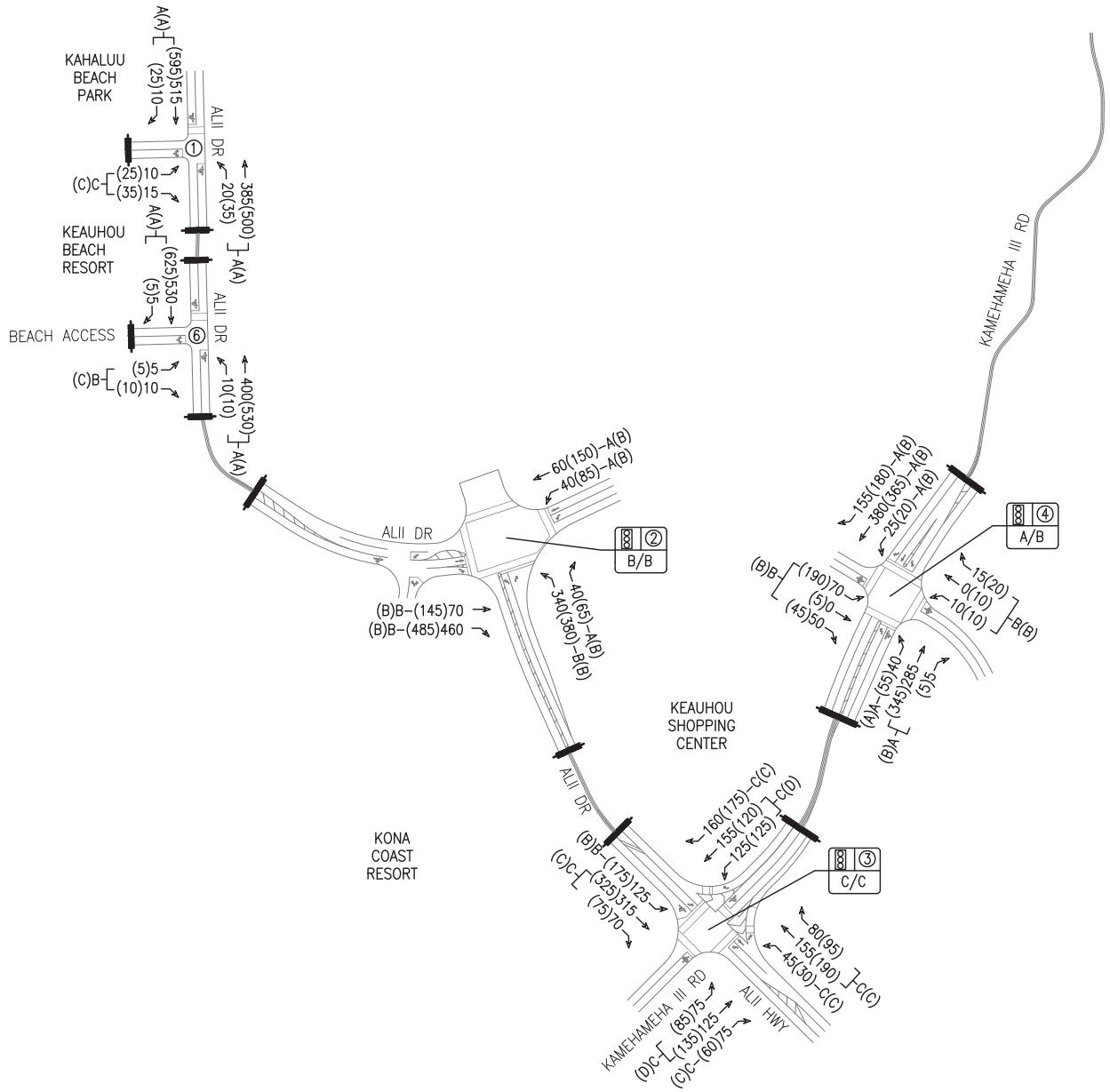

Source:

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Figure 4.5 - Future (Year 2023) Traffic Volumes With Project

Kahalu'u, Hawai'i

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Table 4.7
Future 2023 Levels-of-Service Analysis Results With Project

Study Intersection	Future 2023 Conditions With Project					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1. Ali‘i Drive & Project Driveway						
Eastbound Left-Turn/Right-Turn	15.6	0.07	C	22.1	0.24	C
Northbound Left-Turn/Through	0.7	0.02	A	1.1	0.04	A
Southbound Through/Right-Turn	0.0	0.34	A	0.0	0.40	A
2. Ali‘i Drive/Keauhou Shopping Ctr.						
Eastbound Through	13.7	0.20	B	16.9	0.33	B
Eastbound Right-Turn	14.2	0.33	B	19.7	0.59	B
Westbound Left-Turn	9.5	0.13	A	10.2	0.19	B
Westbound Through	9.4	0.10	A	10.4	0.21	B
Northbound Left-Turn	12.6	0.62	B	18.3	0.68	B
Northbound Right-Turn	9.1	0.04	A	12.5	0.08	B
Overall	12.9	0.48	B	17.0	0.59	B
3. Ali‘i Drive & Kamehameha III Road						
Eastbound Left-Turn/Through	34.6	0.67	C	35.5	0.70	D
Eastbound Right-Turn	27.0	0.05	C	26.8	0.04	C
Westbound Left-Turn/Through	33.2	0.72	C	35.9	0.72	D
Westbound Right-Turn	24.1	0.11	C	26.3	0.12	C
Northbound Left-Turn	21.6	0.22	C	21.1	0.14	C
Northbound Through/Right-Turn	26.5	0.54	C	28.7	0.64	C
Southbound Left-Turn	16.1	0.35	B	16.3	0.50	B
Southbound Through/Right-Turn	26.6	0.71	C	24.9	0.68	C
Overall	27.6	0.70	C	28.0	0.70	C
4. Private Driveway/Keauhou SC & Kamehameha III Road						
Eastbound Left-Turn	6.8	0.10	A	9.8	0.17	A
Eastbound Through/Right-Turn	9.1	0.41	A	13.9	0.55	B
Westbound Left-Turn	6.4	0.05	A	10.5	0.06	B
Westbound Through	9.6	0.53	A	15.3	0.60	B
Westbound Right-Turn	7.6	0.12	A	11.9	0.13	B
Northbound Left-Turn/Through/Right-Turn	14.4	0.02	B	13.3	0.06	B
Southbound Left-Turn/Through/Right-Turn	15.5	0.33	B	18.0	0.62	B
Overall	9.8	0.46	A	14.6	0.58	B
5. Ali‘i Drive & Public Access Driveway						
Eastbound Left-Turn/Right-Turn	14.8	0.04	B	17.7	0.05	C
Northbound Left-Turn/Through	0.3	0.01	A	0.3	0.01	A
Southbound Through/Right-Turn	0.0	0.34	A	0.0	0.40	A

With completion of the redevelopment phase of the project by the year 2023, the study intersections are forecast to operate at conditions similar to that without the project. All movements at all intersections are forecast to operate at LOS D or better, and are summarized below. The project will reduce the number of vehicular trips generated from the property during the weekday morning and afternoon peak hours, and thus have a beneficial effect on traffic conditions.

1. Ali'i Drive and Main Project Driveway. This two-way stop-controlled intersection is forecast to continue operating at LOS C or better for all approaches during both weekday morning and afternoon peak hours of traffic.
2. Ali'i Driveway and Keauhou Shopping Center Driveway. This signalized "T"-intersection is forecast to continue operating at LOS B or better for all approaches during both weekday morning and afternoon peak hours of traffic.
3. Ali'i Highway and Kamehameha III Road. This signalized intersection is forecast to continue operating at LOS D or better for all approaches during both weekday morning and afternoon peak hours of traffic.
4. Kamehameha III Road and Keauhou Shopping Center Driveway. This signalized intersection is forecast to continue operating at LOS B or better for all approaches during both weekday morning and afternoon peak hours of traffic.
5. Ali'i Drive and Public Access Driveway. This one-way stop-controlled intersection would service the parking lot providing public access to the beach on the south end of the property. This intersection is forecast to operate at LOS C or better for all approaches during both weekday morning and afternoon peak hours of traffic.

4.13.6 Electrical and Communication Facilities

The project should have a positive effect by reducing the amount of electrical power required to service buildings and operations associated with the educational complex. Coordination with HELCO would be conducted during the project's design phase to ensure sufficient electrical power is provided to the project.

Availability of telephone services to the site by HTC is sufficient for the proposed redevelopment and planned use. At the appropriate time, HTC will extend the requested services to a demarcation point via customer provided facilities. Availability of telecommunication services to the site by OTWC is also sufficient for the proposed redevelopment and planned use. At the appropriate time, OTWC will extend the requested services to a demarcation point via customer provided facilities.

4.15 PUBLIC FACILITIES

4.15.1 Recreational Facilities

Improvements associated with the project should not have any significant impacts on existing recreational facilities in the surrounding area. The project would not generate the type of population increase that places greater demands on existing recreational facilities or services.

The project would result in a change to former public shoreline access provided through the resort property along with the type of on-site recreational activities allowed by the resort.

Managed access through the property would be implemented to support the change from resort use to an educational complex. Managed access, which involves managing the number of visitors to the site and their interaction with the resources, would minimize disruptions to program activities, maintain the integrity and authenticity of the natural and cultural resources, and ensure the safety and security of students, kupuna (grandparents), and other visitors to the site.

A designated public access point located along the southern extent of the project site and a gated parking lot with 10 public parking spaces off of Ali‘i Drive would replace the former public shoreline access way through the resort property. This new access would be approximately 1,500 feet from the public access at Kahalu‘u Beach Park to the north and 550 feet from public access provided through the Keauhou-Kona Surf and Racquet Club subdivision to the south. This is consistent with the Hawai‘i County Public Access Code (Section 34-5(a)(2)) standards for shoreline access in a resort area, where the "desired spacing shall be from one thousand to two thousand feet apart."

KS would retain ownership of the access way, and would be responsible for managing and maintaining the right-of-way. Access would be unrestricted during the day (from dawn to dusk), and controlled after regular business hours. KS security would gate the right-of-way between dusk and dawn, and individuals using the right-of-way after regular hours would be required to register with KS security. Lateral access along the sandy beach at Mākole‘ā Cove and recreational activities occurring along the shoreline would not be affected.

Demolition and construction-related activities may generate some short-term construction noise, fugitive dust emissions and traffic that create nuisances for park users at the adjacent Kahalu‘u Beach Park and individuals using nearby shoreline resources. Given the proximity of the hotel building to Kahalu‘u Beach Park, it is likely that beach-goers will be inconvenienced by demolition and construction activities. However, compliance with State DOH regulations and permit conditions would mitigate construction-related noise, dust and traffic conditions and minimize the inconvenience to the public. In addition, access to the lagoon and shoreline fronting the existing KBR hotel structure would be prohibited during demolition to insure public safety.

4.15.2 Medical Facilities

Improvements associated with the project would not have any negative short-term or long-term impacts on Kona Community Hospital or other medical facilities in the surrounding area because there would be no major population increase to significantly alter the demand for medical services. While the educational activities conducted on the property may create the potential for an increase in minor accidents (such as cuts, scrapes and bruises), staff present during activities would be available to take care of the majority of incidents. The lower intensity of use and lower average daily on-site density associated with the project is also expected to result in less overall demand for medical services, compared to the former resort use.

4.15.3 Educational Facilities

Improvements associated with the project would not have any negative short- or long-term impacts on existing educational facilities in the surrounding area. The project does not include any new housing units that would increase resident population; therefore, there would be no increase in student enrollment at nearby schools and no additional demands on existing school facilities.

The improvements and facilities developed on the site would support educational programming, and thus have an overall positive beneficial impact on the entire State. The project would provide unique facilities and learning environments, which would result in increased opportunities for schools, community groups, cultural practitioners, and visitors to the area to participate in hands-on, 'āina-based educational activities. Planned improvements would promote safe, convenient access to unique teaching environments and contribute to meaningful and enjoyable learning experiences.

Demolition and construction-related activities may produce short-term noise and fugitive dust emissions that could be disruptive to existing educational programs currently operating at the project site. However, such effects would be temporary, and managed to ensure compliance with existing regulatory practices. The contractor would be required to comply with State DOH regulations and any permit conditions to mitigate nuisance noise and dust emissions. Temporary closures to the project site may be necessary during demolition and construction, in which case existing educational programs may need to be modified or temporarily relocated.

4.15.4 Police and Fire Protection

Police Protection

The project should have minimal effect on the police department's operations and their ability to provide adequate protection services during construction and the subsequent use of the site. KS would continue to provide on-site security to monitor activities within the property during both construction activities and the operation of education facilities.

The potential for emergency calls to the police department is not expected to increase, as there should be no major increases in the resident population. Furthermore, the change from resort use to an educational complex would result in a less-intensive use of the property and a smaller number of people accessing the site on a daily basis.

The number of visitors allowed on the site would be managed to protect the integrity of cultural sites and to minimize conflicts between the educational and cultural activities occurring on the property. Additional police presence (i.e., hiring of off-duty police officers) may be necessary to direct traffic and manage crowds during scheduled special events, which would occur periodically throughout the year.

Fire Protection

The project should have minimal effect on the fire department's operations and their ability to provide adequate protection services during construction and the subsequent use of the site. The potential to increase local demands for fire services is not expected, as there would be no major increases in resident population, and the cultural and educational use of the property would be less-intensive than the former hotel use.

Construction of the proposed improvements would include the necessary fire protection systems to serve the property. Such improvements would be designed in accordance with applicable building and fire codes for access, water supply and fire suppression devices. Coordination would be conducted with the County Fire Department during the project's design phase to review construction plans and address code requirements.

4.16 SECONDARY AND CUMULATIVE IMPACTS

4.16.1 Secondary Effects

Secondary effects, also referred to as indirect effects, are effects caused by a project, but occur later in time or farther removed in distance than direct impacts, but are still reasonably foreseeable. Such effects may include growth inducing effects related to induced changes in land use patterns, population density or growth rate, or related effects on environmental resources or public facilities. For example, a new highway project could induce changes to land use patterns along the improvements. Secondary impact assessments are concerned with impacts that are sufficiently "likely" to occur and not with the speculation of any impact that can be conceived of or imagined.

The proposed project is not expected to have significant secondary impacts on the future resident population, changes to land use patterns in the surrounding area, negative effects on most public facilities and infrastructure, or the natural environment in the immediate area and surrounding Kahalu‘u and Keauhou resort area. Proposed improvements do not include adding new residential housing or visitor units that will increase the future resident or visitor populations in the area. As a result, the project should not have significant indirect effects on public facilities such as schools,

parks, etc. associated with new residents moving into the community. Demolition of the KBR hotel and its 311 visitor units would result in a minor decrease in available visitor units island-wide. However, visitors to the area should be able to be accommodated by other developments in the area which are usually not operating at 100 percent occupancy.

Redevelopment of the property would result in a land use of lower intensity than the former resort use, leading to decreased demands on infrastructure facilities as discussed in this document. Therefore, this would generate a minor beneficial direct effect on infrastructure systems due to reduced demands, and subsequently would not have an indirect adverse effect on these systems. No improvements to increase the capacity or expand existing infrastructure systems would be required due to this project. The project should not have an indirect adverse effect on public facilities such as Kahalu‘u Beach Park. Visitors to that beach park would go there for the ocean recreational activities associated with that site (e.g. snorkeling, surfing, swimming, or sun bathing), and would visit the project site to experience the natural, cultural, and historical resources present.

The project should not influence changes in the existing or future land use pattern of the immediate surrounding area that is already developed with residential, commercial, and visitor-oriented uses. Shoreline areas in the immediate vicinity have been developed and established as either resort, residential, or public uses. The proposed establishment of an education complex would not influence the established land use pattern found in the area. Undeveloped areas mauka of the property are generally owned by KS, and future uses would be dependent upon KS re-evaluating their priorities for the larger West Hawai‘i region and not due to redevelopment of the project site. Thus, any future renovations, redevelopment, or modifications to existing subdivisions, hotels, or businesses in this area would be due to economic reasons associated with that use, and not reflect an indirect effect from redevelopment of the project site.

Demolition of the hotel and redevelopment construction of this project will generate short-term construction jobs that are not expected to result in any permanent in-migration of workers to the island of Hawai‘i to fill these jobs. It is anticipated that qualified local contractors on island would be used for the project’s construction. Therefore, construction of the project should not contribute to significant secondary impacts associated with in-migration of workers.

4.16.2 Cumulative Impacts

Cumulative impacts are typically defined as the effects on the environment that result from the incremental impact of a project when added to past, present, and reasonably foreseeable future actions within the study year. The estimation of future impacts is important for cumulative impact analysis. However, the focus must be on “reasonably foreseeable” actions that are those likely to occur or probable rather than those that are merely possible or subject to speculation. The prediction of reasonably foreseeable impacts thus requires judgment based on information obtained from reliable sources such as approved development plans and land use entitlements received.

The discussion of impacts presented within this document has provided information to assist in addressing the applicable cumulative effects associated with the project and other reasonably foreseeable future actions being implemented. Project improvements should not have significant cumulative impacts on the surrounding environment. Most of the effects are confined to the project site such as short-term construction activities and educational and cultural activities planned to occur. No off-site infrastructure improvements would be required, or significant effects on public facilities as discussed in this document.

The only other known development in the area that is reasonably anticipated to be completed within the 2023 study year is a residential project. Parcel 26 at Kahalu'u for Towne Development of Hawai'i (Towne) is a residential development identified less than a mile north of the project site. This development would consist of 321 multi-family time-share units and 17 single-family detached units located on the mauka side of Ali'i Drive (Geometrician Associates, August 2013).

Although planned for completion and full occupancy by 2017 based on the traffic study in the Draft EA (August 2013) for that development, actual completion could be later given that the project: 1) is still going through the environmental review process; 2) would need to obtain entitlement approval; and 3) obtain review and approval of design plans before construction begins. Given market conditions at that time, it could be developed in phases with full occupancy occurring beyond the 2017 timeframe. Nevertheless, it is still reasonable for the project to be completed within the 2023 study year for this Kahalu'u Ma Kai project.

Short-Term Construction Related Effects

Cumulative impacts could be associated with temporary construction activities, since the timing of the proposed project may occur concurrently with construction of the Towne Development residential development in the surrounding area. Demolition of the hotel would be a large component of construction activities, and is planned to occur in summer 2015. Thus, this demolition work could begin and be completed before construction starts with the residential development since demolition plans are already prepared and will soon be filed to start agency review.

This situation would contribute to increased temporary disruptions and nuisance effects such as increased runoff, noise, dust, and construction worker traffic. However, implementation of BMPs and other measures required as part of permit conditions would reduce these temporary impacts. Construction of the Towne development would similarly involve temporary land-disturbing activities that may result in some temporary disruptions and nuisance effects. However, that development would need to implement its own set of BMPs to minimize potential short-term erosion impacts during such construction activities. Therefore, the cumulative effect from these activities should not be significant and would be temporary. Effects would also be reduced if construction of the residential development occurs later in time.

Effects on Physical and Natural Environment

Redevelopment of the site under the proposed project would have minimal affect on the various physical resources and natural environment such as soils, topography, botanical, faunal, marine, and hydrology as discussed in the respective sections of this document. Redevelopment of the site would result in a land use of lower intensity and density as compared to the prior resort use. Low impact design and sustainability measures incorporated with the new facilities proposed would reduce storm water runoff, improve water quality, and reduce other land-based effects thereby improving shoreline conditions and the marine environment.

The archaeological inventory survey conducted for the project documented existing archaeological resources within the property, and the redevelopment of the property should not have an adverse effect on historic properties. Restoration efforts of historic sites are already being implemented by KS, and these efforts would continue with the project by being integrated into educational programs and activities. Mitigative measures proposed will further support protection and restoration of historic sites thru the implementation of approved an archaeological monitoring plan (to include a burial treatment plan to address inadvertent discoveries) during demolition and construction activities, and adherence to approved preservation plans for all restoration activities.

The Towne residential development will need to implement mitigation in the form of large preservation areas for multiple sites with protective measures; burial treatment plans to ensure preservation of burials and accessibility for lineal descendants; and data recovery to gather additional information valuable for the study of culture and history. Therefore, development of the remaining areas of that site would have no adverse impact on significant historic properties (Geometrician Associates, August 2013). Therefore, based upon these conclusions, the Kahalu‘u Ma Kai project should not contribute to significant negative cumulative impacts on historic or cultural resources. In fact, the overall effect on historic and cultural resources attributable to the project would be positive.

The results of water chemistry analysis conducted for the residential development indicated little or no potential for substantial adverse impacts to marine waters (Kahalu‘u Bay) off that project site. The proposed Towne Development residential project should not change water quality of the offshore area to any discernible extent (Geometrician Associates, August 2013). Therefore, when the proposed Kahalu‘u Ma Kai project is evaluated with this other development occurring in the area, the KS project should not contribute to significant cumulative impacts on the marine environment and water quality of Kahalu‘u Bay.

Effects on Social and Economic Factors

The proposed project along with the Towne residential development would contribute to the overall economic environment by creating temporary construction jobs and wages. This will also have a cumulatively minor, but positive short-term impact on State fiscal factors with the addition of General Excise taxes, corporate taxes, individual income taxes, and other taxes related to industries supporting construction activities such as manufacturers and distributors. Redevelopment of the

project site would result in lower property tax revenue generated to the County, however, the residential development would increase property tax revenue from new homes created on the undeveloped site. Cumulatively, this would be a minor positive effect for the County.

Redevelopment of the project site would not add new residential housing, but decrease 311 visitor units from the island's inventory. The Towne residential development would add 338 residential units to the area. As a result, cumulatively, there would be a slight net increase of 27 units in this area. The 321 timeshare units proposed would essentially replace the 311 hotel units from the KBR serving visitors to the island. Other additional units would be homes for residents. Therefore, the proposed redevelopment project should not contribute to a significant cumulative impact on population in the area. The social character of the area would similarly not be adversely changed by these projects which is predominately resort-oriented.

Effects on Infrastructure and Public Facilities

Redevelopment of the Kahalu'u Ma Kai project site would result in a land use of lower intensity than compared to the former resort which will decrease demands on infrastructure facilities as discussed in this document. The Towne development will place new demands on existing infrastructure facilities. That development has potable water available through an allocation of 349 units from the County DWS, and wastewater will be processed and treated through the privately-owned wastewater system serving the area (Geometrician Associates, August 2013). Therefore, cumulatively, the net effect on existing infrastructure facilities should not be significant.

No significant cumulative impacts are expected on existing school facilities, medical facilities, and police and fire protection services. Redevelopment of the Kahalu'u Makai project site to support education activities conducted with KS educational partners will have a beneficial effect on the educational system and programs in the state. The project would not affect existing educational facilities or personnel requirements (e.g. teachers, administrators, etc.) because the project site would serve as an extension of classrooms and a learning environment for students visiting. The Towne development would have a slight effect on educational facilities due to the 17 single-family residences planned, however, the timeshare units should not because those units would be occupied by visitors.

The proposed project should have minimal effect, if any, on recreational facilities serving the area because it will not increase the future population of residents or visitors in the area that may need to access such facilities. Redevelopment of the property would be for educational programs and cultural practices, but will continue to provide managed access for visitors interested in viewing the heiau and property. Public access would be provided to those wanting to visit the sandy beach on the southern end of the property.

The Towne residential development would have an effect on recreational facilities including Kahalu'u Beach Park due to its walking distance from the development site. Additional residents and visitors staying at timeshare units would likely utilize that beach park for ocean related

recreational activities. However, with removal of the KBR hotel (311 hotel units) and visitors staying at that hotel, the net increase in people visiting the beach park would be minimized and should not have a significant cumulative effect.

CHAPTER 5
CONFORMANCE WITH STATE AND COUNTY PLANS POLICIES AND CONTROLS

This chapter discusses the project's conformance with the State Land Use District regulations, State Environmental Policy (Chapter 344, HRS), and the regulations, policies, and goals set forth by the County's General Plan, County's Kona Community Development Plan, Special Management Area (Chapter 205A, HRS), and Hawai‘i County Zoning Code.

5.1 STATE LAND USE DISTRICT

Pursuant to Title 13, Chapter 205 (Land Use Commission), HRS, all lands in the State of Hawai‘i are classified by the State Land Use Commission (LUC) into four major districts which are referred to as "State Land Use Districts." The four land use districts are the Urban, Rural, Agricultural, and Conservation Districts. Permitted uses within the State Land Use Districts are prescribed under Title 13, Chapter 205, HRS, and the State LUC's Administrative Rules prescribed under Title 15, Subtitle 3, Chapter 15, HAR.

The project site is situated within lands designated as State "Urban District." Permitted uses or activities within the Urban District are regulated by ordinances or regulations of the county within which the Urban District is situated. Thus, Urban District lands on the Island of Hawai‘i are regulated by the ordinances and regulations of the County of Hawai‘i. Figure 5.1 shows the State land use district designations for the project site.

It should be noted that the Urban District boundaries were obtained from State Geographic Information System (GIS) data, and the boundaries along the shoreline do not accurately match the property boundaries. As shown on Figure 5.1, the Urban District boundaries do not include most of Ke‘ekū Heiau and Hāpaiali‘i Heiau, and a portion of Kapuanoni Heiau. In addition, the boundary includes most of the tide pools extending makai fronting the KBR hotel along with a portion of the tide pool between Ke‘ekū and Hāpaiali‘i Heiau. Nevertheless, this project does not include any improvements to these heiau.

5.2 CHAPTER 344, HRS, STATE ENVIRONMENTAL POLICY

Chapter 344, HRS prescribes the overall State's Environmental Policy consisting of policies and guidelines. The purpose for this Chapter is to establish a State policy that encouragea productive and enjoyable harmony between people and their environment. This section discusses the project's conformance and consistency with the pertinent goals, policies, and guidelines described under Chapter 344, HRS.

LEGEND

U Urban District

Note:
The Urban District boundary is based upon the State's GIS database. This shape file does not accurately reflect the property boundary because it includes areas beyond the shoreline.

KAHALU'U MA KAI

Figure 5.1 - State Land Use Districts Map

Kahalu'u, Hawai'i

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Section 344-3(1). Conserve the natural resources, so that land, water, mineral, visual, air and other natural resources are protected by controlling pollution, by preserving or augmenting natural resources, and by safeguarding the State's unique natural environmental characteristics in a manner which will foster and promote the general welfare, create and maintain conditions under which humanity and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawaii.

Discussion: The project will be consistent with this policy as discussed throughout the various sections of this document. The project would involve a lower intensity of land use as compared to the former resort. Redevelopment of the site supporting KS educational programs will increase the range of beneficial uses of the environment through educational activities that would support landscape restoration of the site, improved maintenance and care for resources, and increased education about natural and cultural resources present. Therefore, project activities should have a positive impact on resources associated with the property by highlighting their significance and developing stewardship learning opportunities.

Section 344-3(2). Enhance the quality of life by:

A. Setting population limits so that the interaction between the natural and manmade environments and the population is mutually beneficial.

B. Creating opportunities for the residents of Hawaii to improve their quality of life through diverse economic activities which are stable and in balance with the physical and social environments.

C. Establishing communities which provide a sense of identity, wise use of land, efficient transportation, and aesthetic and social satisfaction in harmony with the natural environment which is uniquely Hawaiian.

D. Establishing a commitment on the part of each person to protect and enhance Hawaii's environment and reduce the drain on nonrenewable resources

Discussion: The project would be consistent with these environmental policies regarding the quality of life. Project improvements would not affect future resident populations, would continue to support visitors to the site to view and learn about cultural resources, and enhance mauka-makai public access and parking on the southern end of the property. Redevelopment of the site will improve the quality of life for residents by supporting KS educational programs along with cultural practices, and management of the property by KS will ensure a balance occurs between protecting natural resources in relation to human activities.

Section 344-4. Guidelines:

1. Population.

A. Recognize population impact as a major factor in environmental degradation and adopt guidelines to alleviate this impact and minimize future degradation;

B. Recognize optimum population levels for counties and districts within the State, keeping in mind that these will change with technology and circumstance, and adopt guidelines to limit population to the levels determined.

Discussion: The project would not affect the existing or future resident population in the area or West Hawai'i district. Providing public access and managing access to sensitive cultural and historical resources on the property would ensure environmental degradation does not occur. Redevelopment of the site would reduce demands on existing infrastructure, and considerably reduce storm water runoff, thereby improving water quality and the nearshore marine environment.

2. *Land, water, mineral, visual, air, and other natural resources*
   - A. *Encourage management practices which conserve and fully utilize all natural resources;*
   - B. *Promote irrigation and waste water management practices which conserve and fully utilize vital water resources;*
   - C. *Promote the recycling of waste water.*
   - D. *Encourage management practices which conserve and protect watersheds and water sources, forest, and open space areas;*
   - E. *Establish and maintain natural area preserves, wildlife preserves, forest reserves, marine preserves, and unique ecological preserves;*
   - G. *Promote the optimal use of solid wastes through programs of waste prevention, energy resource recovery, and recycling so that all our wastes become utilized.*

Discussion: New facilities constructed with redevelopment of the site would support preserving natural and cultural resources, and would be consistent with these guidelines. Low impact design and sustainability measures incorporated into the design of facilities and the site would reduce storm water runoff and other land based effects on natural and marine resources, such as the tide pools and the ocean. Wastewater generated from typical daily use of the site would be treated and recycled on-site.

3. *Flora and fauna*
   - A. *Protect endangered species of indigenous plants and animals and introduce new plants or animals only upon assurance of negligible ecological hazard.*
   - B. *Foster the planting of native as well as other trees, shrubs, and flowering plants compatible to the enhancement of our environment.*

Discussion: This project would support the protection of endangered marine mammals and should not have an adverse effect on endangered sea birds or mammals (Hawaiian hoary bats). Facilities would be designed to incorporate shielding of driveway or facility security lighting. Existing endangered loulu palms would not be affected by construction of new facilities, and one loulu palm located close to the KBR hotel is planned to be relocated to another area of the property prior to hotel demolition. Landscape restoration utilizing native plants within the property as part of educational programming and cultural restoration would be implemented.

4. *Parks, recreation, and open space*
   - *A Establish, preserve and maintain scenic, historic, cultural, park and recreation areas, including the shorelines, for public recreational, educational, and scientific uses.*
   - *B. Protect the shorelines of the State from encroachment of artificial improvements, structures, and activities.*
   - *C. Promote open space in view of its natural beauty not only as a natural resource but as an ennobling, living environment for its people.*

Discussion: The project will establish an educational complex on the property that will support preserving and maintaining historic and cultural resources. It will support cultural practices and educational programming for cultural and lineal descendants, students, other residents, and visitors. Public access to the sandy beach on the southern end of the property would continue via a public pedestrian access path with vehicular parking, and management of the site would ensure visitors viewing the heiau would do so in a sensitive and culturally appropriate manner. Redevelopment of the site would result in a lower intensity of land use and increase open space. Low impact design and sustainability measures incorporated with new facilities would reduce storm water runoff and other land based effects thereby improving shoreline conditions and the marine environment.

5. *Economic development.*
   - *A. Encourage industries in Hawai'i which would be in harmony with our environment.*

Discussion: Redevelopment of the property under this project would support KS educational programs and activities, and enhance coordination efforts and partnerships with other education stakeholders in Hawai'i such as the State public schools and university systems. Better preparing children with enhanced education will provide industries within the State with better qualified personnel. The project site would continue to be a scenic and cultural resource of interest to visitors, and therefore will continue to support the visitor industry.

6. *Transportation.*
   - *C. Encourage public and private vehicles and transportation systems to conserve energy, reduce pollution emission, including noise, and provide safe and convenient accommodations for their users.*

Discussion: The project will reduce the number of vehicle trips to and from the site during the weekday peak commuter periods as compared to the former resort use. This would have a positive effect on the transportation system by reducing pollution emissions and associated noise.

7. *Energy.*
   A. *Encourage the efficient use of energy resources.*

Discussion: Less intensive use of the property will significantly reduce energy use. New facilities would be designed incorporating sustainability elements that will use energy resources more efficiently. Thus, the project should reduce the overall electrical demand as compared to the former resort use.

8. *Community life and housing.*
   A. *Foster lifestyles compatible with the environment; preserve the variety of lifestyles traditional to Hawai'i through the design and maintenance of neighborhoods which reflect culture and mores of the community.*
   B. *Develop communities which provide a sense of identity and social satisfaction in harmony with the environment and provide internal opportunities for shopping, employment, education, and recreation.*
   C. *Encourage the reduction of environmental pollution which may degrade a community.*
   E. *Recognize community appearances as major economic and aesthetic assets of the counties and the State; encourage green belts, plantings, and landscape plans and designs in urban areas; and preserve and promote mountain-to-ocean vistas.*

Discussion: The project will support these guidelines for community life and housing by lowering the intensity of land use, which is more compatible with preserving the historic resources and the cultural history of the area. New facilities would be designed incorporating sustainability elements and a design character reflecting the Hawaiian culture and history of the area. This property has a unique cultural presence that will be restored and maintained under this project providing better harmony with the environment and reducing land based effects (e.g. storm water runoff). Increased open space and landscape restoration implemented within the property as part of educational programming and cultural restoration will improve the appearance and aesthetic value of the property.

9. *Education and culture.*
   A. *Foster culture and the arts and promote their linkage to the enhancement of the environment.*
   B. *Encourage both formal and informal environmental education to all age groups.*

Discussion: Redevelopment of the property with educational facilities will support environmental programming and activities that will complement and enhance understanding of the environment and cultural resources present. 'Āina-based programs with educational partners would be expanded supporting environmental education to all age groups which includes visitors to the site using the Heritage Center.

10. *Citizen participation*
   A. *Encourage all individuals in the State to adopt a moral ethic to respect the natural environment; to reduce waste and excessive consumption; and to fulfill the responsibility as trustees of the environment for the present and succeeding generations;*

B. Provide for expanding citizen participation in the decision making process so it continually embraces more citizens and more issues.

Discussion: Educational and cultural opportunities created by this project would support KS's effort to improve awareness of the importance of the natural environment and cultural resources present. Such opportunities would further the public's understanding of these resources and their importance to Hawaiian history, the environment and culture. The environmental review process undertaken for this project allows for public and government agency input during the review of the Draft EA. Public consultation efforts under this environmental review process help provide decision-makers with a diverse array of information and comments to consider when evaluating this project. KS initiated a broad effort to inform lineal and cultural descendants, residents, community groups, and government agencies about this project prior to preparing this document, thereby fostering public participation at an early phase in the process.

5.3 COUNTY GENERAL PLAN

The *General Plan* for the County of Hawai'i is a policy document expressing the broad goals and policies for the long-range development for the Island of Hawai'i (County, February 2005). Under the *General Plan's* land use pattern allocation guide map (LUPAG), the majority of the project site is designated as a "Resort Node." Areas of the property along the shoreline are designated as "Open Area." Figure 5.2 shows the land use designations for this site and surrounding areas.

This section discusses the project's conformance and consistency with the pertinent policies and guidelines of the County's *General Plan* (County, February 2005). Overall, the proposed project is generally consistent with and supports pertinent goals and policies from this plan based upon its evaluation relative to the results of the impact assessments discussed in this document.

1. Economic Goals

b. Economic development and improvement shall be in balance with the physical, social, and cultural environments of the island of Hawai'i.

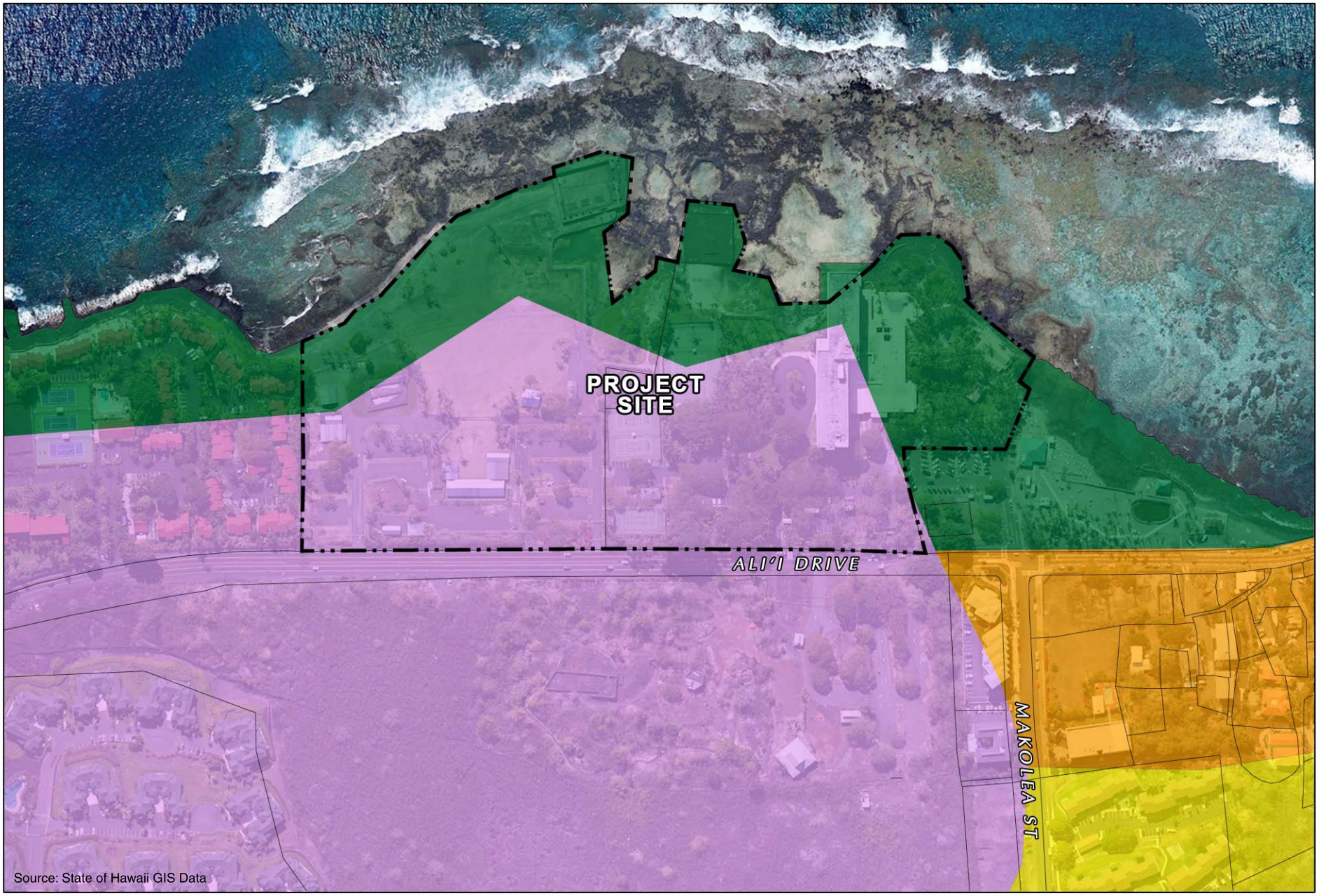
d. Provide an economic environment that allows new, expanded, or improved economic opportunities that are compatible with the County's cultural, natural and social environment.

h. Promote and develop the island of Hawai'i into a unique scientific and cultural model, where economic gains are in balance with social and physical amenities. Development should be reviewed on the basis of total impact on the residents of the County, not only in terms of immediate short run economic benefits.

<u>Policies</u>

(f) Support all levels of educational, employment and training opportunities and institutions.

(h) The land, water, air, sea, and people shall be considered as essential resources for present and future generations and should be protected and enhanced through the use of economic incentives.



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- Open Area
- Resort Node
- Medium Density Urban
- Low Density Urban

KAHALU'U MA KAI

Figure 5.2 - County General Plan LUPAG Map

Kahalu'u, Hawai'i

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Discussion: Redevelopment of the project site would support economic development and opportunities that are in balance and sensitive to the cultural resources and natural environment associated with the property. This project would support KS educational programs and activities, and enhance coordination efforts and partnership with other education stakeholders in Hawai'i such as the State public and private, preschool, elementary school, middle school, high school, and university systems. These educational opportunities will contribute to the development of civically engaged and responsible citizens in the State and abroad.

2. *Energy Goals*
   a. *Strive towards energy self-sufficiency.*
      Policies
      (d) *Strive to educate the public on new energy technologies and foster attitudes and activities conducive to energy conservation.*
      (n) *Encourage energy-saving design in the construction of buildings.*

Discussion: New facilities would be designed incorporating sustainability elements that will make efficient use of energy resources. Thus, the project should reduce the overall electrical demand as compared to the former resort use. Low impact design and sustainability elements incorporated into the redevelopment are planned to be integrated into educational programs supporting these County policies.

3. *Environmental Quality Goals*
   b. *Maintain and, if feasible, improve the existing environmental quality of the island.*
   c. *Control pollution.*
      Policies
      (a) *Take positive action to further maintain the quality of the environment.*
      (d) *Encourage the concept of recycling agricultural, industrial, and municipal waste material.*
      (h) *Work with the appropriate agencies to adopt appropriate measures and provide incentives to control point and nonpoint sources of pollution.*
      (i) *Support programs to prevent harmful alien species from becoming established.*

Discussion: New facilities would be designed incorporating sustainability elements that will control storm water runoff that is retained on-site, filtering pollutants before reaching sensitive ecosystems. Reusable energy systems and the use of native plants will reduce consumption of non-renewable energy sources and potable water demands. Healthy native plants included with landscape restoration should also prevent the spread of alien plant species on the property.

4. *Flooding and Other Natural Hazards Goals*
   - *b. Prevent damage to man-made improvements.*
   - *c. Control pollution.*
   - *d. Prevent damage from inundation.*
   - *e. Reduce surface water and sediment runoff.*

     Policies
     - *(d) Any development within the Federal Emergency Management Agency designated flood plain must be in compliance with Chapter 27.*
     - *(g) Development-generated runoff shall be disposed of in a manner acceptable to the Department of Public Works and in compliance with all State and Federal laws.*
     - *(q) Consider natural hazards in all land use planning and permitting.*

Discussion: New construction and site improvements will be conducted in compliance with the County's floodplain management regulations (Section 27 of the County Code). Design plans would also be coordinated with pertinent State and County agencies for review and approval. Compliance with these regulations along with building codes would reduce potential damage to structures from natural hazards. Therefore, the risk of potential damage from natural hazards should be minimized, and should be at no greater risk of damage than other existing development in the Kahalu'u and Keauhou areas. Coordination with the County to interpret the specific boundaries of flood hazard areas would be conducted during the project's design phase to determine compliance with applicable requirements. Flood hazard lines do not match the contours of the property's actual ground conditions based upon a topographic survey conducted. Thus, actual site conditions reflect elevations that could reduce the extent of the flood hazard areas shown for the site by the FIRM. Redevelopment of the site will considerably reduce impervious surfaces and the resulting volume of storm water runoff and its associated effects. Coordination with the County DPW was conducted which determined redevelopment of the site should reduce runoff volumes to conditions prior to resort development.

5. *Historic Sites Goals*
   - *a. Protect, restore, and enhance the sites, buildings, and objects of significant historical and cultural importance to Hawai'i.*
   - *b. Appropriate access to significant historic sites, buildings, and objects of public interest should be made available.*

     Policies
     - *(a) Agencies and organizations, either public or private, pursuing knowledge about historic sites should keep the public apprised of projects.*
     - *(c) Require both public and private developers of land to provide historical and archaeological surveys and cultural assessments, where appropriate, prior to the clearing or development of land when there are indications that the land under consideration has historical significance.*
     - *(f) Encourage the restoration of significant sites on private lands.*
     - *(g) Collect and distribute historic sites information of public interest and keep an inventory of sites.*

(h) Aid in the development of a program of public education concerning historic sites.

(i) Signs explaining historic sites, buildings and objects shall be in keeping with the character of the area or the cultural aspects of the feature.

Discussion: KS has successfully embarked on a program to restore historic properties on the project site, and will continue to do so with other sites as part of educational programs that will be integrated into the redeveloped property. With redevelopment of the site, access for cultural practices would be enhanced and supported. Visitors wanting to view the heiau and other cultural sites would be afforded managed access to accommodate their interest while maintaining appropriate buffers and protocols to ensure the integrity of sites. This also supports broader public education and awareness of cultural resources on the property, and requires activities to occur in a culturally sensitive manner. Archaeological surveys conducted for this project completed fieldwork and subsurface testing to identify significant historic resources present within the property. This also included the preparation of a cultural impact assessment. Coordination has, and will continue to be, conducted with pertinent State and County agencies to identify necessary mitigative measures, such as archaeological monitoring and preservation plans. Therefore, redevelopment of the site as an educational complex would support information retention through preservation and County goals for protection, restoration, interpretation, and display of historic resources.

6. Natural Beauty Goals

a. Protect, preserve and enhance the quality of areas endowed with natural beauty, including the quality of coastal scenic resources.

b. Protect scenic vistas and view planes from becoming obstructed.

c. Maximize opportunities for present and future generations to appreciate and enjoy natural and scenic beauty.

<u>Policies</u>

(a) Increase public pedestrian access opportunities to scenic places and vistas.

(d) Access easement to public or private lands that have natural or scenic value shall be provided or acquired for the public.

(h) Protect the views of areas endowed with natural beauty by carefully considering the effects of proposed construction during all land use reviews.

(i) Do not allow incompatible construction in areas of natural beauty.

Discussion: Redevelopment of the project site would preserve and enhance the natural beauty of the property by creating additional open space. The project will improve scenic views with demolition of the KBR hotel. The architectural design of new facilities would be low scale and culturally appropriate. Redevelopment of the site would increase open space (e.g. removing parking areas, tennis courts) and allow for landscape restoration using native plant materials. These improvements would be visually compatible with the surrounding environment and not alter natural landforms. Open space along the shoreline would be retained with redevelopment as new facilities are located inland and away from the shoreline.

7. Natural Resources and Shoreline Goals

a. Protect and conserve the natural resources from undue exploitation, encroachment and damage.

b, Provide opportunities for recreational, economic, and educational needs without despoiling or endangering natural resources.

c. Protect and promote the prudent use of Hawaii's unique, fragile, and significant environmental and natural resources.

d. Protect rare or endangered species and habitats native to Hawaii.

e. Protect and effectively manage Hawaii's open space, watersheds, shoreline, and natural areas.

f. Ensure that alterations to existing land forms, vegetation, and construction of structures cause minimum adverse effect to water resources, and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation, or failure in the event of an earthquake.

Policies

(a) Require users of natural resources to conduct their activities in a manner that avoids or minimizes adverse effects on the environment.

(b) Encourage a program of collection and dissemination of basic data concerning natural resources.

(c) Maintain the shoreline for recreational, cultural, educational, and/or scientific uses in a manner that is protective of resources and is of the maximum benefit to the general public.

(d) Protect the shoreline from the encroachment of man-made improvements and structures.

(i) Encourage an overall conservation ethic in the use of Hawaii's resources by protecting, preserving, and conserving the critical and significant natural resources of the County of Hawai'i.

(p) Encourage the use of native plants for screening and landscaping.

(q) Develop policies by which native Hawaiian gathering rights will be protected as identified under judicial decisions.

(r) Ensure public access is provided to the shoreline, public trails and hunting areas, including free public parking where appropriate.

(s) Establish a system of pedestrian access trails to places of scenic, historic, cultural, natural, or recreational values.

Discussion: Redevelopment of the project site and its management by KS would ensure natural resources present are protected and maintained. New facilities constructed will support environmental programming and activities that will complement and enhance understanding of the natural environment and cultural resources present. Endangered or rare species would be protected under this project, which would reinforce stewardship and educational programs. Low impact design and sustainability measures incorporated into the design of facilities and site development would reduce storm water runoff and other land based effects on natural and marine resources, such as the tide pools and ocean. As discussed in various sections of this document, scenic resources will be improved, public access will continue to be provided for recreational use, visitors will be allowed to view the heiau and other cultural sites on the property, and facilities are appropriately sited well inland to reduce potential damage from natural hazards. Cultural practices and gathering rights would be supported which includes accommodating a wider array of cultural activities (e.g.

life celebrations, makahiki, and hoike events). Redevelopment of the site would also increase open space and allow for landscape restoration using native vegetation.

8. Public Facilities Goals

a. Encourage the provision of public facilities that effectively service community and visitor needs and seek ways of improving public service through better and more functional facilities in keeping with the environmental and aesthetic concerns of the community.

Health and Sanitation Policies

(f) Continue to encourage programs such as recycling to reduce the flow of refuse deposited in landfills.

(h) Encourage the full development and implementation of a green waste recycling program.

Water System Policies

(a) Water system improvements shall correlate with the County's desired land use development pattern.

(b) All water systems shall be designed and built to Department of Water Supply standards.

(d) Water sources shall be adequately protected to prevent depletion and contamination from natural and man-made occurrences or events.

(e) Water system improvements should be first installed in areas that have established needs and characteristics, such as occupied dwellings, agricultural operations and other uses, or in areas adjacent to them if there is need for urban expansion.

Telecommunications Policies

(a) Encourage underground telephone lines where they are economically and technically feasible.

(d) Work closely with the telephone company to provide all users with efficient ser-vice.

Electricity Policies

(a) Power distribution shall be placed underground when and where practical. Encourage developers of new urban areas to place utilities underground.

Sewer Policies

(b) Private systems shall be installed by land developers for major resort and other developments along shorelines and sensitive higher inland areas, except where connection to nearby treatment facilities is feasible and compatible with the County's long-range plans, and in conformance with State and County requirements.

(f) Require major developments to connect to existing sewer treatment facilities or build their own.

Discussion: Redevelopment of the Kahalu'u Ma Kai project site would result in a land use of lower intensity compared to the former resort which will decrease demands on infrastructure facilities as discussed in this document. The project will support the various policies associated with infrastructure facilities. Recycling efforts would be incorporated into the design of facilities, and these concepts would support educational programs and activities. Recycling of materials from demolition of the hotel and other construction activities would be implemented as appropriate. The project would generate a lower demand of potable water than under resort operations, and the on-site water system would be designed and built in conformance to County DWS standards. Use of LID elements, such

as rainwater harvesting, rain gardens, etc., will also reduce the use of potable water for irrigation purposes. Underground telephone lines would be installed and plans coordinated with telecommunication companies. Similarly, new facilities will result in a decrease in electrical demand, and electrical lines serving the project would be placed underground with design plans coordinated with HELCO. Wastewater generated from project activities would be lower than under prior resort use. Typical daily wastewater flows generated would be collected and treated by the on-site wastewater system proposed, and larger flows from periodic large events would be diverted to the private sewer system serving the area.

9. Recreation Goals

a. Provide a wide variety of recreational opportunities for the residents and visitors of the County.

b. Maintain the natural beauty of recreation areas.

Policies

(c) Recreational facilities shall reflect the natural, historic, and cultural character of the area.

(d) The use of land adjoining recreation areas shall be compatible with community values, physical resources, and recreation potential.

(h) Provide facilities and a broad recreational program for all age groups, with special considerations for the handicapped, the elderly, and young children.

(l) Public access to the shoreline shall be provided in accordance with an adopted program of the County of Hawai'i.

Discussion: The project will establish an educational complex that will support cultural practices and educational programming for both residents and visitors, and persons of all ages, including those with special needs. Public access to the sandy beach on the southern end of the property would continue via a public pedestrian access path to be provided with vehicular parking, and management of the site would ensure visitors viewing the heiau act in a sensitive and culturally appropriate manner. Redevelopment of the site would result in a lower intensity of land use increasing open space within the property and improving its natural beauty. This project would be compatible with the adjoining Kahalu'u Beach Park due to the lower intensity of use and continued access for recreational activities along the sandy south beach area.

10. Land Use Goals

Resort Node: These areas include a mix of visitor-related uses such as hotels, condominium-hotels (condominiums developed and/or operated as hotels), single family and multiple family residential units, golf courses and other typical resort recreational facilities, resort commercial complexes and other support services.

Open: Parks and other recreational areas, historic sites, and open shoreline areas.

Resorts Goals

c. Ensure that resort developments maintain the cultural and historic, social, economic, and physical environments of Hawai'i and its people.

f. Designate and allocate future resort areas in appropriate proportions and in keeping with the social, economic, and physical environments of the County.

h. Encourage the visitor industry to provide resort facilities that offer an educational experience of Hawai'i as well as recreational activities.

i. Coastal resort developments shall provide public access to and parking for beach and shoreline areas.

Open Space

a. Provide and protect open space for the social, environmental, and economic well-being of the County of Hawaii and its residents.

Discussion: The project will involve redevelopment of the property to establish an educational complex that will support KS educational programs, and preserve and maintain historic and cultural resources present. The project will continue to support visitors to the property wanting to view and learn about the heiau and other cultural resources present by providing a unique educational and cultural experience. This will support other visitor-oriented developments in the area by continuing to provide cultural and scenic natural resources of interest to many who visit. Public access to the southern sandy beach would continue via a public pedestrian access path with vehicular parking to be provided. Therefore, the project will support the social, economic, and environmental well-being of the County, its residents, and visitors to the island.

5.4 COUNTY KONA COMMUNITY DEVELOPMENT PLAN

The Kona Community Development Plan (CDP) was adopted by Ordinance 08-131 in 2008. This plan encompasses the districts of North and South Kona that covers about 800 square miles of land area, and accounts for approximately 20 percent of the island's total land area. This plan identifies objectives and policies for eight major areas such as transportation, land use, cultural resources, and environmental resources. The project site is situated within the Kona Urban Area based upon the Official Kona Land Use Map from this plan. The property is also located outside of areas designated for transit-oriented development (TOD) as shown on Exhibit 5.1 (County PD, September 2008).

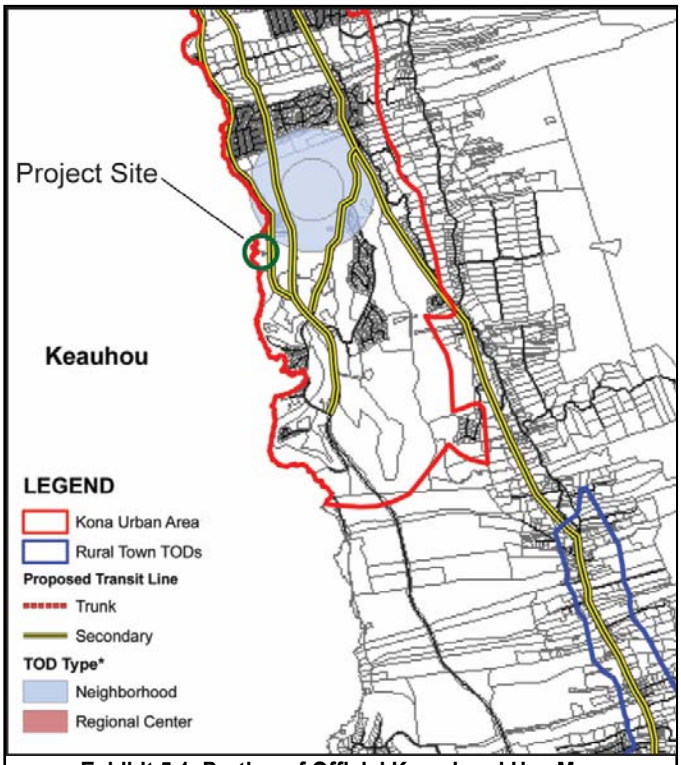


Exhibit 5.1 Portion of Official Kona Land Use Map From Kona Community Development Plan

This section discusses the project's conformance and consistency with the pertinent objectives and policies from the

major elements covered under the County's CDP. Overall, the proposed project is consistent with and supports applicable objectives and policies from this plan based upon its evaluation relative to the results of the impact assessments discussed in this document.

1. Land Use

LU-1: Overall Growth Pattern. To identify areas where higher intensity growth areas should occur and areas where the rural character and open space along the shoreline should be preserved.

Policy LU-1.2: Urban Area. The majority of future growth in Kona shall be directed to the Kona Urban Area shown on the Official Kona Land Use Map.

Discussion: The numerous natural, cultural, and historical sites located on the property supports the redevelopment of an education complex, and is consistent with LU-1 policy. The project site was previously developed for resort use and was the location of the former KBR and KLH. As mentioned previously, the numerous historic sites located on the property compels the area to be preserved and redeveloped at a lower intensity compared to the former resort use and with a more culturally sensitive approach. Increased open space and landscaping using native vegetation would be created on this shoreline parcel.

Policy LU-1.5: Enhanced Shoreline Setback. Beyond the 40 foot shoreline setback regulated by Hawai'i Revised Statutes (HRS) Sections 205A Part III, the County shall explore alternatives (e.g., density transfer based on gross density) for the applicant of a Special Management Area (SMA) Major Permit to dedicate to the government or land trust or encumber as open space for the purpose of realizing a shoreline linear park along as much of Kona's coastline as possible. Consistent with the Federal Coastal Zone Management Act (CZMA) and County of Hawai'i General Plan policy to retain open space and protect natural resources along with public access to and along the shoreline, it shall be a priority of the County to maintain a minimum of 1,000-foot open space no-build setback for undeveloped lands adjacent to the shoreline, on parcels which currently exceed 1,000 feet in depth, in discretionary land use approvals such as SMA major permits, rezonings, and state land use boundary amendments. Structures makai of this setback should be for public recreation and ocean-dependent facilities such as harbor improvements.

Discussion: The demolition of the KBR and KLH remnant facilities and redevelopment of an education complex is consistent with LU-1.5 in three primary ways: 1) the depth of the project site is less than one thousand feet; 2) the project site was previously developed for resort use and the proposed action will decrease the density and intensity of land use and contribute enhanced open space; and 3) the number of natural, cultural, and historical sites located on the property along with the significance of some of the sites to Hawaiian history requires active management to maintain the integrity and intrinsic values of these assets.

2. *Environmental Resources*

ENV-1: Managing Impacts. In order to minimize impacts on the land, make use of best management planning practices for any land-based endeavor by balancing public and private rights, and taking advantage of an ever-improving knowledge of resource sensitivity and natural processes.

Policy ENV–1.5: Sensitive Resources. In the context of Kona's ecology and history, the following natural and cultural resources shall be considered sensitive and therefore shall be inventoried, as part of any permit application to the County Planning Department:

- *Anchialine ponds subject to a management Program addressed in Policy ENV-1.10: Non-Degradation of Anchialine Ponds.*
- *Historic trails.*
- *Archaeological and historic sites subject to protection under HRS Chapter 6E.*
- *Enhanced Shoreline Setback.*

Policy ENV-1.9: Setback Buffer from Flood Corridor. To account for nature's unpredictability, any structure as defined in Chapter 27 Floodplain Management Code shall be in compliance with Section 27-18(d)(5) (Ordinance 07-169).

Policy ENV-1.10: Non-Degradation of Anchialine Ponds. Within the United States, these unique habitats are only found in Hawai`i. Anchialine shall be eligible for the Kona Treasures Fund for restoration and maintenance, subject to the preparation of a maintenance and water quality monitoring plan.

Policy ENV–1.13: Environmental Resource Management Education. A diversity of tools shall be sought to provide increased education and awareness on the part of our residents and visitors regarding the preservation of Kona's environment.

Discussion: The project will not adversely impact valuable coastal ecosystems because redevelopment of the site would result in a lower intensity of land use compared to the former resort. Low impact design and sustainability measures incorporated with new facilities would reduce storm water runoff, improve water quality, and reduce other land-based effects thereby improving shoreline conditions and the marine environment. Improvements would also reduce storm water runoff effects on Po‘o Hawai‘i. Educational programs implemented would enhance the resources present on the property by improving the understanding, management, and technical knowledge of natural, marine, and cultural resources present. Necessary mitigative measures to minimize project related effects have been identified in various sections, and these are predominantly associated with short-term construction activities.

There are no historic trails within the project site that would be affected. Archaeological surveys conducted for this project completed fieldwork and subsurface testing to identify significant historic resources present within the property in compliance with Section 6E, HRS. The resulting report documents existing archaeological resources, and the project should not have an adverse effect on historic properties. Restoration efforts of sites are already being implemented by KS, and these efforts would continue with the project by being integrated into

educational programs and activities. Mitigative measures proposed will further support protection and restoration of historic sites thru an archaeological monitoring plan and preservation plan.

Being located along the shoreline, the project site is located within the floodplain, and improvements will be subject to Chapter 27 of the *Hawai'i County Code*. Impacts from these hazards were discussed in this document and necessary measures would be incorporated into the design of facilities to minimize their susceptibility to damage. Design plans would also be coordinated with pertinent County agencies for review and approval. Coordination with the County will be conducted to interpret the specific boundaries of flood hazard areas. Therefore, the risk of potential damage from these flood hazards should be minimized by compliance with County requirements.

Objective ENV-2: Open Space Network. To develop a networked system of appropriate access to all significant open space resources that enhances opportunities for residents and visitors for recreational, educational, subsistence, or gathering purposes.

Discussion: Public access to the sandy beach along the southern half of the property would continue and be enhanced via a public pedestrian access path with vehicular parking being provided. Management of the site by KS would ensure that recreational viewing of the natural, cultural, and historical sites by visitors is conducted in a sensitive and culturally appropriate manner. Access for lineal and cultural descendants would also be supported to allow cultural practices to be conducted.

3. Cultural Resources

Objective CR-3: Preservation of Kanaka Maoli Culture and Island Values. Ensure that our Kanaka Maoli and island values and cultures are preserved and perpetuated.

Policy CR-3.1: Honor Kanaka Maoli culture and heritage. The Kanaka Maoli culture is the foundation of Hawai'i's living culture. We must ensure that the Kanaka Maoli people are supported and that this part of our culture is perpetuated. The success of this endeavor will ensure that the way of the Kanaka Maoli will guide our actions and behaviors in the years ahead.

Policy CR-3.2: Preserve and perpetuate our Hawaiian and island cultural values by celebrating our cultural diversity and island way of life. Our diversity likewise defines us. Ensuring that our cultural practices flourish through language, dance, song, and art is crucial to sustaining who we are as a people. We must protect and nurture all aspects of our diverse history, traditions and cultures.

Policy CR-3.3: Enable Kanaka Maoli and others to pursue traditional Kanaka Maoli lifestyles and practices. We must provide opportunities to those who want to pursue and perpetuate the way of the Kanaka Maoli.

Discussion: Redevelopment of the project site will support this objective and policies by providing educational programs and activities to help the general public understand the cultural values and significance of the historic sites on the property. KS has already established a program to restore historic properties on the project site and will continue to do so with other historic properties as part of educational programs implemented. Lineal and cultural descendants, along with cultural practitioners, would also have access to the natural and cultural resources on the property. Culturally related special events would also be conducted at the project site such as life celebrations, makahiki, and hoike events. All of these activities and programs support preserving Hawaiian culture, values, and traditions.

4. *Public Facilities, Infrastructure, and Services*

Objective PUB-4: Growth Management. To prioritize and locate growth-supporting infrastructure (water, sewer, drainage) to support the TODs and infill development and to minimize the environmental impacts of such growth.

Policy PUB-4.4: Sewer Priorities. In order to protect the nearshore water quality, the requirement to hookup to the County sewer system (HCC Section 21-5) shall be strictly enforced. The highest priority in expanding the sewer system within the Kona Urban Area shall be to service any shoreline properties that do not have access to a public sewer system and then to service lots within approximately 1 mile of the shoreline. Any new subdivision within 1 mile of shoreline within the Kona Urban Area shall either hookup to the public sewer system, or provide a private treatment system, and/or install dry sewers.

Policy PUB-4.6 Wastewater Reuse Area: Recognizing the limited drinking water supply in the Kona area, every effort should be taken to develop a feasible wastewater reclamation system for non-potable uses.

Discussion: Redevelopment of the Kahalu'u Ma Kai project site would result in a land use of lower intensity compared to the former resort, which will considerably decrease demands on infrastructure facilities as discussed in this document. The project will support the various policies associated with infrastructure facilities and services. Wastewater volume generated from project activities would be lower than under resort use. Typical daily wastewater flows generated would be collected and treated by the on-site wastewater system proposed, and larger flows from periodic large events would be processed by the private sewer system serving the area.

Objective PUB-6. Quality of Life. To foster a sense of community and health through the public realm such as gathering places, parks, pedestrian networks, and open spaces.

Policy PUB–6.4: Environment as a Public Realm and Classroom. For Kona, nature is the most culturally significant public realm as the setting for interaction, stewardship, and learning. The Open Space Network is the primary access point to nature and culture.

Discussion: The project will establish an educational complex that will support KS and public educational programs fostering a sense of community, health, and learning. The project will continue to support visitors to the property wanting to view and learn about the heiau and other cultural resources by providing a unique educational and cultural experience.

5. Energy

Objective ENGY-1. To provide a multi-prong framework, including standards, innovations, incentives, and education, to reduce the dependency on imported fossil fuels through energy efficiency and renewable energy generation.

Policy ENGY-1.5: Distributed Energy and Other Innovative Technology Support. Photovoltaic systems are typically used as distributed generation when connected to the electrical grid where they have the potential to sell excess energy back to the grid. This is an emerging technology with challenges for the utility to incorporate such systems into the grid. This policy is aspirational and expresses general support in whatever way possible (e.g., permit coordination, grants) to encourage further development in this endeavor.

Discussion: New facilities would be designed incorporating sustainability elements that will improve the efficient use of energy resources. Thus, the project should reduce the overall electrical demand as compared to the former resort use.

5.5 COUNTY SPECIAL MANAGEMENT AREA

The entire project site is located within the County's Special Management Area (SMA) and is therefore subject to the regulations prescribed under the County's Rule 9 (Special Management Area). Redevelopment of the site proposed under this project, including demolition of the hotel, requires a SMA Use Permit (Major) from the County Planning Commission.

The County's SMA process is intended to comply with the State's Coastal Zone Management (CZM) policies and regulations prescribed under Chapter 205A, HRS which originate from the Federal Coastal Zone Management Act (CZMA) of 1972. The State's CZM objectives and policies under Chapter 205A, HRS are incorporated within the County's SMA regulations.

The proposed project's consistency with applicable SMA objectives and policies, and pertinent review guidelines are discussed below.

A. Objectives:

1. *Provide coastal recreational opportunities accessible to the public.*
2. *Protect, preserve, and where desirable, restore those natural and man-made historic and pre-historic resources in the coastal zone management area that are significant in Hawaiian and American history and culture.*
3. *Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.*

4 Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

5. Provide public or private facilities and improvements important to the State's economy in suitable locations.

6. Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.

7. Stimulate public awareness, education, and participation in coastal management.

8. Protect beaches for public use and recreation.

B. Policies:

1. Recreational Resources:

b. Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by;

i. Protecting coastal resources uniquely suited for recreation activities that cannot be provided in other areas;

ii. Requiring replacement of coastal resources having significant recreational value, included but not limited to surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;

Discussion: The project will not adversely affect coastal resources with significant recreational value because redevelopment of the property will result in a lower intensity of land use increasing open space within the property. Low impact design and sustainability measures incorporated with new facilities would reduce storm water runoff and other land based effects thereby improving shoreline conditions and the marine environment. Therefore, the project will not require replacement of coastal resources having significant recreational value.

iii. Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;

iv. Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;

v. Ensuring public recreational use of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;

vi. Adopting water quality standards and regulating point and nonpoint sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;

Discussion: Public access to the sandy beach along the southern half of the property would continue and be enhanced via a public pedestrian access path with vehicular parking being provided. Management of the site by KS would ensure that recreational viewing of the natural, cultural, and historic sites by visitors is conducted

in a sensitive and culturally appropriate manner. Low impact design and sustainability measures incorporated with the new facilities and site redevelopment would reduce storm water runoff and other land based effects. This would improve water quality, shoreline conditions, and the marine environment.

2. *Historic Resources:*
   a. *Identify and analyze significant archaeological resources;*
   b. *Maximize information retention through preservation of remains and artifacts or salvage operations; and*
   c. *Support state goals for protection, restoration, interpretation, and display of historic resources.*

Discussion: As discussed in Chapters 3 and 4, archaeological surveys conducted for this project completed fieldwork and subsurface testing to identify significant historic resources present within the property. The resulting report documents existing archaeological resources, and the project should not have an adverse effect on historic properties. Restoration efforts for sites are already being implemented by KS, and these efforts would continue with the project by being integrated into educational programs and activities. Mitigative measures discussed in Chapter 4 will further support protection and restoration of historic sites thru an archaeological monitoring plan and preservation plan. Such efforts support information retention through preservation and support State goals for protection, restoration, interpretation, and display of historic resources.

3. *Scenic and Open Space Resources:*
   a. *Identify valued scenic resources in the coastal zone management area;*
   b. *Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;*
   c. *Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources.*

Discussion: Valued scenic resources in the project area were identified and addressed in this document. Scenic views identified were along Ali'i Drive, a lookout along Kamehameha III Road, and of the heiau within the project site. The project will improve scenic views with demolition of the KBR hotel. The architectural design of new facilities would be low scale and culturally appropriate. Redevelopment of the site would increase open space and allow for landscape restoration using native vegetation. These improvements would thus be visually compatible with the surrounding environment and not alter natural landforms. Open space along the shoreline would be retained with redevelopment as new facilities are located inland.

4. *Coastal Ecosystems:*
   a. *Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;*
   b. *Improve the technical basis for natural resource management;*
   c. *Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;*
   e. *Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.*

Discussion: The project will not adversely impact valuable coastal ecosystems because redevelopment of the site would result in a lower intensity land use. Low impact design and sustainability measures incorporated with new facilities would reduce storm water runoff, improve water quality, and reduce other land based effects thereby improving shoreline conditions and the marine environment. Educational programs would utilize the resources present on the property and improve the understanding, management, and technical knowledge of natural, marine, and cultural resources present.

5. *Economic uses;*
   a. *Concentrate coastal dependent development in appropriate areas;*
   b. *Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor industry facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and*
   c. *Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:*
      i. *Use of presently designated locations is not feasible;*
      ii. *Adverse environmental effects are minimized; and*
      iii. *The development is important to the State's economy.*

Discussion: These economic policies are pertinent to coastal dependent developments such as harbors, ports, and visitor industry facilities. Therefore, the project is not a coastal dependent development given the purpose for these policies. The property is located along the coastline, and was previously developed as a visitor facility for resort use under the KLH and KBR. Redevelopment of the project site into an educational complex and cultural center would result in a land use of lower intensity as compared to the prior resort use. Nevertheless, the presence of heiau and other cultural resources on the property were historically established due to the unique natural resources associated with the site and coastline. These resources continue to serve as an important reason for redeveloping the site and emphasize the

restoration and educational value associated with this project. As discussed in Chapter 4, the project should not have a significant impact on the environment, and will lessen runoff, reduce infrastructure demands, and allow for landscape restoration. Permitting redevelopment of the property would be appropriate because the facilities needed to support educational programs are tied to existing resources on the property. The project should not have adverse environmental effects, and the project is important to the State's economy, education, and cultural practices.

6. *Coastal hazards:*
   b. *Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint source pollution hazards.*
   c. *Ensure that developments comply with requirements of the Federal Flood Insurance Program;*

Discussion: Being located along the shoreline, the project site is subject to natural hazards such as hurricanes, tsunami, and flooding. Impacts from these hazards were discussed in this document and necessary measures would be incorporated into the design of facilities to minimize their susceptibility to damage. Design plans would also be coordinated with pertinent State and County agencies for review and approval. The tsunami evacuation zone designated at the project site extends to the area slightly inland (mauka) of Ali'i Drive. The moderately rising elevation mauka of the project site also creates safer areas for evacuation such as at the Keauhou Shopping Center. To minimize potential hurricane or tsunami damages to facilities, new buildings and structures would be designed and constructed in conformance with applicable building codes. Therefore, the risk of potential damage from natural hazards should be minimized, and be at no greater risk of damage than other existing development in the Kahalu'u and Keauhou areas. Construction and site improvements will require compliance with the County's floodplain management regulations, and coordination with the County will be conducted to interpret the specific boundaries of flood hazard areas. Therefore, the risk of potential damage from these flood hazards should be minimized by compliance with County requirements.

7. *Managing Development:*
   c. *Communicate the potential short- and long-term impacts of proposed significant coastal developments early in their life-cycle and in terms understandable to the general public to facilitate public participation in the planning and review process.*

Discussion: This document addresses the short and long-term impacts of project improvements, and its distribution during the public review process supports communication of information to the public. Other efforts made by KS have been to facilitate public participation and input on this project; including consultations

with lineal and cultural descendants, community organizations, and community meetings (open house).

8. *Public participation;*
   a. *Promote public involvement in coastal zone management processes;*
   b. *Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal issues, developments, and government activities; and*

Discussion: The publication and processing of this environmental document allows for information to be distributed to the public and for public participation to address comments and concerns associated with the project. The environmental assessment will also comply with this policy through its use in the submittal of a Special Management Area Use Permit for the proposed project. The processing of this application by the County Planning Department will involve consultation with review agencies, a public hearing held by the Planning Department, as well as the review and approval by the County Planning Commission to ensure the project's consistency with coastal management policies. As already discussed, KS has also made a concerted effort to contact affected stakeholders during the early consultation phase of this project.

9. *Beach protection;*
   a. *Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion.*

Discussion: New structures would be setback well inland from the shoreline. Generous open space would be present along the entire makai area of this property. Therefore, the project should not interfere with the natural shoreline processes.

10. *Marine resources;*
   a. *Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;*
   b. *Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;*
   d. *Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and*
   e. *Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.*

Discussion: The project would not involve use or development affecting marine or coastal resources. New facilities would be setback inland away from the shoreline. Management of the property by KS and educational programs conducted would support management of these resources. Educational programs would support the research, study, and better understanding of ocean processes and marine life within the property. Such activities would also support potential development of new or innovative technologies or practices for protecting marine and coastal resources. BMPs will protect these resources during the demolition phase of the project.

C. Review Guidelines

a) All development in the special management area shall be subject to reasonable terms and conditions set by the council to ensure that:

1) Adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas and natural reserves is provided to the extent consistent with sound conservation principles;

2) Adequate and properly located public recreation areas and wildlife preserves are reserved;

3) Provisions are made for solid and liquid waste treatment, disposition and management which will minimize adverse effects upon special management area resources; and

4) Alterations to existing land forms and vegetation; except crops, and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation or failure in the event of earthquake.

Discussion: The Applicant (KS) is open to reasonable terms and conditions to allow the project to be consistent with applicable SMA policies. Based upon the assessment results, no unique terms or conditions should be required for this project. Redevelopment of the site would result in a land use of lower intensity as compared to the prior resort use. The project should not have a significant impact on the environment, and will improve effects associated with the site, such as lessening runoff, reducing infrastructure demands, and allowing for landscape restoration. Public access to the sandy beach along the southern half of the property would continue and be enhanced via a public pedestrian access path and accessory vehicular parking. Management of the site by KS would ensure that recreational viewing of the natural, cultural, and historical sites by visitors is conducted in a sensitive and culturally appropriate manner. Solid waste and wastewater would be appropriately disposed of and should have minimal effect on area resources. BMPs would be implemented by the contractor during construction activities to minimize short-term effects in compliance with permit conditions. Redevelopment of the site would increase open space and allow for landscape restoration using native vegetation. These improvements would be visually compatible with the surrounding environment and not alter natural landforms.

b) No development shall be approved unless the council has first found that:

1) The development will not have any substantial, adverse environmental or ecological effect except as such adverse effect is minimized to the extent practicable and clearly outweighed by public health and safety, or compelling public interest. Such adverse effect shall include, but not be limited to, the potential cumulative impact of individual developments, each one of which taken in itself might not have a substantial adverse effect and the elimination of planning options;

2) The development is consistent with the objectives and policies set forth in Section 25-3.1 and area guidelines contained in HRS Section 205A-26;

3) The development is consistent with the county general plan, development plans and zoning. Such a finding of consistency does not preclude concurrent processing where a development plan amendment or zone change may also be required.

Discussion: The project should not have any substantial adverse environmental or ecological impact based upon the assessment results addressed in this document. Necessary mitigative measures to minimize project related effects have been identified in various sections, and these are predominantly associated with short-term construction activities. This assessment also includes evaluating the potential cumulative impact from this project on the environment. The project would be consistent with the pertinent SMA objectives and policies as previously addressed. Proposed improvements would also be consistent with the County's land use plans and policies.

c) The council shall seek to minimize, where reasonable:

1) Dredging, filling or otherwise altering any bay, estuary, salt marsh, river mouth, slough or lagoon;

2) Any development which would reduce the size of any beach or other area usable for public recreation;

3) Any development which would reduce or impose restrictions upon public access to tidal and submerged lands, beaches, portions of rivers and streams within the special management area and the mean high tide line where there is no beach;

4) Any development which would substantially interfere with or detract from the line of sight toward the sea from the state highway nearest the coast; and

5) Any development which would adversely affect water quality, existing areas of open water free of visible structures, existing and potential fisheries and fishing grounds, wildlife habitats, or potential or existing agricultural uses of land.

Discussion: The project would not significantly impact the various factors identified under this review guideline, and no unique measures or conditions should be required. Project improvements would have no effect on: 1) the dredging, filling, or altering of any bay, estuary, salt marsh, river mouth, slough, or lagoon; 2) reducing the size of any beach or area used for public recreation; 3) reducing access or imposing restrictions on public access to tidal and submerged lands, beaches, rivers

and streams; and 4) fisheries and fishing grounds, wildlife habitats, and existing agricultural uses of land. Redevelopment of the site would result in a land use of lower intensity as compared to the prior resort use, will have fewer effects on the natural environment, and will overall result in a net improvement with regard to environmental impacts and natural resources.

5.6 COUNTY ZONING REGULATIONS

Permitted land uses and activities under the County's jurisdiction are prescribed under Chapter 25, Zoning, of the *Hawai'i County Code*, as amended (County, June 2005). The project site is zoned V-.75, Resort-Hotel District, and Figure 5.3 shows the current zoning for the project site and surrounding areas. This section discusses the project's conformance and consistency with the County's zoning code. Overall, the project would be consistent with applicable provisions of the zoning code related to the V-.75, Resort-Hotel District.

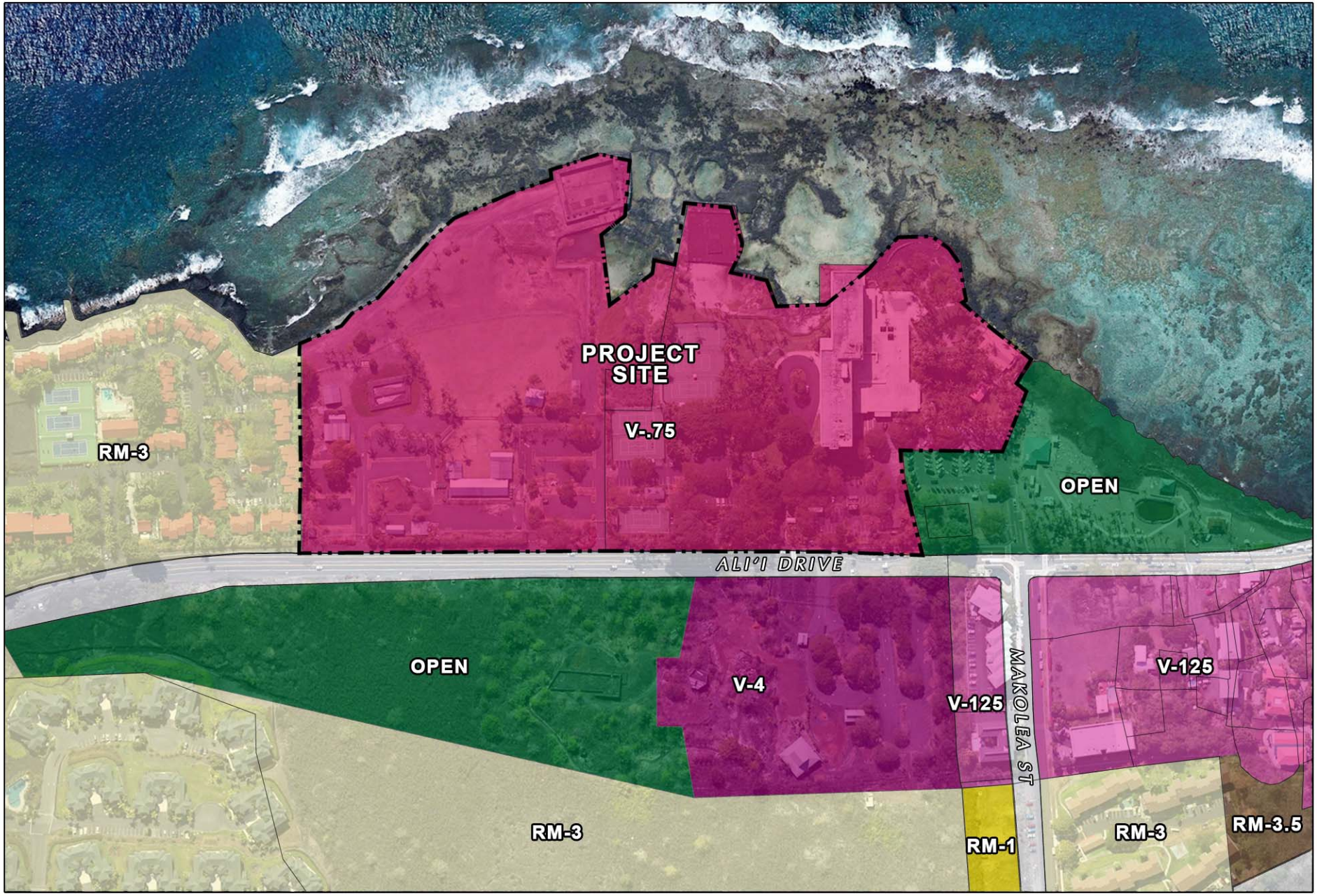
5.6.1 Consistency with Zoning District Permitted Uses

Under the V-.75, Resort-Hotel District for the project site, the applicable maximum density is 750 square feet of land area for each dwelling unit or separate rentable unit. The County's Resort-Hotel zoning district (V) applies to areas to accommodate the needs and desires of visitors, tourists, and transient guests. It applies to specific areas where public roads and public utilities are available or where suitable alternate private facilities are assured (County, 2005).

Permitted uses within this zoning district include: 1) museums; 2) meeting facilities; and possibly 3) community buildings. Due to the unique characteristics of this project, which will redevelop a former resort site to an educational complex, the proposed use should meet one or more of these three permitted uses within the V-.75 zoning district.

Consultation with the County PD indicated that they would review the details associated with this project for consistency with the underlying resort-hotel zoning district. The redeveloped use should retain some components of a "visitor use" to support the existing Resort-Hotel zoning district. Therefore, subject to County PD review, the project should be consistent with the V-.75 zoning district falling under one of the three permitted uses. Definitions for two of the uses prescribed under Section 25-1-5 are provided below. There is no definition for "museums" specified under this section.

1. "Meeting facility" is defined as a permanent facility for nonprofit recreational, social or multi-purpose use, which has no overnight accommodations, and which may be for organizations operating on a membership basis for the promotion of members' mutual interests or may be primarily intended for community purposes. Typical uses include private clubs, union halls, community centers, and student centers.



LEGEND

- Open Districts
- RM-1 - Multiple-Family Residential Districts
- RM-3 - Multiple-Family Residential Districts
- RM-3.5 - Multiple-Family Residential Districts
- V-.75 - Resort-Hotel Districts
- V-125 - Resort-Hotel Districts
- V-4 - Resort-Hotel Districts

KAHALU'U MA KAI

Figure 5.3 - County Zoning Districts Map

Kahalu'u, Hawai'i

0 175 350 FEET

KAMEHAMEHA SCHOOLS®

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2. "Community building" means a public or privately-owned building for civic, social, educational, cultural, and recreational activities which is not operated primarily for financial gain.

The "museum" definition would be appropriate because the entire property serves as a cultural and archaeological resource that will be enhanced and restored to the benefit KS educational programs. The property and its cultural and natural resources also support educating the broader community as evident by existing programs (Kia'i 'Āina Kualoloa and Puana Ka 'Ike), and finally visitors to the site through the Heritage Center and associated programs.

The "meeting facility" use would also be appropriate for this project because the redeveloped site would be used for non-profit social or multi-purpose use (educational and cultural). No overnight accommodations in the form of visitor units are included under the project. Although overnight camping would be conducted, this would occur with students sleeping as a group in an elevated or slab-on-grade wood structure reflecting the 1800's ranch-style sleeping hales. A pavilion could be used as a flexible space if needed.

The "community building" use would similarly be appropriate because the project would be a privately-owned facility used for educational and cultural activities that is not primarily operated for financial gain. The Heritage Center would serve visitors to the site to allow viewing of the heiau and other cultural resources, and to learn more about the property, the history of the region, and its cultural resources. Recreational activities would continue to be supported by a pedestrian access with parking lot on the southern end to allow public access to the south beach area for activities such as sun bathing, shoreline fishing, or other activities.

5.5.2 Consistency with Development Standards

The County's Resort-Hotel District development standards are specified under Chapter 25, Division 9 of the zoning code, and the project's consistency with these standards is summarized.

1. Height Limit. The height limit is 45 feet, except in the Kahalu'u Bay area which is 90 feet.
   Discussion: New facilities proposed would be well within the 90-foot height limit for the project site, along with the 45-foot height limit for other areas under this zoning district.
2. Minimum Building Site Area. The minimum building site in this district is 15,000 square feet.
   Discussion: The property meets this requirement because the project site totals 22.73 acres in area.
3. Minimum Building Site Average Width. Each building site in this district shall have a minimum average width of 90 feet.
   Discussion: The property meets this requirement with over 400 feet in width at its narrowest section.

4. Minimum Yards. The minimum yards this district are as follows: 1) Front and rear yards, 20 feet; and 2) side yards, 8 feet for one story, and an additional 2 feet for each additional story.

   Discussion: New facilities constructed would meet these minimum yard setback distances. Only the present Kalani Kai building would not meet the 20-foot rear yard requirement because it is existing, and should be considered an existing non-conforming use.

5. Landscaping. Landscaping needs to be provided on a minimum of 20 percent of the total land area, except for lots containing only one single-family dwelling and accessory buildings. Parking areas shall not be included within the area required for landscaping on any building site.

   Discussion: Landscaping would be provided for well over 20 percent of the total property with much of it consisting of grassed open space areas supporting educational activities.

6. Off-Street Parking. Off-street parking and loading requirements are discussed in Section 25-4.51 of the County's zoning code.

   Discussion: It was estimated that about 96 off-street parking stalls would be required for the project using the County's requirements. About 108 parking stalls are planned for the site, which is sufficient to meet the minimum parking requirements. The design phase of the project will develop final floor areas for facilities and calculate the required off-street parking and loading requirements. Design plans and parking requirements would be coordinated with the County PD for review and approval.

CHAPTER 6
CONSULTED AGENCIES AND ORGANIZATIONS

Consultation with various government agencies and the community has been conducted for this project during development of the conceptual redevelopment plan and as part of the pre-assessment consultation process in preparing this document. KS has conducted numerous meetings with lineal and cultural descendants, community organizations, and residents to discuss the project and preliminary conceptual plans. Solicitation letters were also distributed to several agencies as part of pre-assessment consultation to obtain their input and comments on the project to identify issues that should be addressed. Finally, KS held two community meetings at the Sheraton Kona Resort at Keauhou Bay on October 17 and 18, 2013 to brief the public on the project and solicit input. These consultation efforts are discussed in this Chapter, and copies of comment letters received from the pre-assessment consultation phase are included in Appendix A of this document

6.1 PRE-ASSESSMENT CONSULTATION

Consultation with various government agencies and community organization was undertaken to obtain information on agency requirements and potential issues so that they could be addressed in this Draft EA. Consultation involved distributing a pre-assessment consultation letter with supporting documentation to various parties requesting their written comments. A listing of those parties consulted is below and those providing written responses have been identified with a "»" symbol. Copies of written comments received and responses to these comments are included in Appendix A.

<u>Federal Agencies</u>

U.S. Department of Army, Honolulu District, Corps of Engineers
» Regulatory Branch
» U.S. Department of Interior, Fish and Wildlife Services
U.S. Department of Agriculture, Natural Resources Conservation Service
U.S. Department of Homeland Security, Coast Guard, District 14
U.S. Environmental Protection Agency, Region 9
U.S. National Oceanic Atmospheric Administration, National Marine Fisheries Service

<u>State of Hawai‘i</u>

» Department of Accounting and General Services
Department of Business, Economic Development and Tourism (DBEDT)
DBEDT, Director
DBEDT, Land Use Commission
» DBEDT, Office of Planning
» Department of Defense
Department of Education

State of Hawai‘i (continued)

Department of Health (DOH)
DOH, Director
» DOH, Environmental Health Program, Hawai‘i District
» DOH, Environmental Management Division, Clean Air Branch
» DOH, Environmental Management Division, Clean Water Branch
» DOH, Environmental Management Division, Wastewater Branch
» DOH, Environmental Planning Office
Department of Land and Natural Resources (DLNR)
DLNR, Chairperson
DLNR, Commission on Water Resource Management
DLNR, Division of Aquatic Resources
DLNR, Division of Conservation and Resources Enforcement
DLNR, Division of Forestry and Wildlife
» DLNR, Engineering Division
DLNR, Hawai‘i Island Burial Council
» DLNR, Land Division
» DLNR, Office of Conservation and Coastal Lands
DLNR, State Historic Preservation Division
Department of Transportation (DOT)
» DOT, Director
DOT, Hawai‘i District Office
Office of Hawaiian Affairs

County of Hawai‘i

Office of the Mayor
Civil Defense Agency
Department of Environmental Management (DEM)
DEM, Director
» DEM, Solid Waste Division
DEM, Wastewater Division
» Department of Parks and Recreation
Department of Public Works (DPW)
DPW, Director
DPW, Building Division
» DPW, Engineering Division
DPW, Traffic Division
» Department of Water Supply
Hawai‘i Fire Department
» Hawai‘i Police Department
Mass Transit Agency

County of Hawaiʻi (continued)

Planning Department (PD)
» PD, Director
PD, Kona Community Development Plan Action Committee
PD, Cultural Resources Commission

Utilities, Elected Officials, and Organizations

» Hawaiian Telcom
Hawaiian Electric Light Company

Senator Josh Green, 3rd Senate District
Representative Denny Coffman, 5th House District
Councilmember Dru Mamo Kanuha, County Council District 7

Daughters of Hawaiʻi
Ms. Barbara Nobriga
Mr. Scott Seymour
Edith Kanakaʻole Foundation
Ehunui Kaimalino
Historic Hawaiʻi Foundation
Keauhou Canoe Club
Keauhou-Kona Surf and Racquet Club, Board of Directors Chair
» Kohala Center
Kona Hawaiian Civic Club
Mr. Maurice Kahawaii
Mr. Aka DeMesa
Na Kālai Waʻa
Royal Order of Kamehameha, Moku O Kona
Mr. Alika Desha
Mr. Russell Paio
Mr. Ralph Alapai
Ms. Halani Berard
» Ms. Christine Epenesa (Note: Comment letter received stemming from open house meeting)
Mr. Mitchell Fujisaka
Mr. Kalani Hamm
Mr. Floyd Kahalioumi
Ms. Velma Kauhi
Ms. Lily Kong
Mr. Mike Matsukawa
Mr. Charles Nahale
Ms. Clarissa Yamamoto

6.2 CONSULTATION WITH EDUCATIONAL AND COMMUNITY ORGANIZATIONS

KS conducted a series of meetings with several community organizations and educational partners from August 2012 through April 2014. Over 47 informal consultation meetings with these stakeholders were conducted by KS, and these consultations included briefings with County representatives. For several stakeholders (e.g. lineal and cultural descendants), multiple meetings were conducted to first introduce them to the project early in the planning process (2012-2013 timeframe) and then later to update them on the project status and conceptual plans (2013 to 2014 timeframe).

Meetings consisted of informal discussions with representatives along with presentations to organizations. These meetings generally varied from small group discussions with a handful of representatives to larger groups of about 20 to 25 persons. Meetings were held with various types of organizations that included: 1) lineal and cultural descendants; 2) native Hawaiian organizations such as the Royal Order of Kamehameha and Daughters of Hawai‘i; 3) residents of surrounding developments such as the Keauhou Surf and Racquet Club; 4) community organizations such as The Kohala Center; and 5) other groups, such as a presentation to the West Hawai‘i Association of Realtors at their membership meeting. These meetings allowed KS to brief participants on the project, discuss preliminary plan concepts being considered, and obtain their general comments, suggestions, and questions.

Many meetings were also held with KS educational partners that included the University of Hawai‘i at Hilo; University of Hawai‘i, Hawai‘i Community College; State Department of Education, West Hawai‘i Complex representatives such as principals, teachers, and administration personnel; and KS Cultural Council and KS Alumni Association and Parents. These meetings allowed KS to introduce the project, discuss conceptual plans, and obtain important feedback on educational programming opportunities. This information was used in the development of program requirements, site plan alternatives, and eventually the proposed conceptual site plan.

6.3 PUBLIC INFORMATIONAL MEETINGS

KS hosted two public community meetings to discuss the status of the project, the planned vision for the property, preliminary plan concepts, and to obtain questions and comments from the public. These meetings were held over a two-day period from October 17th to 18th, 2013. They were held at the Sheraton Kona Resort and Spa at Keauhou Bay, and Exhibit 6.1 shows the flyer distributed to notify the public. Notice of these community meetings were also placed in the October 10, 2013 edition of the West Hawai‘i Today.

About 100 persons attended the first community meeting held Thursday evening. About 65 persons attended the second community meeting held Friday morning. Appendix A includes a copy of the sign-in sheets from these meetings. Also included is a map identifying where participants from the first meeting came from. Attendees were asked to place a sticker on an aerial map generally indicating from what area they reside. Information received was used in the development of program requirements and project site plan alternatives.

Exhibit 6.1 KS Open House Meetings Flyer

CHAPTER 7
FINDINGS AND ANTICIPATED DETERMINATION

To determine whether a proposed action may have a significant effect on the environment, the Approving Agency (County Planning Department) needs to consider every phase of the action, the expected primary and secondary consequences, cumulative effect, and the short- and long-term effects. The agency's review and evaluation of the proposed action's effect on the environment would result in a determination of whether: 1) the action would have a significant effect on the environment, and an Environmental Impact Statement Preparation Notice should be issued, or 2) the action would not have a significant effect warranting a Finding of No Significant Impact.

This chapter addresses the anticipated determination based upon the evaluation criteria prescribed for the County Approving Agency. A Finding of No Significant Impact (FONSI) determination is presently anticipated for this project.

7.1 ANTICIPATED DETERMINATION

A FONSI determination should be warranted for the Kahalu‘u Ma Kai Project based upon the assessment results and information provided in this document. The findings supporting this anticipated determination are based upon discussion of the project's effect on the environment in relation to the 13 Significance Criteria prescribed under the State Department of Health's Administrative Rules Title 11, Chapter 200.

The results of the assessments conducted have determined that the proposed project should not have a significant impact on the surrounding environment. Redevelopment of the project site and changing it from resort use to an educational complex supporting KS educational programs would involve a lower intensity of development. Sustainable and low impact design measures planned to be incorporated would reduce impacts such as storm water runoff and subsequently improve surrounding natural resources. The lower intensity of use planned would also reduce demands on existing infrastructure facilities.

7.2 FINDINGS

1. Involve an irrevocable commitment to loss or destruction of any natural or cultural resource.

The proposed project would not result in the irrevocable commitment to loss or destruction of any natural or cultural resource. Existing cultural resources, such as the heiau, would be protected, and managed access for visitors would ensure cultural sensitivity would be maintained while they are visited. Low impact design and sustainability measures incorporated into the design of facilities and site development would reduce storm water runoff and other land based effects on natural resources, such as the tide pools. Project improvements should thus not have a significant negative impact on natural or cultural resources present on the property, and appropriate best management

practices and mitigative measures will be implemented during construction activities as discussed in this document.

2. Curtails the range of beneficial uses of the environment.

The project would not curtail the range of beneficial uses associated with this property. The project will increase the range of beneficial uses of the environment through educational programs and activities that would support landscape restoration of the site, improved maintenance and care for resources, and increased education about the natural and cultural resources present. Visitors would continue to be able to visit the site to view and learn about the cultural resources, and public access will be provided to the sandy beach at Mākole‘ā Cove.

3. Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders.

The improvements should not conflict with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS. A discussion of the project's consistency with applicable guidelines was provided in Chapter 5 of this document.

4. Substantially affects the economic welfare, social welfare and cultural practices of the community or state.

The project will provide minor short-term economic benefits in the form of construction jobs, income, and additional tax revenue to the State. The change from resort use to educational and cultural use of the property would reduce the amount of property tax revenue received by the County. However, this decrease would be a minor economic effect in comparison to total property tax revenues collected island wide. Social benefits would include increased educational opportunities for students, island residents, and visitors. These changes in use of the property would have a beneficial impact within the area, and will not change the overall character of the surrounding predominantly resort-oriented community. This project is expected to have a beneficial effect on Hawaiian culture by creating opportunities for increased indigenous practices associated with the heiau. Consultation with lineal and cultural descendants showed that removal of the KBR hotel and its impact on Kapuanoni Heiau were viewed as an important step in restoring the cultural importance of this property.

5. Substantially affects public health.

The project would not substantially affect public health as discussed in various sections of this document. Minimal short-term effects on public health from construction activities are anticipated relative to various health issues such as air quality and noise. Short-term construction-related effects would be mitigated by complying with pertinent State or County regulations and conditions of ministerial permits obtained. Best management practices will also be implemented as part of construction activities.

6. Involves substantial secondary impacts, such as population changes or effects on public facilities.

The project should not have any substantial secondary impacts on the social environment, infrastructure facilities, and public facilities. Improvements do not involve adding residential housing or visitor accommodation units that may generate population changes and increase demands on public facilities. Redevelopment of the project site would instead reduce the demand placed on existing infrastructure facilities. The project would not contribute to in-migration of residents to the island.

7. Involves a substantial degradation of environmental quality.

The project would not contribute to a substantial degradation to the quality of the surrounding environment. As discussed in several sections of this document, the redevelopment of the property would result in a lower intensity of land use thereby reducing demands on existing infrastructure facilities. Low impact design and sustainability measures incorporated into the design of facilities and the site would also reduce storm water runoff and other land based effects on natural resources, such as the tide pools and ocean. Appropriate mitigative measures will be implemented to address construction-related impacts on the environment in coordination with appropriate government agencies. Therefore, the project would result in an improvement to the environmental quality of natural resources present within the property and in the surrounding area.

8. Individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions.

This project would not have significant cumulative effect on the environment as discussed in Chapter 4 nor does it commit to larger actions. Redevelopment of the property would result in a lower intensity of land use and all phases of the project were included in this document.

9. Substantially affect a rare, threatened, or endangered species, or its habitat.

The project would not have a substantial adverse effect on endangered, threatened, or rare species or resources present on the property. The endangered loulu palm found on the property would be preserved and potentially serve as a source for supporting increased population of that palm. The one loulu palm situated close to the KBR hotel would be relocated following appropriate measures to minimize damage to it from demolition activities. Redevelopment of the site would not substantially impact endangered marine mammals, and educational programs implemented would support increased education and understanding of these species to support its protection.

10. Detrimentally affect air or water quality or ambient noise levels.

The project should not have detrimentally significant impacts on air, water quality, or ambient noise levels as discussed in this document. Impacts associated with these factors would be limited to short-term construction activities. However, such impacts are expected to be minor, will be monitored to minimize nuisance effects (e.g. odors), and include mitigative measures such as best management practices. Construction activities would also be subject to applicable State and County regulations and permit conditions.

11. Affect or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.

Being located along the shoreline, the project site is subject to certain natural hazards such as hurricane, tsunami, and flooding. Impacts from these hazards were discussed in this document and necessary measures would be incorporated into the design of facilities to minimize their susceptibility to damage. Design plans would also be coordinated with pertinent State and County agencies for review and approval.

The existing heiau located along the shoreline could receive some damage to walls predominantly from wave forces from a hurricane or tsunami. Any damages to the heiau would be repaired by KS and such work could be incorporated as part of educational programming. The tsunami evacuation zone designated at the project site extends to the area slightly inland (mauka) of Ali'i Drive. The moderately rising elevation proceeding inland of the project site also creates safer areas higher up for evacuation such as at the Keauhou Shopping Center.

To minimize potential hurricane or tsunami damages to facilities, new buildings and structures would be designed and constructed in conformance to applicable building codes. Therefore, the risk of potential damage from high winds, large waves, and storm surge should be minimized, and should be at no greater risk of damage than other residential, commercial, and resort buildings in the Kahalu'u and Keauhou areas.

Several new facilities would be unavoidably located within flood areas that cover the majority of the property. Construction and site improvements will require compliance with the County's floodplain management regulations, and coordination with the County will be conducted to interpret the specific boundaries of flood hazard areas. Therefore, the risk of potential damage from these flood hazards should be minimized by compliance with County requirements.

12. Substantially affect scenic vistas and view planes identified in county or state plans or studies.

Redevelopment of the project site would improve scenic views of the coastline and scenic resources as discussed in this document. Demolition of the large seven-story KBR hotel would remove views of that structure in relation to the surrounding low-scale and natural resources in the background.

13. Require substantial energy consumption.

The project will not require substantial energy consumption or place increased demands on the capacity of supporting electrical facilities because redevelopment of the site would result in a lower intensity of use.

CHAPTER 8
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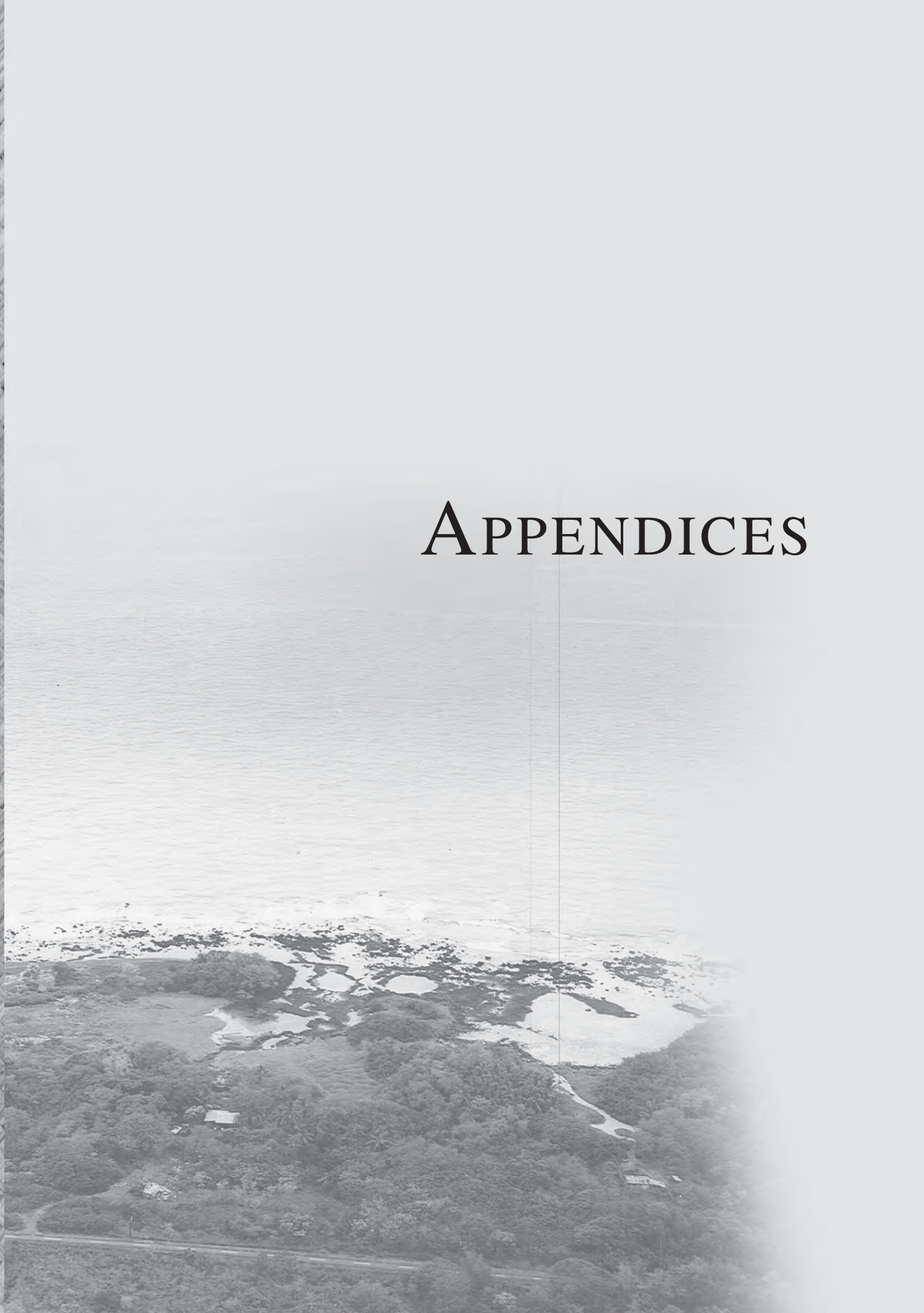
Appendices



Appendix A

PRE-ASSESSMENT CONSULTATION

DEPARTMENT OF THE ARMY
HONOLULU DISTRICT, U.S. ARMY CORPS OF ENGINEERS
FORT SHAFTER, HAWAII 96858-5440

October 17, 2013

Regulatory Branch

File No. POH-2013-00038

Helbert Hastert & Fee
Attn: Mr. Ronald Sato
2024 North King Street, Suite 200
Honolulu, Hawaii 96819

PERMIT REQUIRED

Dear Mr. Sato:

This responds to your October 10, 2013 email for the proposed Kamehameha Schools Kahaluu Ma Kai project at coordinates 19.576382°N latitude, 155.967158°W longitude in (Keauhou) Kailua-Kona, Hawaii Isle, Hawaii (TMKs: (3) 7-8-013: 002, 013, 042, and 043). We have assigned the project the reference number **POH-2013-00038**. Please cite the reference number in any future correspondence concerning this project.

The U.S. Army Corps of Engineers (the Corps) has jurisdiction over certain waterbodies pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404). Section 10 requires that a DA permit be obtained for certain structures or work in or affecting navigable waters of the United States (U.S.), prior to conducting the work (33 U.S.C. 403). Section 404 requires that a DA permit be obtained for the placement or discharge of dredged and/or fill material into waters of the U.S., including wetlands, prior to any discharge (33 U.S.C. 1344). For tidally influenced waters, in the absence of adjacent wetlands, the shoreward limit of the Corps' jurisdiction extends to the High Tide Line, which in Hawai'i may be approximated by reference to the Mean Higher High Water Mark (MHWWM). For non-tidal waters, the lateral limits of the Corps' jurisdiction extend to the Ordinary High Water Mark (OHWM) or the approved delineated boundary of any adjacent wetlands.

The Pacific Ocean at this location is considered a navigable water and a water of the U.S. Based on the conceptual information provided, it appears the proposed project would involve work within and/or over navigable waters of the U.S., and may result in the placement and/or discharge of dredged and/or fill material into waters of the U.S. below the OHWM; therefore, **a DA permit is required**. This permit determination may be revised provided additional information is submitted for consideration.

This permit determination does not relieve you of the responsibility to obtain any other permits, licenses, or approvals that may be required under County, State, or Federal law for your proposed work.

Should you have any questions regarding this permit determination, please contact Ms. Joy Anamizu of this office at (808) 835-4308, by fax (808) 835-4126 or by e-mail at joy.n.anamizu@usace.army.mil. Please refer to **File Number POH-2013-00038** in all future communications with this office regarding this project or other projects at any of the locations.

Thank you for giving us the opportunity to review this proposal and for your cooperation with our regulatory program. Please be advised you can provide comments on your experience with the Honolulu District Regulatory Branch by accessing our web-based customer survey form at http://per2.nwp.usace.army.mil/survey.html

Sincerely,

George P. Young, P.E.
Chief, Regulatory Branch

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May 27, 2014

Mr. George P. Young, P.E., Chief
Regulatory Branch
Corps of Engineers
U.S. Department of the Army, Honolulu District
Fort Shafter, Hawai'i 96858-5440

Dear Mr. Young:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043
POH-2013-00038

Thank you for your letter of October 17, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

Demolition of the existing hotel building of the former Keauhou Beach Resort would involve some work over and within existing tide pools fronting the structure which has been determined to be navigable waters of the U.S. Therefore, we acknowledge your determination that a Department of Army (DA) Permit would be required for this hotel demolition. Redevelopment of the remainder of the property would not involve construction work within navigable waters.

We did have two meetings with your regulatory branch staff to discuss the project, solicit initial comments, and better assess permit requirements. Based upon those discussions, a delineation of wetlands and other waters of the U.S. within the property was conducted by another member of the project's design team, and the resulting report was submitted to your department for review. We will continue coordinating with your staff to address requirements needed for the permit application.

The Draft EA will address the applicability of a DA Permit to the project. We appreciate your comments, and a copy of the Draft EA will be submitted to the COE for review and comments.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
Tel. 808.545.2055 • Fax 808.545.2050 • www.hhf.com • e-mail: info@hhf.com

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
2014-SL-0005
2014-TA-0013

NOV 0 6 2013

Mr. Ronald. A Sato
Helber, Hastert & Fee
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Subject: Species list for the Kamehameha Schools Kahaluu Ma Kai Project, Keauhou, Hawaii

Dear Mr. Sato:

We are in receipt of your letters dated October 5 and October 10, 2013, requesting technical assistance and a species list for establishment of a cultural educational complex on Kamehameha Schools land in Keauhou, Hawaii. We are providing a response to both requests in one letter. The project, known as Kahaluu Ma Kai, will require a Department of Army Nationwide Permit (POH-2013-00038). This response is in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*), the National Environmental Policy Act (NEPA) of 1969 [42 U.S.C. 4321 *et seq.*; 83 Stat. 852], as amended, the Fish and Wildlife Coordination Act (FWCA) of 1934 [16 U.S.C. 661 *et seq.*; 48 Stat. 401], as amended, and other authorities mandating review for impacts on trust resources.

The project site consists of 22.73 acres of shoreline and was formerly the site of the Kona Lagoon Hotel and the recently closed Keauhou Beach Resort. Kamehameha Schools is proposing to redevelop the project site and change the property's primary use from resort to a cultural educational complex. The portion of the existing Keauhou Beach Resort hotel will be demolished.

Species List

Based on our databases, including data compiled by the Hawaii Biodiversity and Mapping Program, we find that the threatened green sea turtle (*Chelonia mydas*) may use the proposed project site for basking or nesting. There is no designated critical habitat within the proposed project area.

TAKE PRIDE® IN AMERICA

Sea turtles come ashore to nest on beaches from May through September, peaking in June and July. Optimal nesting habitat is a dark beach free of barriers that restrict movement. Nesting turtles may be deterred from approaching or laying successful nests on lighted or disturbed beaches. If they do come ashore, they may become disoriented by artificial lighting, leading to exhaustion and placement of a nest in an inappropriate location (such as at or below the high tide line where nests are unlikely to be successful). Hatchlings that emerge from unprotected nests may be disoriented by artificial lighting, move inland instead of toward the ocean, and not make it successfully to the ocean.

The U.S. Fish and Wildlife Service (Service) consults on sea turtles and their use of terrestrial habitats (beaches where nesting and/or basking is known to occur) and the National Marine Fisheries Service consults on sea turtles and their use of off-shore and open ocean habitats. To help you minimize potential impacts to sea turtles in terrestrial habitats, we are providing you the following avoidance and minimization measures. Please note that implementation of these measures does not ensure that impacts to listed species can be avoided, and further coordination with our office on compliance with the ESA may be required.

- A qualified biologist should conduct a visual survey of the project site just prior to commencement or resumption of construction activities to ensure that no green sea turtles or nests are present.
- If green sea turtles are found within the project area, or approach the project area while construction is occurring, all potentially disruptive activities (including human activity, mechanical or construction disturbance) should be stopped until the animal(s) voluntarily leave the area.
- Construction should happen during daytime hours.

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.

General Comments

Terrestrial, aquatic, and marine fish and wildlife resources occur immediately adjacent to the proposed terrestrial and submerged project areas. Particular attention should be given to potential construction and vessel-related impacts to sea turtles, water quality, seabirds and migratory birds, coral reefs, macroalgae beds, and rare and native species and their habitats. The direct, indirect, and cumulative effects of potential impacts over time should be discussed in the Environmental Assessment. Measures to avoid unnecessary impacts and minimize unavoidable impacts should also be addressed including the use of silt curtains to contain suspended sediments. Impacts that cannot be avoided or minimized should be mitigated.

Enclosed is our Best Management Practices (BMP) for construction work in aquatic environments. These BMPs will help to reduce erosion, sedimentation, and other adverse impacts to aquatic resources. As project plans are developed, the Service's Aquatics Ecosystem Conservation Program should be included in planning conversations in order to assure that the

applicant is in compliance with regulatory requirements for their U.S. Army Corps of Engineers permit.

If you have questions regarding the species list please contact Rachel Rounds (phone: 808-792-9400, email: Rachel_Rounds@fws.gov). If you have questions regarding our comments for marine resources please contact Nadiera Sukhraj (phone: 808-792-9400; email: Nadiera_Sukhraj@fws.gov).

Sincerely,

for

Loyal Mehrhoff
Field Supervisor

U.S. Fish and Wildlife Service
Recommended Standard Best Management Practices

The U.S. Fish and Wildlife Service recommends that the measures below be incorporated into projects to minimize the degradation of water quality and minimize the impacts to fish and wildlife resources.

1. Turbidity and siltation from project-related work shall be minimized and contained within the vicinity of the site through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions.

2. Dredging/filling in the marine environment shall be scheduled to avoid coral spawning and recruitment periods and sea turtle nesting and hatching periods.

3. Dredging and filling in the marine/aquatic environment shall be designed to avoid or minimize the loss special aquatic site habitat (beaches, coral reefs, wetlands, etc.) and the function of such habitat shall be replaced.

4. All project-related materials and equipment (dredges, barges, backhoes, etc.) to be placed in the water shall be cleaned of pollutants prior to use.

5. No project-related materials (fill, revetment rock, pipe, etc.) should be stockpiled in the water (intertidal zones, reef flats, stream channels, wetlands, etc.) or on beach habitats.

6. All debris removed from the marine/aquatic environment shall be disposed of at an approved upland or ocean dumping site.

7. No contamination (trash or debris disposal, non-native species introductions, attraction of non-native pests, etc.) of adjacent habitats (reef flats, channels, open ocean, stream channels, wetlands, beaches, forests, etc.) shall result from project-related activities. This shall be accomplished by implementing a litter-control plan and developing a Hazard Analysis and Critical Control Point Plan (HACCP – see http://www.haccp-nrm.org/Wizard/default.asp) to prevent attraction and introduction of non-native species.

8. Fueling of project-related vehicles and equipment should take place away from the water and a contingency plan to control petroleum products accidentally spilled during the project shall be developed. Absorbent pads and containment booms shall be stored on-site, if appropriate, to facilitate the clean-up of accidental petroleum releases.

9. Any under-layer fills used in the project shall be protected from erosion with stones (or core-loc units) as soon after placement as practicable.

10. Any soil exposed near water as part of the project shall be protected from erosion (with plastic sheeting, filter fabric etc.) after exposure and stabilized as soon as practicable (with native or non-invasive vegetation matting, hydroseeding, etc.).

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May 27, 2014

Dr. Loyal Mehrhoff, Field Supervisor
Pacific Islands Administrator
Fish & Wildlife Services
U.S. Department of the Interior
300 Ala Moana Blvd., Room 3-122, Box 50088
Honolulu, Hawai'i 96813

Dear Dr. Mehrhoff:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of November 6, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project along with consultation under Section 7 of the Endangered Species Act (ESA) of 1973.

We appreciate the species list information provided to us, and determination that there is no designated critical habitat within the project area. We note the data indicating the green sea turtle (*Chelonia mydas*) may use the tide pools and sandy beach for basking or nesting, along with information provided on their behavior. Avoidance and minimization measures identified will be incorporated into best management plans implemented during construction activities, primarily associated with the demolition of the KBR hotel. Planned redevelopment of the property would not involve construction work within navigable waters, and would be located considerable distances away from the shoreline. Coordination with the National Marine Fisheries Service will also be conducted to address their use of off-shore and open ocean habitats.

The Draft EA will address potential effects on other terrestrial, aquatic and marine fish and wildlife resources within the project area. Measures to avoid unnecessary impacts and minimize unavoidable impacts would be addressed. Such measures would incorporate pertinent standard best management practices from the list provided.

We will coordinate with your office to address potential impacts on federally listed species as part of the ESA compliance. This would include coordination with the Service's Aquatics Ecosystem Conservation Program as part of regulatory requirements for preparing the U.S. Department of Army permit application.

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
Tel. 808.545.2055 • Fax 808.545.2050 • www.hhf.com • e-mail: info@hhf.com

We appreciate your comments, and a copy of the Draft EA will be submitted to the Service for review and comments.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

NEIL ABERCROMBIE
GOVERNOR

Dean H. Seki
Comptroller

Maria E. Zielinski
Deputy Comptroller

(P)1271.3

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

NOV 18 2013

Mr. Ronald A. Sato, AICP
Helbert Hastert & Fee, Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Sato:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawaii
TMK: (3) 7-8-013:002, 013, 042, and 043

This is in response to your letter, dated October 5, 2013 regarding the subject project. The proposed project does not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time. You may send us a copy of the Draft EA as a pdf file format on a CD.

If you have any questions, please call me at 586-0400 or your staff may call Mr. David DePonte of the Public Work Division at 586-0492.

Sincerely,

DEAN H. SEKI
Comptroller

c: Mr. Jerry Watanabe, DAGS-Hawaii District

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May 27, 2014

Mr. Dean H. Seki, Comptroller
Department of Accounting and General Services
State of Hawai'i
P.O. Box 119
Honolulu, Hawai'i 96810-0119

Dear Mr. Seki:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of November 18, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

We note this project does not impact any of your department's facilities or projects, and you have no comments at this time. A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

OFFICE OF PLANNING
STATE OF HAWAII

NEIL ABERCROMBIE
GOVERNOR

JESSE K. SOUKI
DIRECTOR
OFFICE OF PLANNING

235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: http:/planning.hawaii.gov/

Ref. No. P-14158

October 31, 2013

Mr. Ronald A. Sato, AICP
Helber, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Sato:

Subject: Kamehameha Schools Kahaluu Ma Kai Project, Draft Environmental Assessment Pre-Consultation, Kahaluu, Hawaii

Thank you for the opportunity to provide comments on the Kamehameha Schools Kahaluu Ma Kai project.

We have reviewed the documents submitted to our office by letter dated October 7, 2013, and have the following comments to offer:

1. The entire state is defined to be within the Coastal Zone Management Area, see Hawaii Revised Statutes §205A-1 (definition of "coastal zone management area"). The Draft Environmental Assessment (Draft EA) should include a discussion of the proposed project's ability to meet the objectives and policies set forth in HRS §205A-2.

2. The proposed project lies within the Special Management Area (SMA) delineated by the County of Hawaii. The planning departments of the various county administrations are charged with assessing the requirements for SMA use and Shoreline Setback Variances. Please consult with the County of Hawaii, Planning Department, for a determination as to whether an SMA permit is required for this project.

3. CZM federal consistency review by the Hawaii CZM Program may be required if a Department of the Army Permit from the U.S. Army Corps of Engineers is required for any portion of the project.

4. The proposed project may have nonpoint pollution impacts on coastal waters. Please review the Hawaii Watershed Guidance, which provides a summary and links to management measures that may be implemented to minimize coastal nonpoint

pollution impact. Specifically, please examine the sections on "Urban Areas, Site Development" (page 122). The Watershed Guidance is available at http://files.hawaii.gov/dbedt/op/czm/initiative/nonpoint/HIWatershedGuidance Final.pdf.

5. The Draft EA should include the Coastal Zone Management Act, HRS Chapter 205A, in the list entitled: "Relationship to Land Use Plans, Policies, and Controls."

When the Draft Environmental Assessment is released, our office would prefer to receive a PDF file format on CD. If you have any questions regarding this comment letter, please contact Josh Hekekia of our Hawaii CZM Program at 587-2845.

Sincerely,

Jesse K. Souki
Director

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May 27, 2014

Mr. Jesse Souki, Director
Office of Planning
Department of Business, Economic Development & Tourism
State of Hawai‘i
P.O. Box 2359
Honolulu, Hawai‘i 96804-2359

Dear Mr. Souki:

Subject: Kamehameha Schools Kahalu‘u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu‘u, Hawai‘i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of October 31, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

We will address the comments in the Draft EA which are: 1) objectives and policies for Section 205A-2, HRS under the chapter addressing conformance to plans and policies; 2) consultation with the County on the Special Management Area requirements; and 3) non-point pollution impacts on coastal waters. A U.S. Department of Army permit will be required for demolition of the resort hotel structure, and federal consistency review under Hawai‘i's Coastal Zone Management Program will be conducted as part of that process.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD. Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

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NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
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

November 13, 2013

Helber Hastert & Fee, Planners
Attention: Mr. Ronald A. Sato, AICP, Associate
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

via email: rsato@hhf.com

Dear Mr. Sato:

SUBJECT: Kamehameha Schools Kahaluu Ma Kai Project; Draft Environmental Assessment Pre-Assessment Consultation, Helber Hastert & Fee for Kamehameha Schools, Applicant, Kahaluu, Hawaii, TMKs: (3) 7-08-013: 002, 013, 042 & 043

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comments.

At this time, enclosed are comments from the (i) Engineering Division, (ii) Hawaii District Land Office, and (iii) Office of Conservation and Coastal Lands on the subject matter. Should you have any questions, please feel free to call Kevin Moore at (808) 587-0426. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

'13 OCT 09 AM 10:15 ENGINEERING

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

October 9, 2013

MEMORANDUM

FR:

~~TO:~~

DLNR Agencies:
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
__Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

RECEIVED
LAND DIVISION
2013 OCT 17 AM 9:42
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

TO:

~~FROM:~~ Russell Y. Tsuji, Land Administrator
SUBJECT: Kamehameha Schools Kahaluu Ma Kai Project; Draft Environmental Assessment Pre-Assessment Consultation
LOCATION: Kahaluu, Hawaii, TMKs: (3) 7-08-013: 002, 013, 042 & 043
APPLICANT: Helber Hastert & Fee for Kamehameha Schools

Transmitted for your review and comment is information on the above referenced project. We would appreciate your comments on this document. Please submit any comments by November 13, 2013. If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Kevin Moore at 587-0426. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed: _____

Print name: Carty S. Chang, Chief Engineer
Date: 10/16/13

cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/KevinMoore
Ref.:KahaluuKamSchoolDEAPreCon
Hawaii.626

COMMENTS

( ) We confirm that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Flood Zone ___.

( ) Please note that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Flood Zone____.

(X) Please note that the correct Flood Zone Designations for the project site, according to the Flood Insurance Rate Map Panel Numbers 1551660928C dated September 16, 1988 (Copy attached), are Zones X, AE and VE. The National Flood Insurance Program (NFIP) does not regulate developments within Zone X. However, the NFIP does regulate developments within Zones AE and VE as indicated in bold letters below.

(X) Please note that the project must comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken. If there are any questions, please contact the State NFIP Coordinator, Ms. Carol Tyau-Beam, of the Department of Land and Natural Resources, Engineering Division at (808) 587-0267.

Please be advised that 44CFR indicates the minimum standards set forth by the NFIP. Your Community's local flood ordinance may prove to be more restrictive and thus take precedence over the minimum NFIP standards. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:

( ) Mr. Mario Siu Li at (808) 768-8098 or Ms. Ardis Shaw-Kim of the City and County of Honolulu, Department of Planning and Permitting.

(X) Mr. Frank DeMarco at (808) 961-8042 of the County of Hawaii, Department of Public Works.

( ) Ms. Carolyn Cortez at (808) 270-7813 of the County of Maui, Department of Planning.

( ) Ms. Stanford Iwamoto at (808) 241-4884 of the County of Kauai, Department of Public Works.

( ) The applicant should include project water demands and infrastructure required to meet water demands. Please note that the implementation of any State-sponsored projects requiring water service from the Honolulu Board of Water Supply system must first obtain water allocation credits from the Engineering Division before it can receive a building permit and/or water meter.

( ) The applicant should provide the water demands and calculations to the Engineering Division so it can be included in the State Water Projects Plan Update.

( ) Additional Comments: _____

( ) Other: _____

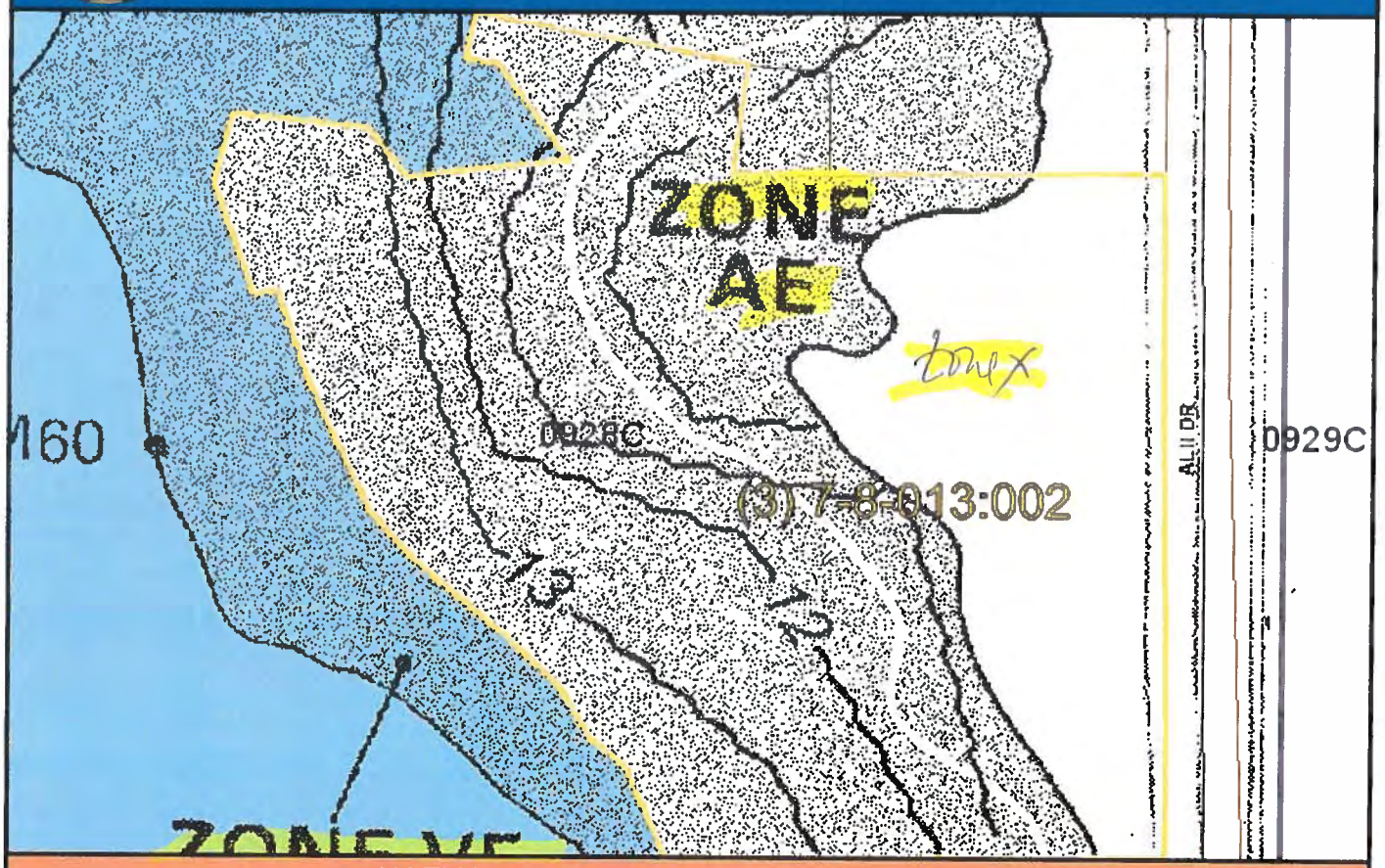
Should you have any questions, please call Ms. Suzie S. Agraan of the Planning Branch at 587-0258.

Signed: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: 10/16/13

State of Hawaii

FLOOD HAZARD ASSESSMENT REPORT



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD ZONE DEFINITIONS

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD – The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water-surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

- Zone A: No BFE determined.
- Zone AE: BFE determined.
- Zone AH: Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
- Zone AO: Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
- Zone V: Coastal flood zone with velocity hazard (wave action); no BFE determined.
- Zone VE: Coastal flood zone with velocity hazard (wave action); BFE determined.
- Zone AEF: Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

NON-SPECIAL FLOOD HAZARD AREA – An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

- Zone XS (X shaded): Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- Zone X: Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

- Zone D: Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

PROPERTY INFORMATION

COUNTY:	HAWAII
TMK NO:	(3) 7-8-013-002
PARCEL ADDRESS:	78-6780 ALII DRIVE KAILUA KONA, HI 96740
FIRM INDEX DATE:	APRIL 02, 2004
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL(S):	1551660928C
PANEL EFFECTIVE DATE:	SEPTEMBER 16, 1988

PARCEL DATA FROM:	JUNE 2013
IMAGERY DATA FROM:	MAY 2005

IMPORTANT PHONE NUMBERS

County NFIP Coordinator	
County of Hawaii	
Frank DeMarco, CFM	(808) 961-8042
State NFIP Coordinator	
Carol Tyau-Beam, P.E., CFM	(808) 587-0267

Disclaimer: The Department of Land and Natural Resources (DLNR) assumes no responsibility arising from the use of the information contained in this report. Viewers/Users are responsible for verifying the accuracy of the information and agree to indemnify the DLNR from any liability, which may arise from its use.

If this map has been identified as 'PRELIMINARY' or 'UNOFFICIAL', please note that it is being provided for informational purposes and is not to be used for official/legal decisions, regulatory compliance, or flood insurance rating. Contact your county NFIP coordinator for flood zone determinations to be used for compliance with local floodplain management regulations.

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
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

2013 OCT 10 P 1:01

RECEIVED
LAND DIVISION
HILO, HAWAII

2013 OCT 28 AM 10:10
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

RECEIVED
LAND DIVISION

October 9, 2013

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
__Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Kamehameha Schools Kahaluu Ma Kai Project; Draft Environmental Assessment Pre-Assessment Consultation
LOCATION: Kahaluu, Hawaii, TMKs: (3) 7-08-013: 002, 013, 042 & 043
APPLICANT: Helber Hastert & Fee for Kamehameha Schools

Transmitted for your review and comment is information on the above referenced project. We would appreciate your comments on this document. Please submit any comments by November 13, 2013. If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Kevin Moore at 587-0426. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(✓) Comments are attached.

Signed: _____

Print name: GORDON C. HEU
Date: 10/25/13

cc: Central Files

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

75 Aupuni Street, Room 204
Hilo, Hawaii 96720
PHONE: (808) 961-9590
FAX: (808) 961-9599

October 23, 2013

MEMORANDUM

TO: Russell Y. Tsuji, Land Administrator

FROM: Candace Martin, Land Agent, HDLO

SUBJECT: Kamehameha Schools Kahaluu Ma Kai Project; Draft Environmental Assessment Pre-Assessment Consultation, Kahaluu, Hawaii, TMK: (3) 7-08-013:002, 013, 042 and 043.

In response to your request for comments dated October 9, 2013 on the subject matter, we offer the following:

The parcel of State land identified as Tax Map Key: (3) 7-08-013:042 is actually a non-exclusive term building easement (GLS-5963), first issued February 7, 1969 as GLS-4227. Abandonment or cancellation of the easement requires the removal of the existing improvements and restoration of the easement area to an original state (or as close as possible). We have determined this to mean, the removal of all protruding concrete footings and/or structures to the level of the immediately surrounding ground.

The legal description of the easement area refers to measurements "along highwater mark, along R.P. 6856 ...", which indicates the shore-side boundary of the easement area will change with the shoreline boundary.

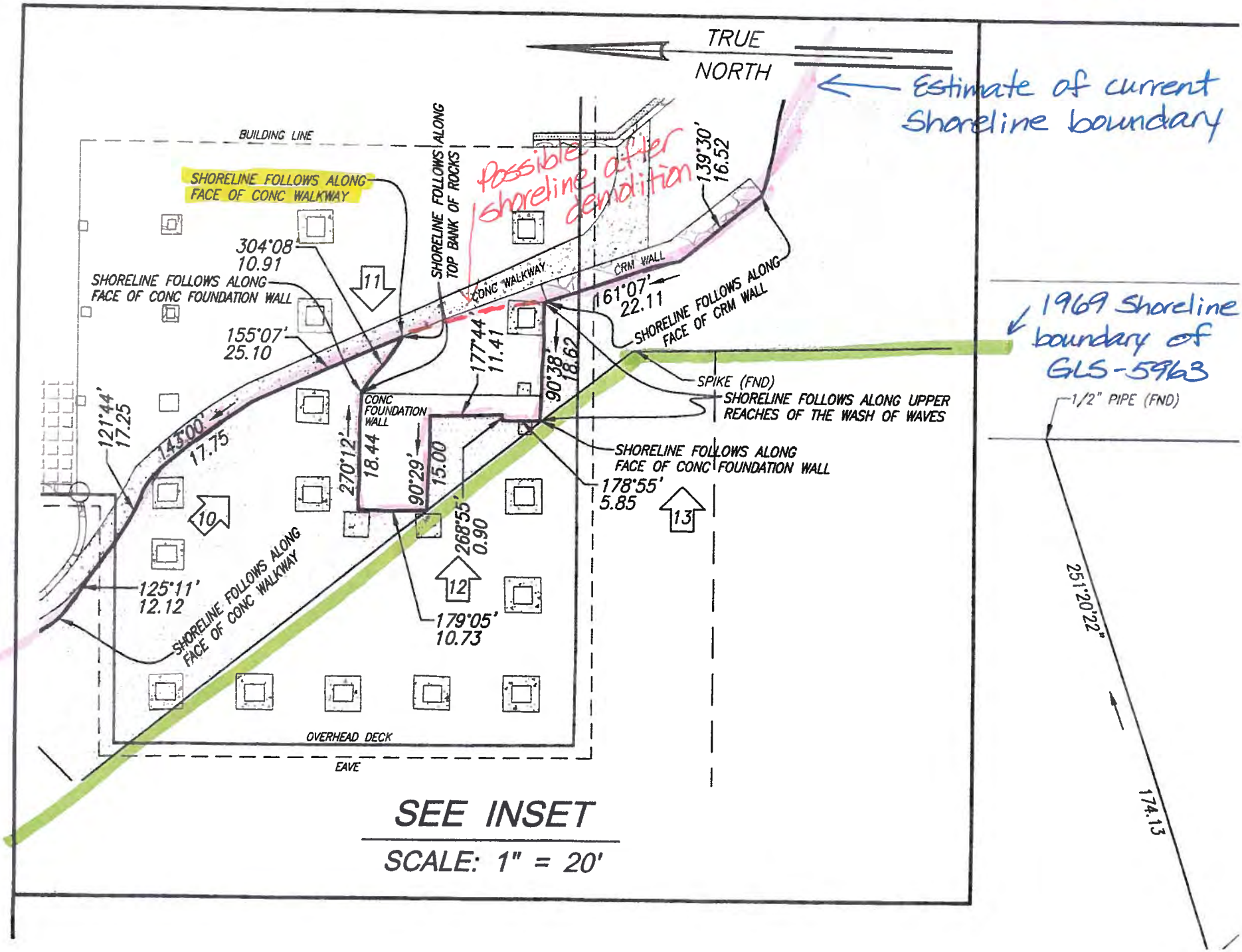
Indications are, the shoreline in the proposed project area has changed dramatically since the original survey in 1969 (refer to attached Exhibit A). Therefore, the shoreline must be certified prior to Land Division reviewing any demolition plans/activities in order to determine the area required to be restored as mentioned above.

We recommend the applicant seek approval from the Board of Land and Natural Resources for mutual cancellation of the easement once the improvements are removed and the area is restored.

If you have any questions, please feel free to contact me at (808) 961-9590. Thank you.

cc: District Files

EXHIBIT A


TRUE
NORTH
Estimate of current Shoreline boundary
BUILDING LINE
SHORELINE FOLLOWS ALONG FACE OF CONC WALKWAY
SHORELINE FOLLOWS ALONG TOP BANK OF ROCKS
Possible shoreline after demolition
139°30'
16.52
304°08'
10.91
SHORELINE FOLLOWS ALONG FACE OF CONC FOUNDATION WALL
11
CONC WALKWAY
CRM WALL
161°07'
22.11
SHORELINE FOLLOWS ALONG FACE OF CRM WALL
155°07'
25.10
177°44'
11.41
90°38'
18.62
1969 Shoreline boundary of GLS-5963
SPIKE (FND)
SHORELINE FOLLOWS ALONG UPPER REACHES OF THE WASH OF WAVES
1/2" PIPE (FND)
121°44'
17.25
145°00'
17.75
CONC FOUNDATION WALL
270°12'
18.44
90°29'
15.00
SHORELINE FOLLOWS ALONG FACE OF CONC FOUNDATION WALL
178°55'
5.85
13
10
268°55'
0.90
12
125°11'
12.12
SHORELINE FOLLOWS ALONG FACE OF CONC WALKWAY
179°05'
10.73
251°20'22"
174.13
OVERHEAD DECK
EAVE
SEE INSET
SCALE: 1" = 20'

HA-14-58

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
OFFICE OF CONSERVATION
AND COASTAL LANDS
2013 OCT -9 A 10: 50
DEPARTMENT OF LAND &
NATURAL RESOURCES
STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

October 9, 2013

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
__Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Kamehameha Schools Kahaluu Ma Kai Project; Draft Environmental Assessment Pre-Assessment Consultation
LOCATION: Kahaluu, Hawaii, TMKs: (3) 7-08-013: 002, 013, 042 & 043
APPLICANT: Helber Hastert & Fee for Kamehameha Schools

Transmitted for your review and comment is information on the above referenced project. We would appreciate your comments on this document. Please submit any comments by November 13, 2013. If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Kevin Moore at 587-0426. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(✓) Comments are attached.

Signed: K. Tiger Mills
Print name: K. Tiger Mills
Date: 11-1-2013

cc: Central Files

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ESTHER KIA'AINA
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 HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

REF:OCCL:TM

Correspondence: HA 14-58

NOV - 1 2013

MEMORANDUM

TO: Russell Y. Tsuji, Administrator
Land Division

FROM: Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

SUBJECT: Pre-EA Consultation for Kamehameha Schools Kahalu`u Ma Kai Project Located at Kahalu`u, North Kona, TMKs: (3) 7-8-013: various

The Office of Conservation and Coastal Lands has reviewed the information regarding the subject matter and note that submerged land ma kai of the certified shoreline lies within the Conservation District Resource subzone. All proposed work within the Conservation District shall be reviewed by the OCCL to determine what type of authorization may be required.

Regarding the demolition of the Keauhou Beach Resort, pursuant to the Hawaii Administrative Rules (HAR) §13-5-22, P-8 STRUCTURES AND USES, EXISTING, Demolition, removal of existing structures, facilities, land, and equipment requires a Site Plan Approval. Site plans, such as construction, site restoration or any other plans that are to take place upon submerged land should be submitted to OCCL for review.

Should you have any questions regarding this memorandum, contact Tiger Mills of the OCCL at (808) 587-0382.

RECEIVED
LAND DIVISION
2013 NOV -4 A 11:15
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

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May 27, 2014

Mr. Russell Tsuji, Land Administrator
Land Division
Department of Land and Natural Resources
State of Hawai'i
P.O. Box 621
Honolulu, Hawai'i 96809

Dear Mr. Tsuji:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of November 13, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project. Our responses address the comments from each division.

Engineering Division

We appreciate the information received on flood zones designated within the project area based upon the Flood Insurance Rate Map for this area. Coordination has been, and will continue to be, conducted with the County of Hawai'i, Department of Public Works to address applicable rules and requirements.

It should be noted that the flood hazard lines do not match the contours of the property's actual ground conditions based upon a topographic survey conducted. Actual site conditions reflect elevations that could reduce the extent of the flood hazard areas shown for the site by the FIRM. Coordination with the County to interpret the specific boundaries of flood hazard areas under Section 27-16(c) of the Hawai'i County Code would be conducted during the project's design phase to determine compliance with applicable requirements.

Land Division – Hawai'i District

We confirm that the State-owned parcel (TMK parcel 42) is associated with the portion of the existing hotel extending over the tide pool is a building easement with the State. Demolition of the hotel will require cancellation of this easement, and removal of the existing concrete footings in the tide pools supporting this building. Based upon consultation with the land division by the project team's civil engineer, the columns would be first cut off at or near the footings, and the remaining concrete footings removed to bring the concrete level with the bottom of the tide pool.

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
Tel. 808.545.2055 • Fax 808.545.2050 • www.hhf.com • e-mail: info@hhf.com

Consultation has also been conducted with this division regarding the need and timing for a shoreline survey. A shoreline survey would not be required now prior to submittal of demolition plans for review by this division. The shoreline survey would be conducted for this area after demolition of the building to determine the new shoreline boundary without the hotel. Approval from the Board of Land and Natural Resources will be obtained for mutual cancellation of the easement after demolition activities are completed.

Office of Conservation and Coastal Lands

We confirm that the submerged land seaward (*makai*) of the certified shoreline is designated as State Conservation District, Resource Subzone. With the exception of the demolition of the existing hotel building, no redevelopment improvements or construction activities are planned to occur within the tide pools or seaward of the shoreline. A Site Plan Approval will be obtained from this division for the demolition of the hotel building.

A copy of the Draft EA will be submitted to your department and divisions for review and comments as a pdf file format on a CD. Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

NEIL ABERCROMBIE
GOVERNOR

MAJOR GENERAL DARRYLL D. M. WONG
DIRECTOR OF CIVIL DEFENSE

DOUG MAYNE
VICE DIRECTOR OF CIVIL DEFENSE

PHONE (808) 733-4300
FAX (808) 733-4287

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

November 7, 2013

Mr. Ronald Sato, AICP
Helbert Hastert and Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Sato:

Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation

Thank you for the opportunity to comment on this proposed project.

After reading the documents provided for the project, we have determined that there is no siren coverage for the project area. Therefore, we request that one 121 db(c) omni-directional siren be installed on the property.

We will work with the developer to determine the best location for the siren site.

We defer to the appropriate State and federal agencies as to the protection of coastal and marine environment as well as the cultural, historical, and archeological elements of the property.

If you have any questions please call Ms. Havinne Okamura, Hazard Mitigation Planner, at (808) 733-4300, extension 556.

Sincerely,

FOR DOUG MAYNE
Vice Director of Civil Defense

HHF PLANNERS
places for people

May 27, 2014

Mr. Doug Mayne, Vice Director
Office of the Director of Civil Defense
Department of Defense
State of Hawai‘i
3949 Diamond Head Road
Honolulu, Hawai‘i 96816-4495

Dear Mr. Mayne:

Subject: Kamehameha Schools Kahalu‘u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu‘u, Hawai‘i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of November 7, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

The project's design team will coordinate with your department to determine the best location for a siren site during the design phase of the property's redevelopment.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
Tel. 808.545.2055 • Fax 808.545.2050 • www.hhf.com • e-mail: info@hhf.com

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

13-974A CAB

November 15, 2013

Mr. Ronald A. Sato, AICP
Associate
Helber, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Sato:

SUBJECT: Draft Environmental Assessment Pre-Assessment Consultation
Kamehameha Schools Kahaluu Ma Kai Project, Kahaluu, Hawaii
TMK: (3) 7-08-013: 002, 013, 042 and 043

Construction/Demolition that may involve Asbestos
If the proposed project includes renovation/demolition activities which may involve asbestos, the applicant should contact the Asbestos Abatement Office in the Indoor and Radiological Health Branch at 586-5800.

Control of Fugitive Dust
A significant potential for fugitive dust emissions exists during all phases of demolition and construction. The activities must comply with the provisions of Hawaii Administrative Rules, §11-60.1-33 on Fugitive Dust. We encourage the contractor to implement a dust control plan, which does not require approval by the Department of Health, to comply with the fugitive dust regulations. Dust control measures may include, but are not limited to, the following:

a) Planning the different phases of construction, focusing on minimizing the amount of 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 dust from shoulders and access roads;
e) Providing adequate dust control measures during weekends, after hours, and prior to daily start-up of construction activities; and
f) Controlling dust from debris being hauled away from the project site. Also, controlling dust from daily operations of material being processed, stockpiled, and hauled to and from the facility.

We can view the Draft Environmental Assessment online once we have been informed of its availability. If you have any questions, please contact Mr. Barry Ching of the Clean Air Branch at 586-4200.

Sincerely,

NOLAN S. HIRAI, P.E.
Manager, Clean Air Branch

BC:rg

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places for people

May 27, 2014

Mr. Nolan S. Hirai, P.E., Manager
Clear Air Branch
Department of Health
State of Hawai'i
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

Dear Mr. Hirai:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of November 15, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

A hazardous material inspection of the Keauhou Beach Resort hotel was conducted, and determined the presence of asbestos-containing materials (ACM) in the samples collected. As a result, the ACMs will be removed prior to demolition of the hotel, and your Asbestos Abatement Office will be contacted by the design team or contractor during the design phase of the hotel demolition to coordinate this removal.

Construction activities, particularly the demolition of the hotel, could result in fugitive dust emissions. Dust control measures will be incorporated into the hotel demolition and redevelopment design plans as part of best management practices for implementation by the contractor. The measures identified in your letter will be considered and incorporated into design plans as appropriate along with other measures developed.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
Tel. 808.545.2055 • Fax 808.545.2050 • www.hhf.com • e-mail: info@hhf.com

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
EMD/CWB

10065PJF.13

October 18, 2013

Mr. Ronald A. Sato
AICP
Helber, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Sato:

SUBJECT: Comments on the Draft Environmental Assessment Pre-Assessment Consultation for the Kamehameha Schools Kahaluu Ma Kai Project Kahaluu, Island of Hawaii, Hawaii

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, dated October 5, 2013, requesting comments on your project. The DOH-CWB has reviewed the subject document and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54, and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at: http://health.hawaii.gov/epo/files/2013/05/CWB-standardcomment.pdf.

1. Any project and its potential impacts to State waters must meet the following criteria:

   a. Anti-degradation policy (HAR, Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.

   b. Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.

   c. Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

2. You may be required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55). An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. To request NPDES permit coverage, you must submit the CWB Individual

NPDES Form through the e-Permitting Portal and the hard copy certification statement with $1,000 filing fee. Please open the e-Permitting Portal website at: https://eha-cloud.doh.hawaii.gov/epermit/View/home.aspx. You will be asked to do a one-time registration to obtain your login and password. After you register, click on the Application Finder tool and locate the "CWB Individual NPDES Form." Follow the instructions to complete and submit this form.

3. If your project involves work in, over, or under waters of the United States, it is highly recommended that you contact the Army Corp of Engineers, Regulatory Branch (Tel: 438-9258) regarding their permitting requirements.

   Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40 of the Code of Federal Regulations, Section 122.2; and HAR, Chapter 11-54.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards. Non-compliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

If you have any questions, please visit our website at: http://health.hawaii.gov/cwb, or contact the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

ALEC WONG, P.E., CHIEF
Clean Water Branch

JF:rh

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May 27, 2014

Mr. Alec Wong, P.E., Chief
Clean Water Branch
Department of Health
State of Hawai'i
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

Dear Mr. Wong:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter dated October 18, 2013 providing comments as part of pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project. Our responses are numbered to correspond to your comments, and we will also review the branch's standard comments mentioned to evaluate their applicability.

1. The project should be consistent with the anti-degradation policy under Chapter 11-54, HAR because redevelopment of the property will result in a significant reduction of impervious surfaces reducing surface runoff (over 90%), and thus have a beneficial effect on water quality. The Draft EA will address these effects along with the State's water classification designation for the site and water quality criteria under Chapter 11-54, HAR.
2. National Pollutant Discharge Elimination System (NPDES) individual permit coverage for construction activities will be obtained for this project. An application will be prepared and filed with your branch in accordance with the procedures identified.
3. A Department of Army permit will be required for demolition of the hotel building, and coordination has already been initiated with the U.S. Corps of Engineers resulting in an assigned project number (POH-2013-00038). A Section 401 Water Quality Certification would be applicable, and an application will be prepared for processing with your branch.
4. The information of non-compliance with water quality and permitting requirements is noted and appreciated.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
Tel. 808.545.2055 • Fax 808.545.2050 • www.hhf.com • e-mail: info@hhf.com

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

NEIL ABERCROMBIE
GOVERNOR

LORETTA J. FUDDY, A.C.S.W., M.P.H.
Director of Health

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 916
HILO, HAWAII 96721-0916

MEMORANDUM

DATE: November 8, 2013

TO: Ronald A. Sato
Helber Hastert & Fee Planners, Inc.

FROM: Newton Inouye
District Environmental Health Program Chief

SUBJECT: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013:002, 013, 042 and 043

The applicant would need to meet the requirements of our Department of Health Air Pollution Rules, Chapter 60.1, Title 11, State of Hawaii for fugitive dust control. If there is need to discuss these requirements, please contact our Clean Air Branch staff at Ph. 933-0401.

As a demolition and renovation activity, the Federal Register, 40 CFR Part 61, National Emission Standard for Hazardous Air Pollutants, Asbestos NESHAP Revision; Final Rule, November 20, 1990, requires the owner/operator to inspect the affected areas to determine whether asbestos is present.

Under the Asbestos School Hazard Abatement Response Act (ASHARA), all persons who conduct inspections (i.e. perform sampling and assessment of suspected asbestos-containing material) in schools or public and commercial buildings must have an active Asbestos Hazard Emergency Response (AHERA) certificate-of-training from an accredited training provider.

Under NESHAP's regulation, the owner/operator would be required to file with the Department of Health, Noise, Radiation and Indoor Air Quality Branch, an Asbestos Demolition/Renovation notification 10 working days prior to demolition of each building or the disturbance of regulated asbestos-containing material. All regulated quantities and types of asbestos-containing materials would be subject to emission controls, proper collection, containerizing, and disposal at a permitted landfill.

Under a renovation project, if the amount of friable or non-friable material rendered friable is less than 160 square feet, the project would not be subject to the NESHAP requirements. However, the persons who conduct activities related to abatement and/or disturbances to friable

material greater than three square feet or three linear feet, must have an active AHERA certificate of training from an accredited provider for that specific discipline (i.e., project designer, abatement supervisor and worker).

If you have any further questions, please feel free to contact the Indoor Air & Radiological Health Branch at (808) 586-5800.

Construction activities must comply with the provisions of Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control."

1. The contractor must obtain a noise permit if the noise levels from the construction activities are expected to exceed the allowable levels of the rules.

2. Construction equipment and on-site vehicles requiring an exhaust of gas or air must be equipped with mufflers.

3. The contractor must comply with the requirements pertaining to construction activities as specified in the rules and the conditions issued with the permit.

Should there be any questions on this matter, please contact the Department of Health at 933-0917.

We recommend that you review all of the Standard Comments on our website: http://hawaii.gov/health/environmental/env-planning/landuse/landuse.html. Any comments specifically applicable to this project should be adhered to.

The same website also features a Healthy Community Design Smart Growth Checklist (Checklist) created by Built Environment Working Group (BEWG) of the Hawaii State Department of Health. The BEWG recommends that state and county planning departments, developers, planners, engineers and other interested parties apply the healthy built environment principles in the Checklist whenever they plan or review new developments or redevelopments projects. We also ask you to share this list with others to increase community awareness on healthy community design.

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May 27, 2014

Mr. Newton Inouye, Chief
Hawai'i District Environmental Health Program
Department of Health
State of Hawai'i
P.O. Box 916
Hilo, Hawai'i 96721-0916

Dear Mr. Inouye:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of November 8, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

Compliance with the State's Air Pollution Control Regulations under Chapter 11-60, HAR on fugitive dust control will be achieved with by the contractor during construction activities. The project's design team or contractor will contact your branch staff if needed to clarify requirements.

A hazardous material inspection of the Keauhou Beach Resort hotel was conducted and determined the presence of asbestos-containing materials (ACM) in the samples collected. As a result, the ACMs will be removed prior to demolition of the hotel, and the department's Asbestos Abatement Office will be contacted by the design team or contractor during the design phase of the hotel demolition to coordinate on this removal.

All removal will be completed by a certified asbestos abatement contractor under controlled conditions in accordance with Federal EPA and State Department of Health regulations. Work would also be monitored by an independent industrial hygiene professional. Appropriate notification will be given to the Noise, Radiation and Indoor Air Quality Branch by the contractor prior to demolition of the building as indicated. Persons conducting the work will have appropriate certificate of training.

Construction activities will comply with Chapter 11-46, HAR concerning community noise control, and a noise permit would be obtained by the contractor for the hotel demolition, and if applicable, construction of redeveloped areas.

We will also review the branch's standard comments mentioned which generally pertain to items that will be more appropriately addressed as part of the project's design phase. The Healthy Community Design Smart Growth Checklist identified will also be reviewed by the project's design team, and those principles will be incorporated into design plans, as appropriate.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

13-192
Kahaluu Ma Kai

October 14, 2013

Mr. Ronald A. Sato, AICP
Helber, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Sato:

SUBJECT: KAMEHAMEHA SCHOOLS KAHALU`U MA KAI PROJECT DRAFT ENVIRONMENTAL ASSESSMENT PRE-ASSESSMENT CONSULTATION, KAHALU`U, HAWAI`I TMK: (3) 7-8-013: 002, 013, 042 AND 043

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your letter dated October 5, 2013. Thank you for allowing us to review and comment on the subject document. The document was routed to DOH's Indoor Radiological Health Branch and the island of Hawaii's District Health Office. They will provide specific comments to you if necessary. EPO recommends that you review the Standard Comments found on our website: http://health.hawaii.gov/epo/home/landuse-planning-review-program/. You are required to adhere to all Standard Comments specifically applicable to this application. We strongly encourage you to factor in sea level rise into your designs.

EPO appreciates your work to create healthy, active, and sustainable communities.

We wish to receive notice of the environmental assessment's availability when it is completed. We request a written response confirming receipt of this letter and any other letters you receive from DOH in regards to this submission. You may mail your response to: 919 Ala Moana Blvd., Ste. 312, Honolulu, Hawaii 96814. However, we would prefer an email submission to epo@doh.hawaii.gov. We anticipate that our letter(s) and your response(s) will be included in the final document. If you have any questions, please contact me at (808) 586-4337.

Mahalo,

Laura Leialoha Phillips McIntyre, AICP
Manager, Environmental Planning Office

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May 27, 2014

Via Email: epo@doh.hawaii.gov

Ms. Laura Leialoha Phillips McIntyre, AICP, Manager
Environmental Planning Office
Department of Health
State of Hawai‘i
919 Ala Moana Blvd., Room 312
Honolulu, Hawai‘i 96814

Dear Ms. McIntyre:

Subject: Kamehameha Schools Kahalu‘u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu‘u, Hawai‘i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of October 14, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

We will review the branch's standard comments mentioned which generally pertain to items that will be more appropriately addressed as part of the project's design phase. Effects from sea-level rise will be evaluated by the project's design team and addressed in the Draft EA.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD. This letter is also being emailed to your branch as requested.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

LUD-3 7 8 013 002 etc-ID1467
KS – Kahaluu Ma Kai Project

October 24, 2013

Mr. Ronald A. Sato, AICP
Helber, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Sato:

Subject: Kamehameha Schools Kahaluu Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
(former Keauhou Beach Resort at 78-6740 Alii Drive, Kailua-Kona, HI 96740)
TMK (3) 7-8-013: 002, 013, 042 and 043 22.73 acres

Thank you for allowing us the opportunity to review the subject document which requests comments on the Draft Environmental Assessment Pre-Assessment Consultation for the Kamehameha Schools Kahaluu Ma Kai Project. We have the following information and comments regarding the subject document.

The subject project is located in the critical wastewater disposal area as determined by the Hawaii County Wastewater Advisory Committee. Wastewater treatment and disposal have not been adequately addressed in the subject document; therefore, we cannot offer any substantial comments. If a County sewer connection is not available, domestic wastewater generated by the project shall be handled by a wastewater system that complies with our chapter 11-62, Hawaii Administrative Rules (HAR), "Wastewater Systems".

Should you have any questions, please contact Mr. Mark Tomomitsu of my staff at telephone (808) 586-4294 or fax (808) 586-4300.

Sincerely,

SINA PRUDER, P.E., CHIEF
Wastewater Branch

LM/MST:lmj

c: Ms. Laura McIntyre, DOH-Environmental Planning Office\
Mr. Dane Hiromasa, DOH-WWB's Kona Staff

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May 27, 2014

Ms. Sina Pruder, P.E., Chief
Wastewater Branch
Environmental Management Division
State Department of Health
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

Dear Ms. Pruder:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of October 24, 2013 providing comments as part of our pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

We note your determination that the project site is located within the critical wastewater disposal area. The Draft EA will include discussion of the proposed on-site wastewater collection and treatment system to produce R-2 water for irrigation at the project site. A County sewer connection is not available at the project site, however, wastewater from these areas are collected by a privately-operated sewer system and treatment plant.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

STP 8.1374

November 15, 2013

Mr. Ronald A. Sato, AICP
Helber Hastert and Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Sato:

Subject: Kamehameha Schools (KS) Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
TMK: (3) 7-8-013:002, 013, 042 and 043

Thank you for requesting the State Department of Transportation's (DOT) review of the subject project. DOT understands KS proposes to establish a cultural educational complex on the former Keauhou Beach Resort facilities and remnant Kona Lagoon Hotel facilities. Access to the project will be off Ali'i Drive.

The Draft Environmental Assessment (DEA) should discuss and evaluate the project's contribution to the cumulative traffic impacts on State highways facilities in the area. KS is required to obtain a permit from DOT Highways Division, Hawaii District Office, for the transport of oversized and/or overweight materials and equipment on State highway facilities.

DOT appreciates the opportunity to provide comments. DOT would prefer receiving a copy of the DEA as a pdf file format on a CD. If there are any other questions, please contact Mr. Norren Kato of the DOT Statewide Transportation Planning Office at telephone number (808) 831-7977.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

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May 27, 2014

Mr. Glenn Okimoto, Ph.D., Director
Department of Transportation
State of Hawai'i
869 Punchbowl Street
Honolulu, Hawai'i 96813-5097

Dear Mr. Okimoto:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your department's letter of November 9, 2013 providing comments as part of pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

The project should not have a significant impact on State highway facilities because redevelopment of the property will result in a considerable decrease in project generated traffic as compared to conditions during operation of the former Keauhou Beach Resort. The Draft EA will address traffic impacts on roadway facilities and include a traffic impact analysis study. A permit will be obtained from the Highways Division, Hawai'i District Office by the contractor for the transport of oversized materials and equipment on State highway facilities.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

William P. Kenoi
Mayor

Walter K.M. Lau
Managing Director

BJ Leithead Todd
Director

John A. Medeiros
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanaō'a Street, Suite B • Hilo, Hawai`i 96720

(808) 961-8083 · Fax (808) 961-8086

http://www.hawaiicounty.gov/environmental-management/

Mr. Ronald A. Sato
Helber, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawai'i 96813

Aloha Mr. Sato,

The County of Hawai'i Department of Environmental Management Solid Waste Division would like to confirm that we have received the solicitation for comments for the upcoming Draft Environmental Assessment for the Kamehameha Schools Kahalu'u Ma Kai Project.

As you may recall in 2007, the Hawai`i County Council joined hundreds of states, counties, cities, nationwide municipalities, and countries passing legislation adopting the mission to reduce our county's ecological footprint. With the right strategy and appropriate education, we can all begin to see valuable resources in our waste and divert those resources from the landfill to the right place for recovery.

As such the Solid Waste Division highly recommends that you consider the following:

- Contact your local builder's association, your county solid waste department, or your state environmental agency. They will provide information on recyclers and waste haulers in your area.
- Consider whether deconstruction techniques can be used to prepare your site for renovation or construction. In some communities, deconstruction auctions are being effectively used to move building materials into the reuse market.
- Check with local salvagers before purchasing new products. You might be surprised to find that many of them offer cabinets, doors, windows, and flooring that are in good condition for greatly reduced prices.
- Donate the C&D materials that you are not planning to use to a local affiliate of Habitat for Humanity and/or other nonprofit organizations; as well as any ReUse Centers.

Additionally, the Solid Waste Division reminds to you visit www.hawaiizerowaste.org for any additionally information you may need regarding any County of Hawai'i Solid Waste Facility or regarding any other municipal waste inquiries.

Thank you for giving the County of Hawai'i Solid Waste Division the opportunity to provided comments for the upcoming Kahalu'u Ma Kai Project for Kamehameha Schools.

Mahalo,

Greg Goodale, Division Chief
Solid Waste Division
Department of Environmental Management
County of Hawai'i

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May 27, 2014

Mr. Greg Goodale, Division Chief
Solid Waste Division
Department of Environmental Management
County of Hawai‘i
25 Aupuni Street
Hilo, Hawai‘i 96720

Dear Mr. Goodale:

Subject: Kamehameha Schools Kahalu‘u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu‘u, Hawai‘i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your department's letter received November 8, 2013 providing comments as part of pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

The project's design team will obtain information on recyclers and waste haulers in the area as part of the design process, particularly for the demolition of the former Keauhou Beach Resort hotel structure. Deconstruction techniques will be evaluated for feasibility and practicality for preparing the site for redevelopment. Local salvagers will be considered as well by the design team. Construction and debris materials will be evaluated and considered for possible donation, if appropriate.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
Tel. 808.545.2055 • Fax 808.545.2050 • www.hhf.com • e-mail: info@hhf.com

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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

November 8, 2013

Ronald A. Sato, ACIP
Helber, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, HI 96813

PRE-ENVIRONMENTAL ASSESSMENT
KAMEHAMEHA SCHOOLS KAHALU'U MA KAI PROJECT
TAX MAP KEY 7-8-013:002, 013, 042 AND 043

This is in response to your Pre-Environmental Assessment letter dated October 5, 2013.

Please be informed that there are two (2) existing 4-inch meters serving Parcel Nos. 2 and 43. These meters are connected to an existing 12-inch waterline along Ali'i Drive.

The Department will request estimated maximum daily water usage calculations, prepared by a professional engineer licensed in the State of Hawai'i, for review and approval. After review of the calculations, the Department will determine if the existing meter(s) serving the parcels are adequate to support the water demand. The water usage calculations should include the estimated peak flow in gallons per minute and the total estimated maximum daily water usage in gallons per day, including all irrigation/landscaping use.

Should there be any questions, please contact Mr. Ryan Quitoriano of our Water Resources and Planning Branch at 961-8070, extension 256.

Sincerely yours,

Kurt Y. Inaba
for Quirino Antonio, Jr., P.E.
Manager-Chief Engineer

RQ:dfg

HHF PLANNERS
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May 27, 2014

Mr. Quirino Antonio, Jr., P.E., Manager-Chief Engineer
Department of Water Supply
County of Hawai‘i
345 Kekuanaoa Street, Suite 20
Hilo, Hawai‘i 96720

Dear Mr. Antonio:

Subject: Kamehameha Schools Kahalu‘u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu‘u, Hawai‘i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your department's letter of November 8, 2013 providing comments as part of pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

Thank you for informing us of the two existing 4-inch meters serving parcels No. 02 and 43 of the project site, and their connection to the 12-inch waterline running along Ali‘i Drive.

A preliminary engineering report will be included in the Draft EA that has estimated maximum daily and peak flow water usage calculations. The existing meters serving the project should be adequate to serve the new facilities constructed under the site's redevelopment, but we will await your review of information in the Draft EA for confirmation.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

AMENDED

William P. Kenoi
Mayor

Duane Kanuha
Director

Bobby Command
Deputy Director

West Hawai'i Office
74-5044 Ane Keohokalole Hwy
Kailua-Kona, Hawai'i 96740
Phone (808) 323-4770
Fax (808) 327-3563

County of Hawai'i

East Hawai'i Office
101 Pauahi Street, Suite 3
Hilo, Hawai'i 96720
Phone (808) 961-8288
Fax (808) 961-8742

November 12, 2013

Mr. Ronald A. Sato, AICP
Helber, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, HI 96813

Dear Mr. Sato:

SUBJECT: DRAFT EVIRONMENTAL ASSESSMENT PRE-ASSESSMENT CONSULTATION
PROPOSED KAMEHAMEHA SCHOOLS MA KAI PROJECT
TMK: (3) 7-8-013:002,013,042 AND 043
Kahaluu Beach Section, N. Kona HI (COR-13-087962)

Thank you for your letter dated October 5, 2013 requesting information from this office regarding the preparation of the draft environmental assessment for the proposed project to establish a cultural educational complex on property owned by Kamehameha Schools (KS). The parcels are zoned V-.75 (Resort-Hotel– 750 square feet for each dwelling unit or each separate rentable unit, or similar rentable unit) and the proposed project is located within the State Land Use Urban District.

According to your letter, KS is proposing to redevelop the project site, and change the property's primary use from resort to a cultural educational complex supporting aina-based education and culture-based instruction with the construction of eight new buildings, and the renovation of one existing building, to house these activities. The project also includes the demolition of the existing hotel on the site, except for the basement, which may be retained for part of the project's facilities and operations.

Along with analyzing potential impacts that may occur from the construction and operation of the proposed project with the preparation of the draft environmental assessment, please include a discussion on the following:

- Potential impacts to historical and cultural resources before, during and after demolition of the hotel and area near the lagoon **and suggest appropriate mitigating measures to minimize those impacts**

- Potential impacts to historical and cultural resources and during and after construction of the proposed project **and suggest appropriate mitigating measures to minimize those impacts**
- Potential impacts to the shoreline from the demolition and proposed construction of the project **and suggest appropriate mitigating measures to minimize those impacts.**
- Public access to the shoreline, before, during, and after the proposed project. **Public access should be to and along the shoreline.**
- Direct and indirect impacts to Kahalu'u Beach Park
- Federal, State and County regulations/permit requirements that apply to demolition of the existing hotel and proposed project within the Special Management Area; proposed work within the shoreline setback area, shoreline, and coastal waters; and requirement for certified shoreline survey.
- **Clearly identify all agencies, entities and individuals consulted during the process dealing with the various areas of concerns, especially cultural and archaeological, where they should explain how these contacted entities participated in the process to develop the vision for these lands.**

In addition, the proposed project must also be considered relative to other planning efforts in the area. Please provide a discussion on any consistencies or inconsistencies the proposed project may have to the Kona Community Development Plan and the Hawai'i County General Plan.

We have no further comments to offer at this time. However, please keep our office informed and provide us with a copy of the Draft Environmental Assessment for our review.

Should you have any questions, please contact Rosalind Newlon of our West Hawaii Office at 323-4770.

Sincerely,

for B. Mark

DUANE KANUHA
Planning Director

RJN:rjn
\\Coh22\planning\Staff\Newlon\Letters\COR-13-087962 Ma Kai Project-amended.doc

cc: West Hawaii Office

HHF PLANNERS
places for people

May 27, 2014

Mr. Duane Kanuha, Director
Planning Department
County of Hawai'i
Aupuni Center
101 Pauahi Street, Suite 3
Hilo, Hawai'i 96720

Dear Mr. Kanuha:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your department's amended letter dated November 12, 2013 providing comments as part of pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

Discussion of the project's effects on historical and cultural resources will be included in the Draft EA, and will include an archaeological inventory survey (AIS) and cultural impact assessment. Project effects from construction activities (e.g. hotel demolition) and after redevelopment of the site will be discussed along with identifying appropriate mitigative measures. Activities prior to demolition and reconstruction should not impact historic and cultural sites because nothing is planned in their vicinity, other than any mitigation work necessary from the AIS study.

Impacts to the shoreline from the hotel's demolition will be discussed, and several proposed best management practices to be implemented will be identified. Redevelopment of the property should have a beneficial effect due to a large reduction in impervious surfaces that will decrease storm water runoff and subsequent impacts to water quality. A marine biological assessment study will be included in the Draft EA describing existing marine conditions and water quality.

Current public access within the property will be discussed along with public access planned during construction activities and after redevelopment. A permanent pedestrian path for public access to and from the shoreline will be provided as part of the project along the southern boundary of the property. Public access would then be available along the sandy beach on the south end of the property. Public access will be discussed in more detail in the Draft EA.

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
Tel. 808.545.2055 • Fax 808.545.2050 • www.hhf.com • e-mail: info@hhf.com

Direct and indirect impacts to Kahalu‘u Beach Park will be discussed. Regulatory permits for demolition of the hotel and redevelopment of the property will be identified. Discussion of the project's conformance with pertinent State and County land use plans and policies will also be provided which includes the County's General Plan and Kona Community Development Plan. Proposed work within the shoreline setback area and shoreline will be discussed. Project improvements would not occur within coastal waters.

The requirement for a shoreline survey has been addressed via a May 8, 2014 letter submitted to the County Planning Department from Mr. Steven S.C. Lim requesting a waiver from the shoreline certification requirements under the SMA permit procedures. The letter also addresses establishment of the 40-foot shoreline setback line shown on an accompanying Site Plan with that letter. The proposed improvements are located well outside of the conservative 40-foot shoreline setback line being proposed, and are considerably inland from the actual shoreline.

The Draft EA will discuss the consultation efforts taken during the preparation of this document which includes extensive community consultations by Kamehameha Schools with lineal and cultural descendants, community organizations, individuals, and agencies.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

William P. Kenoi
Mayor

Harry S. Kubojiri
Police Chief

Paul K. Ferreira
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

October 11, 2013

Mr. Ronald A. Sato, AICP
Helber, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, Hawai'i 96813

Dear Mr. Sato:

RE: DRAFT ENVIRONMENTAL ASSESSMENT PRE-ASSESSMENT CONSULTATION FOR KAMEHAMEHA SCHOOLS KAHALU'U MA KAI PROJECT, KAHALU'U, HAWAI'I, TMK (3) 7-08-013: 002, 013, 042 AND 043

This is in response to your letter dated October 5, 2013, requesting comments on the above-referenced project.

We have no comments or objections to offer at this time.

Should you have any questions or concerns, please contact Captain Randal M. Ishii, Commander of the Kona District, at 326-4646, extension 299.

Sincerely,

HARRY S. KUBOJIRI
POLICE CHIEF

PAUL H. KEALOHA JR.
ASSISTANT CHIEF
AREA II OPERATIONS

RMI:dmv
RS130697

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May 27, 2014

Mr. Harry Kubojiri, Police Chief
Hawai‘i Police Department
County of Hawai‘i
349 Kapiolani Street
Hilo, Hawai‘i 96720

Dear Mr. Kubojiri:

Subject: Kamehameha Schools Kahalu‘u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu‘u, Hawai‘i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your department's letter of October 11, 2013 providing comments as part of pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

We note your department has no comments or objections to offer at this time.

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

William P. Kenoi
Mayor

Walter K. M. Lau
Managing Director

Warren H. W. Lee
Director

Brandon A. K. Gonzalez
Deputy Director

County of Hawai'i
DEPARTMENT OF PUBLIC WORKS
Aupuni Center
101 Pauahi Street, Suite 7 · Hilo, Hawai'i 96720-4224
(808) 961-8321 · Fax (808) 961-8630
www.co.hawaii.hi.us

October 11, 2013

Ronald A. Sato, AICP
Helbert, Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu HI 96813

SUBJECT: Draft Environmental Assessment Pre-Assessment Consultation
Kamehameha Schools Kahalu'u Ma Kai Project
Kahaluu, North Kona, Hawaii
TMKs: (3rd) 7-8-013: 002, 013, 042 and 043

We reviewed the subject dated October 5, 2013 and have the following comments:

Flood Zones "VE and AE, affect the subject parcels as designated by the Flood Insurance Rate Map (FIRM), dated September 16, 1988 Panel 155166 0928C. Any new construction or substantial improvements within Flood Zones VE and AE will be subject to the requirements of Chapter 27 - Flood Plain Management, of the Hawaii County Code. Site plans should show the effective floodplain boundaries, available from the Department of Public Works.

In 2008, the Federal Emergency Management Agency (FEMA) issued a Hurricane Study for Hawai'i County. In terms of potential risk to life and property, the more protective Base Flood Elevations and Special Flood Hazard Areas from FEMA's hurricane study, were incorporated onto FEMA's July 2011, Preliminary Digital Flood Insurance Rate Maps (Preliminary DFIRMs). Until FEMA's Preliminary DFIRMs become effective, the County will continue using FEMA's current effective Flood Insurance Rate Maps and Flood Insurance Study for Hawai'i County. We advise all coastal property owners to review FEMA's Preliminary DFIRMs and design/construct as appropriate. The Preliminary DFIRMs can be reviewed at the State of Hawai'i, Department of Land and Natural Resources' website: http://gis.hawaiinfip.org/fhat/. Preliminary DFIRM Panels affected are 155166 0953F and 0954F. They are also available at http://www.r9map.org/Pages/ProjectDetailsPage.aspx?choLoco=92&choProj=201

We note the main entry is spaced only 100 feet from the entry to the existing unoccupied activity center across Alii Drive. Such close spacing is not recommended as it sets up left turning conflicts for vehicles exiting the two properties simultaneously.

Off-street parking should be provided on-site for the public shoreline access and any proposed activities on the site.

We would appreciate a copy of the Draft Environmental Assessment on CD. If you have any questions, please contact Kiran Emler of our Kona office at (808) 323-4851.

Ben Ishii, Division Chief
Engineering Division

KE
Copy:-- ENG-HILO/KONA
Planning Director

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May 27, 2014

Mr. Ben Ishii, Chief
Engineering Division
Department of Public Works
County of Hawai'i
Aupuni Center
101 Pauahi Street, Suite 7
Hilo, Hawai'i 96720

Dear Mr. Ishii:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your department's letter of October 11, 2013 providing comments as part of pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

We appreciate the information received on flood zones designated within the project area based upon the Flood Insurance Rate Map for this area, and the update on the Hurricane Study for the County. Coordination has been, and will continue to be, conducted with the County Department of Public Works to address rules and requirements for redevelopment of the property within flood areas.

It should be noted that existing flood hazard lines do not match the contours of the property's actual ground conditions based upon a topographic survey recently conducted. Actual site conditions reflect elevations that could reduce the extent of the flood hazard areas shown for the site by the FIRM. Coordination with the County to interpret the specific boundaries of flood hazard areas under Section 27-16(c) of the Hawai'i County Code would be conducted during the project's design phase to determine compliance with applicable requirements.

The existing main driveway entry to the project site serving the former Keauhou Beach Resort will continue to be used with the project's redevelopment. The property located adjacently across (mauka of) the project site is owned by Kamehameha Schools. Coordination with the County will be conducted to address the driveway location for that property to reduce left-turn conflicts for vehicles exiting that property, which is currently minimal.

Off-street parking will be provided to accommodate proposed facilities and activities conducted resulting from the site's redevelopment. A 10-stall parking lot specifically for use by the public for shoreline access will also be provided and located at the southern end of the property.

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
Tel. 808.545.2055 • Fax 808.545.2050 • www.hhf.com • e-mail: info@hhf.com

A copy of the Draft EA will be submitted to your department for review and comments as a pdf file format on a CD.

Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

Christine K. Epenesa
PO Box 291, Kailua-Kona, Hi 96745-0291
Phone: (808)960-4696
Email: c.epenesa@yahoo.com

November 5, 2013

Kā'eo Duarte, Ph.D.
Kamehameha Schools Bishop Estate
Director of Strategic Initiatives, West Hawai'i
76-6831 Ali'i Drive
Kailua-Kona, Hawai'i 96740

Aloha e Kā'eo,

I am writing you requesting your consideration of and response to my questions and concerns regarding the Kahalu'u Ma kai Project discussed at the Community Meeting held on Thursday, October 17th. We were greeted with lots of aloha and understanding for our concerns with you as well as members of your staff and planning teams, and appreciate the opportunity to join in the discussion and hear the plans set out for this project.

Many years ago, the Kona Lagoon was taken down with the same intentions made known of the Kahalu'u Ma kai project. Today, the area leaves many, including my 'ohana and I, nothing but a sad, unwelcoming vibe. We, kama'āina and 'ohana to this area stand at the street side looking in greeted by a fence. An internationally understood sign, Keep Out – You are not welcome here. Is this how we will view the Kahalu'u Ma kai project in the coming years? Our greatest fear is to see this at the Keauhou Beach Hotel site. This area is so special to my 'ohana, the thought that the opportunity for my mother to take my children and grandchildren to the land she was raised on to share the mana'o and stories she has, teach what she was taught and create new memories with us could no longer be a reality drives me to express my concerns to you today.

When at the community meeting, I asked specifically about the fencing around the Kona Lagoon site, if this was the future of Kahalu'u Ma kai. One person told me there will be a fence, yet another said no there will not be a fence. Either way, it will not be accessible for any and all. I was told that use of the area and the facilities of the area will be for mainly educational groups. My question, what about the rest of us?

I understand there is a need to protect the area, to preserve the cultural sites of the land and agree with that completely. Full public access could damage the site, as not all people walk and act with honorable intentions and care. However, an effort needs to be made to make these sites and this area accessible to those not a part of your educational system. Those, who like us, have ties to the area, yearn to continue to share the way of life here, as it is taught to us by our own kupuna still here today.

I am glad my children will be able to see this site with their school groups, my nieces and nephews with their College classes, maybe even tourist or newcomers enrolling in a class, but what about my mother and I? When I inquired about this at the meeting, I was told that I could request and make arrangements to come on property. So, I can call, make arrangements, ask permission to come onto the land that these groups have access to. I can enroll in the class they are enrolled in, if there's availability. I can learn what they have available to learn when they have opportunities to enroll and learn. But my question, my frustration with this is, can you teach me what my mother can about the area, the land and the practices that took place here before our time? Can you show me where my kupuna stood, where my grandmother fished and gathered from? Can you sit at the site with me and tell me the stories my grandfather, even my great grandfather told my mother to share with me and my children? Simply put, no. KSBE can't teach me these things, my kupuna can, my mother can. Let the kupuna teach us, on their time, in their own way, on the land which is home to us.

It is understood clearly that you, KSBE are the land owners. You alone are the final say in what goes on with this land. But I ask, is it really your land? Or are you the ones chosen to protect and uphold the culture and history of this land? You may physically own it, but really this land and all its cultural value and beauty belong to the people. Our kupuna, our 'ohana were the ones born and raised here, living off of this land, worshiping and working on this land. I believe that the 'ohana of this land should be a part of the planning, or at least given the chance to give their mana'o on your plans. Give the 'ohana the chance to make a meaningful contribution to this project, to realize our potential for positive involvement in preserving the area, our culture, and our history as well as making this remarkable property available to those with it in their heart to become one with the area.

I have been informed that there is a small circle group that you reach out to for input and information on the area or specific topics. That is a start, but why should you stop there? Open this group up; there is more mana'o available to you if you open your mind and hearts to receive it. Many think that this is the time to fight, to attempt to stop what is going on, I disagree. What will be done, will be done but if we all come together and willingly work together, what can be done is unstoppable. We can see a project come forth that we can all be proud of, proud to be a part of. But for that to happen, you, KSBE need to welcome that

participation. A council, I feel is a great way to make this happen. A group of 'ohana from the area as well as experts and the KSBE staff should come together as this council, officially. Mana'o can be shared both ways, and I believe more kōkua and support for your project will come forward when the 'ohana feels that KSBE wants that and honestly feels that working together is the best option for the Keauhou-Kahalu'u preservation.

Mahalo for your time, I look forward to seeing the progress of this project guided by reaching out to all whose genealogy encompasses generations at Kahalu'u.

Me ke aloha pumehana,

Christine K. Epenesa

Cc: Kahalu'u Ma kai Project
Scott Ezer
Talia Ruth
Mikahala Roy
Lily Kong
Aloha Aina Music
Royal Order of Kamehameha I, Moku O Kona
Nā Wai Iwi Ola Foundation

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May 27, 2014

Ms. Christine K. Epenesa
P.O. Box 291
Kailua-Kona, Hawai'i 96745-0291

Dear Ms. Epenesa:

Subject: Kamehameha Schools Kahalu'u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu'u, Hawai'i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of November 5, 2013 providing comments as part of pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

Thank you for taking the time to attend the community meeting held on October 17th. We also appreciate you sharing your experiences and cultural history for the property. Kamehameha Schools (KS) appreciates your input on access to the site for various groups such as lineal and cultural descendants, kupuna, various members of the 'ohana, and general public. Managing access is a priority for the safety of students and to minimize disruptions to activities, however, KS will provide separate accommodations for lineal and cultural descendants wanting to visit the site from tours associated with general visitors to the property. Such separate accommodations will also include kupuna or other members of the 'ohana wanting to visit the site.

KS has conducted extensive outreach to lineal and cultural descendants, community organizations, and individuals regarding this project, and will continue to do so to keep everyone apprised of the project status. Your suggestion for establishing a council for consultations is appreciated and will be taken into consideration.

A copy of the Draft EA will be submitted to you for review and comments as a pdf file format on a CD. Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

P.O. Box 437462, Kamuela, Hawai'i 96743 | Tel.808-887-6411 | Fax.808-885-6707 | www.kohalacenter.org

THE KOHALA CENTER
education. environment. empowerment.

November 7, 2013

Mr. Ronald Sato, AICP
Helber Hastert & Fee Planners, Inc.
733 Bishop Street, Suite 2590
Honolulu, HI 96813

Dear Mr. Sato,

Thank you for inviting us to offer comments on the preparation of the Draft EA for Kamehameha Schools Kahalu'u Ma Kai Project. Through a ten-year MOA with the County of Hawai'i, The Kohala Center manages the beach park at Kahalu'u Bay, just north of your project site. Through the Kahalu'u Bay Education Center, established in partnership with the County of Hawai'i, we are working to improve the natural environment through educational, public outreach, and research efforts that teach respect and reverence for the natural and cultural resources of Kahalu'u Bay.

We are excited that another jewel in the Kahalu'u *ahupua'a* is to be enhanced with the purpose of educating Hawai'i's students, teachers, residents and visitors. We at The Kohala Center (TKC) ask to work together with Kamehameha Schools Keauhou-Kahalu'u Education Group (KKEG) as you evolve plans for Kahalu'u Ma Kai and as we implement our long term plans for Kahalu'u Bay, so that the two resources be planned in consideration of each other and within the larger context of the Kahalu'u *ahupua'a*. With collaboration toward a common goal of land stewardship and on-site education, we can set the path for the protection of Kahalu'u's cultural and natural resources for generations to come.

As you prepare the Draft Environmental Assessment, we ask that you include the following considerations:

Traffic and parking – Please describe how the flow of daily visitors and special event guests are to be accommodated through management of access, provisions of on- and off-site parking, bus service, etc. With over 400,000 learners (including KS beneficiaries), teachers, residents, and visitors accessing Kahalu'u Bay annually, we are well aware of demand to explore and enjoy coastal Kahalu'u. We believe that Kahalu'u Ma Kai will generate the same enthusiasm, and with it, the challenge of balancing access and education with protection of natural and cultural resources at the project site and nearby.

Visual Impact – As you develop physical plans, please consider the location of service areas and back-of- house functions and their visual impact to surrounding public areas, including Kahalu‘u Beach Park. Please also describe the visual character of the facilities to be developed.

Construction impact to nearshore environment – Please describe measures to prevent adverse impacts of construction activities to water quality and the nearshore environment.

Cumulative Impacts – Please consider cumulative impacts of surrounding projects, to include Towne Development plans for Parcel 26, upon infrastructure and traffic.

To conclude, *mahalo* for including us in the environmental review process. We look forward to collaborating in our mutual goals of protecting the cultural and natural resources of the Kahalu‘u *ahupua‘a*, sharing these resources through place-based hands-on education, and nurturing the stewards of tomorrow.

Sincerely,

Cindi Punihaole
Program Director
Kahalu‘u Bay Education Center

Cc: Robert Fitzgerald, Deputy Director County of Hawai‘i Parks and Recreation

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May 27, 2014

Ms. Cindi Punihaole, Program Director
Kahalu‘u Bay Education Center
The Kohala Center
P.O. Box 437462
Kamuela, Hawai‘i 96743

Dear Ms. Punihaole:

Subject: Kamehameha Schools Kahalu‘u Ma Kai Project
Draft Environmental Assessment Pre-Assessment Consultation
Kahalu‘u, Hawai‘i
TMK (3) 7-08-013: 002, 013, 042 and 043

Thank you for your letter of November 7, 2013 providing comments as part of pre-assessment consultation efforts for the preparation of the Draft Environmental Assessment (Draft EA) for the subject project.

Thank you for the information on the Kahalu‘u Bay Education Center and your organization's efforts with Kamehameha School's Keauhou-Kahalu‘u Education Group. The Draft EA will address the project's effects on traffic and on-site parking conditions. A traffic impact analysis study will be included in the document. We would like to point out that traffic generated from this project would be considerably less than that occurring under the former Keauhou Beach Resort operations.

Visual impact from redevelopment of the site with new facilities will be addressed. Information on the visual character of new facilities planned will also be included in the Draft EA. Overall, the project should have a beneficial effect on visual resources, particularly due to the demolition of the 7-story hotel structure.

Construction-related effects on the nearshore environment will also be addressed. Best management practices will be incorporated into design plans to minimize effects. Overall, the redevelopment of the site should have a beneficial effect on water quality due to a significant decrease in impervious surfaces a and resulting decrease in storm water runoff from the site. Cumulative impacts will also be addressed and include the Towne Development project.

A copy of the Draft EA will be submitted to you for review and comments as a pdf file format on a CD. Thank you for your participation in this process. If you need additional information, please contact me by phone at 457-3172, or by email at rsato@hhf.com.

Sincerely,

Ronald A. Sato, AICP
Associate

Pacific Guardian Center • 733 Bishop Street, Suite 2590 • Honolulu, Hawaii 96813
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Appendix B

BOTANICAL SURVEY

Botanical Survey of Kahalu‘u Ma Kai Project Area
Island of Hawai‘i

By Ron Terry, Ph.D., and Layne Yoshida, B.A.
Geometrician Associates, LLC
With assistance of Peter Van Dyke
Manager, Amy B.H. Greenwell Ethnobotanical Garden

Prepared for Helber Hastert Fee
March 2014

Areas and Scope of Survey

At the request of planner Ronald Sato, Geometrician Associates conducted a botanical survey of an approximately 22.73-acre shoreline property comprising three TMKs (3-7-8-013:013 and 043 and 3-7-8-013:002) (Figures 1-2). This is currently the site of the recently closed (October 2012) Keauhou Beach Resort Hotel and the long demolished Kona Lagoon Hotel, between Ali‘i Drive and the shoreline, at Kahalu‘u, Island of Hawai‘i. The survey involved a full assessment of flora and vegetation. The objectives of the botanical survey were to 1) describe the vegetation; 2) list all species encountered; and 3) identify threatened or endangered plant species.

A further goal of the project was to assess the general impact on botanical resources of the proposal by landowner Kamehameha Schools (KS) to establish an educational and cultural complex as part of a project called Kahalu‘u Ma Kai. According to KS, the purpose for this project is to facilitate its mission of education by restoring a historically and culturally significant property to support ‘āina-based educational and culture-based instructional approach in West Hawai‘i. Activities involving physical alteration of the existing grounds include demolition of the former hotel facilities (Figure 3).

We surveyed the area on foot during the course of one day in May 2013 and were able to visit all areas. Plant species were identified in the field. Special attention was given to the possible presence of any federally (USFWS 2013) listed threatened or endangered plant species. We were able to make definitive identifications to at least the genus level of all but a few species, which by reason of being sterile or juvenile we were not able to identify. All unidentified species were non-native ornamental or weed species. During this visit and a follow-up one by Peter Van Dyke, Manager of the Amy B.H. Greenwell Ethnobotanical Garden in Captain Cook, we were also able to confirm identifications of several specimens of an endangered palm (*Pritchardia maideniana*), some of which been previously identified by a landscape architect as part of a tree survey on the property undertaken in April 2013 (Figure 4).

Vegetation Type and Influences

The property is located just above sea level and thus the temperature is uniformly warm. Average annual rainfall is about 40 inches, with a summer maximum (UH Hilo Dept. of Geography 1998:56). The geologic substrate is Holocene lava from Hualalai Volcano. Gagne and Cuddihy (1990) described the vegetation in fairly undisturbed littoral areas of Kona as strand vegetation, in which the flora consists of largely pantropical species that disperse in the ocean, are tolerant of salt, and do not often occur inland. Early Hawaiian and subsequent agricultural residential activities together with the spread of weedy plants and trees have totally largely transformed the area, although remnants of the original shoreline plants remain.

The survey area consists of several vegetation types. Most of the area is fully managed and landscaped as part of the grounds of a resort hotel that has just ceased operations and a Hawaiian cultural activity area on the site of a demolished hotel. There are a few small waste areas within the former hotel grounds that are dominated by weeds. Finally, the coastal fringe has natural or semi-managed littoral and an area that appears to contain vegetation that would be classified as wetlands (Figure 5).

Flora

A full list of the roughly 150 plant species found in the surveyed areas is contained in Table 1, below. Most of the plants are non-natives, with only 11 certain native species. There were 10 indigenous (found in Hawai‘i as well as elsewhere), including the trees *hala* (*Pandanus tectorius*) and *kou* (*Cordia subcordata*); the shrubs *‘uhaloa* (*Waltheria indica*) and *naupaka* (*Scaevola sericea*); the herbs *akulikuli* (*Sesuvium portulacastrum*) and *pohinahina* (*Vitex rotundifolia*); the vine *pohuehue* (*Ipomoea pes-caprae*); the fern ally *moa* (*Psilotum nudum*); and the sedges *ahuawa* (*Mariscus javanicus*) and *Pycreus polystachyos*. There were also three species that are likely indigenous, the trees *hau* (*Hibiscus tiliaceus*) and *milo* (*Thespesia populnea*) and the grass *Chrysopogon aciculatus*. Aside from the endangered palm discussed above, there were no other endemic species (found in Hawai‘i and nowhere else).

Of the many non-native species, some individuals are notable because of their size, beauty and general cultural significance, including Polynesian introductions such as coconut palms (*Cocos nucifera*), *kukui* (*Aleurites moluccana*) and *kamani* (*Calophyllum inophyllum*); 19th century introductions with special meaning in Kona, such as tamarind (*Tamarindus indica*); and later introductions that are especially scenic, including royal poinciana (*Delonix regia*) and a large variety of palms.

Threatened and Endangered Plant Species

As discussed above, several individuals of the listed endangered plant species *Pritchardia maideniana* were found in the locations mapped in Figure 4. No other threatened or endangered species was observed, and given the context, none are likely to be present.

Impacts and Mitigation Measures

As discussed above, activities would include demolition of the former hotel facilities and restoration of the Kapuanoni Heiau and other sites within the property. KS has indicated that landscape restoration would include removal of non-native and invasive plants and trees along with diseased trees. Native plants and trees will be used as part of landscape improvements implemented on site. Such plants would also support both educational and cultural practitioner activities. Some of these activities will occur in or near the lagoon and nearshore waters and would require future coordination with resource and regulatory agencies.

In general, the flora of the area is not sensitive from a conservation biology perspective, as the property is essentially a garden of mostly non-native ornamental plants that have mainly aesthetic value.

Although the endangered *loulu* palms were presumably planted as part of landscaping, and the loss of these individual plants would not have an effect on conservation of this plant, it is a listed endangered species that has certain protections. The Hawai‘i Division of Forestry and Wildlife and the U.S. Fish and Wildlife Service should be contacted if there are plans to remove or relocate these individuals to determine legal requirements and mitigation, if any. In addition, the existing *loulu* on the property might represent a seed source for agency recovery actions for the species, particularly if any of them are determined to be wild individuals.

The strand vegetation found on the south end of the property, and the tidal wetlands near the center are two sensitive vegetation types (see Figure 5). Redevelopment of the property should avoid disturbance to these areas. If activities are planned in close proximity to any area that exhibits submergence or near submergence during high tides, these wetlands should be delineated by a professional wetland analyst and the U.S. Army Corps of Engineers should be consulted.

Limitations

No biological survey can claim to have detected every species present. Some plant species are cryptic in juvenile or even mature stages of their life cycle. Dry conditions can render almost undetectable plants that extended rainfall may later invigorate and make obvious. The findings of this survey must therefore be interpreted with proper caution; in particular, there is no warranty as to the absence of any particular species.

REFERENCES

Gagne, W., and L. Cuddihy. 1990. “Vegetation,” pp. 45-114 in W.L. Wagner, D.R. Herbst, and S.H. Sohmer, eds., *Manual of the Flowering Plants of Hawai‘i.* 2 vols. Honolulu: University of Hawai‘i Press.

University of Hawai‘i at Hilo, Dept. of Geography. 1998. *Atlas of Hawai‘i.* 3rd ed. Honolulu: University of Hawai‘i Press.

U.S. Fish and Wildlife Service (USFWS). 2013. *USFWS Threatened and Endangered Species System (TESS).* Washington: GPO. http://ecos.fws.gov/tess_public/StartTESS.do.

Table 1. Plant Species Detected at Property

Scientific Name	Family	Common Name	Life Form	Status*
Abutilon grandifolium	Malvaceae	Hairy Abutilon	Shrub	A
Albizia lebbeck	Fabaceae	Siris Tree	Tree	A
Aleurites moluccana	Euphorbiaceae	Kukui	Tree	A
Allamanda sp.	Apocynaceae	Allamanda	Herb	A
Aloe vera	Aloeaceae	Aloe	Herb	A
Alpinia purpurata	Zingiberaceae	Red Ginger	Herb	A
Alpinia zerumbet	Zingiberaceae	Shell Ginger	Herb	A
Alternanthera pungens	Amaranthaceae	Alternanthera	Herb	A
Amaranthus viridus	Amaranthaceae	Amaranthus	Herb	A
Archontophoenix alexandrae	Arecaceae	Alexandra Palm	Tree	A
Asystasia gangetica	Acanthaceae	Chinese Violet	Vine	A
Autocarpus altilis	Moraceae	Ulu	Tree	A
Barleria cristata	Acanthaceae	Barleria	Herb	A
Batis maritima	Bataceae	Batis	Herb	A
Bidens cynapiifolia	Asteraceae	Bidens	Herb	A
Boerhavia coccinea	Nyctaginaceae	Boerhavia	Herb	A
Bougainvillea sp.	Nyctaginaceae	Bougainvillea	Shrub	A
Calophyllum inophyllum	Clusiaceae	Kamani	Tree	A
Capsicum sp.	Solanaceae	Pepper	Herb	A
Carica papaya	Caricaceae	Papaya	Shrub	A
Catharanthus roseus	Apocynaceae	Madagascar Periwinkle	Herb	A
Centella asiatica	Apiaceae	Asiatic Pennywort	Herb	A
Cerbera manghas	Apocynaceae	Cerbera	Tree	A
Chamaesyce hirta	Euphorbiaceae	Spurge	Herb	A
Chamaesyce hypericifolia	Euphorbiaceae	Graceful Spurge	Herb	A
Chamaesyce prostrata	Euphorbiaceae	Spurge	Herb	A
Chloris barbata	Poaceae	Fingergrass	Grass	A
Chlorophytum sp.	Lilliaceae	Chlorophytum	Herb	A
Chrysopogon aciculatus	Poaceae	Chrysopogon	Herb	I?
Citrus sp.	Rutaceae	Citrus	Shrub	A
Cleome gynandra	Capparaceae	Spider Wisp	Herb	A
Clusia rosea	Clusiaceae	Autograph Tree	Tree	A
Cocos nucifera	Arecaceae	Niu	Tree	A
Codiaeum variegatum	Euphorbiaceae	Croton	Shrub	A
Commelina benghalensis	Commelinaceae	Commelina	Herb	A
Cordia subcordata	Boraginaceae	Kou	Tree	I
Cordyline fruticosa	Agavaceae	Ki	Shrub	A
Crescentia cujete	Bignoniaceae	Calabash Tree	Tree	A
Crinum spp.	Lilliaceae	Crinum	Herb	A
Cynodon dactylon	Poaceae	Bermuda Grass	Grass	A
Cyperus involucratus	Cyperaceae	Cyperus	Herb	A
Cyperus sp.	Cyperaceae	Cyperus	Herb	A
Delonix regia	Fabaceae	Royal Poinciana	Tree	A
Digitaria insularis	Poaceae	Sourgrass	Grass	A

Table 1, continued				
Scientific Name	**Family**	**Common Name**	**Life Form**	**Status***
Dracaena fragrans	Agavaceae	Massangeana	Shrub	A
Dracaena marginata	Agavaceae	Money Tree	Shrub	A
Dracaena reflexa	Agavaceae	Dracaena	Shrub	A
Eleusine indica	Poaceae	Wiregrass	Grass	A
Epipremnum pinnatum	Araceae	Pothos	Vine	A
Eragrostis sp.	Poaceae	Eragrostis	Grass	A
Euphorbia sp.	Euphorbiaceae	Euphorbia	Herb	A
Ficus microcarpa	Moraceae	Banyan	Tree	A
Gardenia taitensis	Rubiaceae	Tiare	Shrub	A
Graptophyllum sp.	Acanthaceae	Graptophyllum	Shrub	A
Hedyotis corymbosa	Rubiaceae	Hedyotis	Herb	A
Heliconia psittacorum	Heliconiaceae	Heliconia	Herb	A
Heliconia rostrata	Heliconiaceae	Heliconia	Herb	A
Heliconia sp.	Heliconiaceae	Heliconia	Herb	A
Hibiscus spp.	Malvaceae	Hibiscus	Shrub	A
Hibiscus tiliaceus	Malvaceae	Hau	Tree	I?
Hyophorbe lagenicaulis	Arecaceae	Bottle Palm	Tree	A
Hyptis pectinata	Lamiaceae	Hyptis	Herb	A
Ipomoea alba	Convolvulaceae	Moon Flower	Vine	A
Ipomoea batatas	Convolvulaceae	Sweet Potato	Vine	A
Ipomoea obscura	Convolvulaceae	Ipomoea	Vine	A
Ipomoea pes-carpe	Convolvulaceae	Beach Morning Glory	Vine	I
Jatropha integerrima	Euphorbiaceae	Jatropha	Shrub	A
Kalanchoe tubiflora	Crassulaceae	Kalanchoe	Herb	A
Kyllinga brevifolia	Cyperaceae	Kyllinga	Herb	A
Kyllinga nemoralis	Cyperaceae	Kyllinga	Herb	A
Lantana sp.	Verbenacae	Lantana	Shrub	A
Leucaena leucocephala	Fabaceae	Koa Haole	Shrub	A
Livistona chinensis	Arecaceae	Chinese Fan Palm	Tree	A
Lycopersicon sp.	Solanaceae	Tomato	Herb	A
Macadamia integrifolia	Proteaceae	Macadamia	Tree	A
Mariscus javanicus	Cyperaceae	Cyperus	Herb	I
Megathyrsus maximus	Poaceae	Guinea Grass	Grass	A
Microsorum scolopendria	Polypodiaceae	Maile Scented Fern	Fern	A
Momordica charantia	Cucurbitaceae	Balsam Pear	Vine	A
Monstera deliciosa	Araceae	Monstera	Shrub	A
Morinda citrifolia	Rubiaceae	Noni	Shrub	A
Murraya paniculata	Rutaceae	Mock Orange	Shrub	A
Musa sp.	Heliconiaceae	Banana	Shrub	A
Nerium oleander	Apocynaceae	Oleander	Shrub	A
Noronhia emarginata	Oleaceae	Madagascar Olive	Shrub	A
Oxalis corymbosa	Oxalidaceae	Pink Wood Sorrel	Herb	A
Pandanus tectorius	Pandanaceae	Hala	Tree	I

Table 1, continued				
Scientific Name	**Family**	**Common Name**	**Life Form**	**Status***
Passiflora edulis	Passifloraceae	Passion Fruit	Vine	A
Passiflora suberosa	Passifloraceae	Passiflora	Vine	A
Philodendron bipinnatifidum	Araceae	Philodendron	Shrub	A
Philodendron spp.	Araceae	Philodendron	Shrub	A
Phoenix roebelenii	Arecaceae	Pygmy Date Palm	Shrub	A
Phyllanthus debilis	Euphorbiaceae	Niruri	Herb	A
Phyllantus sp.	Euphorbiaceae	Phyllanthus	Shrub	A
Pithecellobium dulce	Fabaceae	Opiuma	Tree	A
Plantago major	Plantaginaceae	Common Plantain	Herb	A
Pluchea symphytifolia	Asteraceae	Sourbush	Shrub	A
Plumbago auriculata	Plumbaginaceae	Plumbago	Shrub	A
Plumeria obtusa	Apocynaceae	Singapore Plumeria	Shrub	A
Plumeria rubra	Apocynaceae	Plumeria	Shrub	A
Polyscias guilfoylei	Araliaceae	Panax	Shrub	A
Polyscias scutellaria	Araliaceae	Panax	Shrub	A
Polyscias sp.	Araliaceae	Panax	Shrub	A
Portulaca oleracea	Portulacaceae	Pigweed	Herb	A
Portulaca pilosa	Portulacaceae	Portulaca	Herb	A
Pritcharadia thurstonii	Arecaceae	Thurston Fan Palm	Tree	A
Pritchardia maideniana	Arecaceae	Loulu	Tree	E, END
Pritchardia pacifica	Arecaceae	Fiji Fan Palm	Tree	A
Prosopis pallida	Fabaceae	Kiawe	Tree	A
Pseuderanthemum carruthersii	Acanthaceae	Pseuderanthemum	Shrub	A
Psilotum nudum	Psilotaceae	Moa	Herb	I
Ptychosperma elegans	Arecaceae	Solitaire Palm	Tree	A
Ptychosperma macarthurii	Arecaceae	Macarthur Palm	Tree	A
Pycreus polystachyos	Cyperaceae	Cyperus	Herb	I
Rhynchelytrum repens	Poaceae	Natal Red Top	Grass	A
Roystonea regia	Arecaceae	Royal Palm	Tree	A
Samanea saman	Fabaceae	Monkeypod	Tree	A
Sansevieria sp.	Agavaceae	Sansevieria	Herb	A
Scaevola sericea	Goodeniaceae	Beach Naupaka	Shrub	I
Schefflera actinophylla	Araliaceae	Umbrella Tree	Tree	A
Schefflera arboricola	Araliaceae	Dwarf Umbrella Tree	Shrub	A
Senecio madagascariensis	Asteraceae	Senecio	Herb	A
Sesuvium portulacastrum	Aizoaceae	Akulikuli	Herb	I
Spathodea campanulata	Bignoniaceae	African Tulip	Tree	A
Sphagneticola trilobata	Asteraceae	Wedelia	Herb	A
Strelitzia nicolai	Strelitziaceae	Giant Bird of Paradise	Shrub	A
Strelitzia regina	Strelitziaceae	Bird of Paradise	Herb	A
Syagrus romanzoffiana	Arecaceae	Queen Palm	Tree	A
Syngonnium sp.	Araceae	Syngonium	Vine	A
Syzygium cumini	Myrtaceae	Java Plum	Tree	A
Tabebuia heterophylla	Bignoniaceae	Pink Tecoma	Tree	A
Talinum sp.	Portulacaceae	Talinum	Herb	A

Table 1, continued				
Scientific Name	**Family**	**Common Name**	**Life Form**	**Status***
Tamarindus indica	Fabaceae	Tamarind	Tree	A
Terminalia catappa	Combretaceae	False Kamani	Tree	A
Thespesia populnea	Malvaceae	Milo	Tree	A
Tournefortia argentea	Boraginaceae	Tree Heliotrope	Shrub	A
Tradescantia spathacea	Commelinaceae	Rhoeo	Herb	A
Tradescantia zebrina	Commelinaceae	Zebrina	Herb	A
Tridax procumbens	Asteraceae	Coat Buttons	Herb	A
Triumfetta rhomboidea	Tiliaceae	Triumfetta	Shrub	A
Veitchia merrillii	Arecaceae	Manila Palm	Tree	A
Vernonia cinerea	Asteraceae	Vernonia	Herb	A
Vitex rotundifolia	Verbenaceae	Pohinahina	Herb	I
Waltheria indica	Sterculiaceae	Waltheria	Herb	I
Youngia japonica	Asteraceae	Youngia	Herb	A
Zoysia sp.	Poaceae	Zoysia	Grass	A

*A=Alien E=Endemic I=Indigenous END=Federal and State Listed Endangered

We were unable to identify several plants that lacked fruit , flowers or other identifying characteristics. These included a bromeliad, a lily, and orchid, a composite, and one ornamental shrub not identifiable to family.

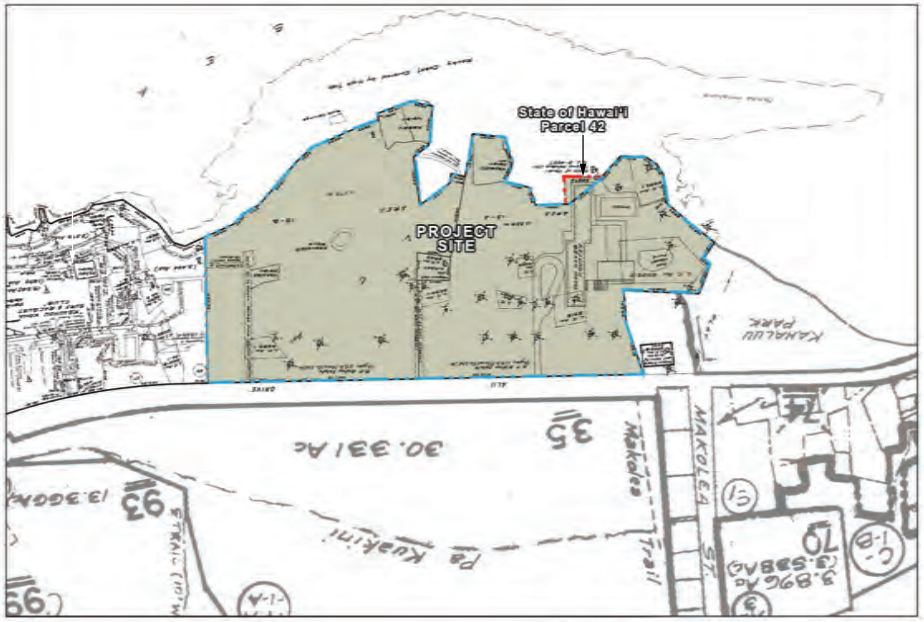
Source: State of Hawai'i GIS Data

KAHALU'U MA KAI

Figure 1 - Project Location Map

Kahalu'u, Hawai'i

0 175 350 FEET



KAHALU'U MANOWAI

Figure 2 - Tax Map Key

Kahalu'u, Hawai'i

0 175 350 FEET

DRAFT CONCEPTUAL SITE PLAN

KAHALU'U MA KAI - December 2013

kya design group

Figure 4. Portion of Existing Tree Plan Indicating Location of Loulu Palms

Figure 5. Location of Strand and Potential Wetlands Vegetation

Appendix C

AVIAN AND TERRESTRIAL MAMMALS SURVEY

Avian and Terrestrial Mammalian Species Surveys Conducted for the Kahalu‘u Ma Kai Project, North Kona District, Island of Hawai‘i

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Introduction and Background

Kamehameha Schools (KS) is proposing to establish an educational and cultural complex on their property located in the Kahalu'u Ahupua'a on the Island of Hawai'i. Activities would include the demolition of the former Keauhou Beach Resort Hotel facilities and remnant Kona Lagoon Hotel facilities, construction of several new structures on the property, and preservation of historic sites. The project site encompasses approximately 22.73 acres of land identified as Tax Map Key (TMK (3) 7-08-013: 002, 013, and 043; and (3) 7-08-013: 042 (State Property) (figure 1).

This report describes the methods used and the results of the avian and terrestrial mammalian surveys conducted on the subject property. The primary purpose of the surveys was to determine whether any species currently proposed for, or listed as threatened or endangered under either federal of State of Hawai'i endangered species statutes are present within the project site. The federal and State of Hawai'i listed species status follows species identified in the following referenced documents, Department of Land and Natural Resources (DLNR) 1998; U. S. Fish & Wildlife Service (USFWS 2005a, 2005b, 2013). Fieldwork was conducted on August 22, 2013.

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text.

General Project and Site Description

The project site is located on the west side of the Island of Hawai'i along the Keauhou-Kahalu'u coastline immediately south of Kahalu'u Bay. The project site consists of approximately 22.73 acres of shoreline property made up of four individual parcels of land. The property is bordered to the north by Kahalu'u Bay, to east by Ali'i Drive, and to the south by the Keauhou-Kona Surf and Racquet Club. This property was formerly the site of the Kona Lagoon Hotel, which was demolished in 2004, and the recently closed Keauhou Beach Resort, which was closed in October 2012.

The project site is comprised of three parcels that are owned by KS and one parcel owned by the State of Hawai'i. The Tax Map Key (TMK) for the three parcels owned by KS are: (3) 7-08-013: 002, 013, and 043. TMK 7-08-013: 042 is a small parcel of about 0.13 acres (5,557 square feet) owned by the State of Hawai'i because it extends beyond the shoreline. This parcel is leased to KS by the State, and includes the portion of the existing resort hotel structure that extends beyond the shoreline into the lagoon.

The project site is generally located along the shoreline in the Kahalu'u Ahupua'a. This site includes large areas that were extensively altered by the construction of the Keauhou Beach Resort and the former Kona Lagoon Hotel.

The southern half of the site is the former Kona Lagoon Hotel site, which was demolished and removed some years ago (Figure 4). It currently consists of a large lawn, and temporary tent structures used to support educational and cultural programs presently being conducted on the site. The majority of the former paved parking lots are still present, along with the Mākole'ā Heiau, and a sewage pump station. A small strip of sandy rocky beach about 600 feet in length is present at the southern end of this site.

Vegetation on the overall site is a mix of ornamental plantings and lawns. The ornamental gardens at the Keauhou Beach Hotel are still being maintained (Figure 3).

Figure 2 – Oblique aerial view of the subject property showing existing conditions

Figure 3 – Ornamental planting on the Keauhou Beach Hotel site looking north

Figure 4 – Grassy field and tents located on the former Kona Lagoons Hotel site looking south

Methods

The avian phylogenetic order and nomenclature used in this report follows the *AOU Check-List of North American Birds* (American Ornithologists' Union, 1998), and the 42nd through the 51st supplements to the Check-List (American Ornithologists' Union, 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chesser *et al.*, 2009, 2010, 2011, 2012, 2013). Mammal scientific names follow (Wilson and Reeder, 2005). Place names follow (Pukui *et al.*, 1976).

Avian Survey Methods

Four avian count stations were sited equidistant from each other across the project site. A single eight-minute avian point count was made at each of the four count stations. Field observations were made with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. The counts and subsequent searches of the site, was conducted between 7:00 am and 10:00 am. Time not spent counting the point count stations was used to search the remainder of the site for species and habitats not detected during the point counts. Weather conditions were ideal, with no rain, unlimited visibility on the sites and winds of between 3 and 6 kilometers an-hour, during point count periods.

Mammalian Survey Methods

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of Hawai'i are alien species, and most are ubiquitous. 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 site. The mammalian survey was conducted concurrently with the avian survey.

Results

Avian Surveys

A total of 303 individual birds of 16 species, representing 12 separate families, were recorded during the station counts. Two of the species detected, Pacific Golden-Plover, *kōlea* (*Pluvialis fulva*), and Wandering Tattler, *ūlili* (*Tringa inacana*) are native species. Both are indigenous migratory shorebird species. The remaining 14 species recorded during the course of this survey are alien to the Hawaiian Islands (Table 1).

No avian species currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs were detected during the course of this survey (DLNR, 1998; USFWS, 2005a, 2005b, 2013).

Avian diversity was low, though in keeping with the habitat present on the site. Three species, Zebra Dove (*Geopilia striata*), Common Myna (*Acridotheres tristis*) and House Finch (*Haemorhous mexicanus*), accounted for 57 percent of all birds recorded during the station counts. Zebra Dove was the most frequently recorded species, accounting for 31 percent of the total number of individual birds recorded during station counts.

Table 1 - Avian Species Detected During Point Counts Kahalu'u Mai Kai Project Site

Common Name	*Scientific Name*	*ST*	*RA*
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Chicken (Domestic)	*Gallus sp.*	D	0.25
	CHARADRIIFORMES		
	CHARADRIIDAE - Lapwings & Plovers		
	Charadriinae - Plovers		
Pacific Golden-Plover, *kōlea*	*Pluvialis fulva*	IM	1.00
	SCOLOPACIDAE - Sandpipers, Phalaropes & Allies		
	Scolopacinae - Sandpipers & Allies		
Wandering Tattler, *ūlili*	*Tringa incana*	IM	0.25
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	2.00
Zebra Dove	*Geopelia striata*	A	23.30
	PASSERIFORMES		
	ZOSTEROPIDAE - White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	8.00
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	13.50
	THRAUPIDAE - Tanagers		
Yellow-billed Cardinal	*Paroaria capitata*	A	3.50
	EMBERIZIDAE - Emberizids		
Saffron Finch	*Sicalis flaveola*	A	3.50
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	3.00
	FRINGILLIDAE - Fringilline and Carduleline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Haemorhous mexicanus*	A	6.50
Yellow-fronted Canary	*Serinus mozambicus*	A	0.75
	PASSERIDAE - Old World Sparrows		
House Sparrow	*Passer domesticus*	A	4.00
	ESTRILDIDAE - Estrildid Finches		
Lavender Waxbill	*Estrilda caerulescens*	A	1.00
Common Waxbill	*Estrilda astrild*	A	2.75
Java Sparrow	*Padda oryzivora*	A	2.50

KEY TO TABLE 2

ST	Status
D	Domesticated – A species which is introduced and is not established in the wild on the Island of Hawai'i
IM	Indigenous Migrant – Native but not unique to Hawai'i, migrant species that does not breed in Hawai'i
A	Alien – Introduced to the Hawaiian Islands by humans
RA	Relative Abundance – Number of birds detected divided by the number of count stations (4)

Mammalian Survey Results

Three terrestrial mammalian species were detected during the course of this survey. One dog (*Canis familiaris*) was seen on the property adjacent to the site along the southern boundary of the survey area. Three cats (*Felis catus*) were seen on the grounds of the Keauhou Beach Hotel and several small Indian mongooses (*Herpestes auropunctatus*) were seen at various locations on the site.

Hawai'i's sole endemic terrestrial mammalian species, the endangered Hawaiian hoary bat, was not detected during this survey. All of the alien mammalian species recorded during this survey are deleterious to avian and floristic components of the remaining native ecosystems present on the Island.

Discussion

Avian Resources

The findings of the avian survey are consistent with the location of the site, and the habitats present on it. As previously discussed, two of the species detected, *kōlea* and *ūlili* are native to the Hawaiian Islands (Table 1). Both are indigenous migratory shorebird species that nests in the high Arctic during the late spring and summer months, returning to Hawai'i and the Tropical Pacific to spend the fall and winter months each year. They usually leave Hawai'i for their trip back to the Arctic in late April or the very early part of May each year. The remaining 14 species recorded are alien to the Hawaiian Islands.

Although no seabirds were detected during this survey, it is probable that the endangered Hawaiian Petrel, *'ua'u* (*Pterodroma sandwichensis*), and the threatened endemic sub-species of the Newell's Shearwater, *'a'o* (*Puffinus auricularis newelli*), over-fly the project area in small numbers between April and the middle of December each year. Both of these pelagic seabird species nest high in the mountains in burrows excavated under thick vegetation, especially '*uluhe* (*Dicranopteris linerais*) fern. There is no suitable nesting habitat for either of these seabird species on, or close to this site. It is also possible that several non-listed indigenous seabird species overfly the site on a seasonal and temporal basis as well.

The primary cause of mortality in the two aforementioned listed seabird species 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 the second most significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for 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).

Mammalian Resources

The findings of the mammalian survey are consistent with the location of the site, and the habitat present on it. All of the terrestrial mammalian species recorded during the course of this survey of the site are alien to the Hawaiian Islands.

Although no rodents were detected during the course of this survey, it is probable that the four established *muridae* known from the Island of Hawai'i, European house mouse (*Mus musculus domesticus*), roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), and possibly black rat (*Rattus exulans hawaiiensis*) use resources within the subject site and within the general project area on a seasonal or temporal basis. All of these introduced rodents are deleterious to native ecosystems and the native faunal species that are dependant on them.

Although, no Hawaiian hoary bats were recorded during the course of this survey this species is regularly seen foraging over the near-shore areas of the property on a seasonal basis (David 2013). This species is found in almost all areas in the mid-to-low elevation areas on the Island of Hawaii that still maintain dense tree cover (Bonaccorso et al., 2005, 2007, David, 2013).

Potential Impacts to Protected Species

Seabirds

The principal potential impact the proposed action poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with the project during the nesting season. The two main areas that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, 1) during construction it is deemed expedient, or necessary to conduct nighttime construction activities, 2) following build-out, the potential operation of streetlights and security lighting during the seabird nesting season. The demolition of the Keahou Beach Hotel will likely reduce the amount of nocturnal lighting present on the property, thus reducing potential impacts to seabird species from the current level.

Hawaiian hoary bat

The principal potential impact that construction and operation of the proposed action poses to bats is during the clearing and grubbing phase of the construction. The trimming or removal of foliage and/or trees may temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, female carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they themselves forage, and very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 1 and September 15, the period in which bats are potentially at risk from vegetation clearing.

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.

- Following build-out, it is recommended that any streetlights or facility security lighting that may be required for public safety reasons be shielded (Reed et al. 1985, Telfer et al. 1987). This minimization measure would serve the dual purpose of minimizing the threat of disorientation and downing of Hawaiian Petrels and Newell's Shearwaters, while at the same time complying with the Hawai'i County Code § 14 – 50 *et seq*. which requires the shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

- It is recommended that to minimize potential impacts to roosting Hawaiian hoary bats, woody vegetation taller than 4.6 meters (15-feet) high not be cleared between June 1 and September 15.

- It is recommended that, where appropriate and practicable, native plant species be considered for landscaping efforts. Not only is this ecologically prudent, but also if the appropriate plants are used, it will also likely save maintenance and water costs over the long term.

Critical Habitat

There is no federally delineated Critical Habitat present on or adjacent to the project site. Thus, the proposed action will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under state law.

Glossary

Ahupua'a – Traditional Hawaiian land division, usually extending from the uplands to the sea.
'A'o – Newell's Shearwater (*Puffinus auricularis newelli*)
Alien – Introduced to Hawai'i by humans
Endangered – Listed and protected under the Endangered Species Act of 1973, as amended (ESA) as an endangered species
Endemic – Native and unique to the Hawaiian Islands
Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally
Kōlea – Pacific Golden-Plove (*Pluvialis fulva*)
Muridae – Rodents, including rats, mice and voles, one of the most diverse families of mammals
Nocturnal – Night-time, after dark
'Ōpe'ape'a – Endemic endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*)
Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young
Sign – Biological term referring tracks, scat, rubbing, odor, marks, nests, and other signs created by animals by which their presence may be detected
Threatened – Listed and protected under the ESA as a threatened species
'Ūa'u – Hawaiian Petrel (*Pterodroma sandwichensis*)
Ūlili – Wandering Tattler (*Tringa incana*)

DLNR – Department of Land and Natural resources
DOFAW – Division of Forestry and Wildlife
ESA – Endangered Species Act of 1973, as amended
TMK – Tax Map Key
USFWS – United State Fish & Wildlife Service

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Appendix D

AIR QUALITY STUDY

AIR QUALITY STUDY

FOR THE PROPOSED

KAHALU'U MA KAI PROJECT

KAHALU'U, HAWAII

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1.0 SUMMARY

Kamehameha Schools is proposing to establish an educational complex and cultural center at Kahalu'u on the island of Hawaii. The proposed project will involve the demolition and removal of the existing resort facilities on the property and the construction of several new structures and facilities on the approximately 23-acre site. This study examines the potential short- and long-term air quality impacts that could occur as a result of the demolition of the existing facilities and the construction and use of the proposed new facilities. Mitigation measures are suggested, where possible and appropriate, to reduce any potential air quality impacts.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are comparable to the national standards except those for nitrogen dioxide and carbon monoxide which are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the project area is very much affected by its coastal situation and by nearby mountains. Winds are predominantly light and variable, although kona storms generate occasional strong winds from the south or southwest during winter. Temperatures in the project area are generally very consistent and moderate with average daily temperatures ranging from about 65°F to

85°F. The extreme minimum temperature recorded at the nearby Old Kona Airport is 47°F, while the extreme maximum temperature is 93°F. Average annual rainfall in the area amounts to about 28 inches with each month typically contributing about 2 to 3 inches.

Except for persistent impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion, the present air quality of the project area is believed to be relatively good. The limited air quality data that are available for the area from the Department of Health and officially reported to date indicate that air pollution concentrations are generally within state and national air quality standards except for the standard for fine particulate. The elevated fine particulate concentrations are due to vog.

If the proposed project is given the necessary approvals to proceed, there may be some short-term impacts on air quality in the project area due to fugitive dust emissions during project demolition and construction phases. State air pollution control regulations require that there be no visible fugitive dust emissions at the project property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. For this project, the generally light winds at the project site should help to reduce any offsite dust impacts. Project demolition plans currently call for the vacant hotel building to first be gutted of interior components (drywall, plaster, glass, etc.) and then the exterior structure crushed from the top down. Dust control measures will include sealing the windows and building openings during the interior removal work to contain dust emissions and watering of the building structure

during exterior crushing operations. These measures should substantially control fugitive dust emissions during demolition work.

Earth-moving activities associated with the construction of new facilities at the site could also generate fugitive dust emissions. Watering of active work areas is normally the primary means of controlling these dust emissions. Other dust control measures could include use of wind screens, limiting the size of disturbed areas, stabilizing inactive areas, and paving parking areas and establishing landscaping early in the construction schedule.

During both demolition and construction phases of the project, haul trucks should be covered when in motion to prevent windage when hauling loads to and from the site. Haul trucks tracking dirt onto adjacent paved roadways can sometimes be a significant source of dust near construction sites. This should be monitored and steps should be taken if necessary to keep adjacent paved roadways clean.

As a means to evaluate and document the effectiveness of the project dust control program, monitoring of dust at the project boundaries could be considered.

Exhaust emissions from stationary and mobile construction equipment, from the minor disruption of traffic, and from workers' vehicles may also affect air quality during periods of demolition and construction. Exhaust emissions can be mitigated to some

extent by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After project demolition and construction phases are completed, any long-term impacts on air quality due to project-related motor vehicle traffic should be minimal. It is expected that traffic volumes at the project site will be smaller than they were when the project site was in resort use.

2.0 INTRODUCTION

Kamehameha Schools is proposing to establish an educational complex and cultural center on its 22.73-acre shoreline property located in the Kahalu’u Ahupua’a on the island of Hawaii (see Figure 1 for project location). The project site is located on the west side of the Island of Hawaii on the Keauhou-Kahalu’u coastline next to (south of) Kahalu’u Bay. The property is bordered to the north by Kahalu’u Bay, Ali’i Drive on the inland (mauka) side, and the Keauhou-Kona Surf and Racquet Club to the south. The project site is the location of the recently closed Keauhou Beach Resort and was also the site of the Kona Lagoons Hotel before it was demolished in 2004. The main components of the proposed project will consist of:

- Demolition and removal of the existing Keauhou Beach Resort hotel structure and other associated facilities and amenities and the removal of any remnant facilities still present from the Kona Lagoons Hotel.
- Construction of facilities supporting the Kahalu’u Ma Kai cultural educational complex, and conducting various types of educational and cultural related activities on the site.

- Conducting landscape restoration and preservation activities of historic sites within the property.

Demolition work will first involve a “soft demolition” of the hotel interior to remove all wood, plaster, glass, drywall, etc. The removal of the 7-story building super structure with basement parking will then be done in a controlled manner from the top down. The redevelopment of the project site will involve constructing approximately 33,250 square feet of new structures and facilities to support educational and cultural activities on the site. It is expected that demolition work would begin during the summer of 2015 and be completed in 2016. Redevelopment work would begin thereafter and is expected to be completed in phases over a 20-year period.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from demolition work and from construction and use of the proposed new facilities as planned. Measures to mitigate project impacts are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national

and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

The national AAQS are reviewed periodically, and multiple revisions have occurred over the past 30 years. In general, the national AAQS have become more stringent with the passage of time and as more information and evidence become available concerning the detrimental effects of air pollution. Changes to the Hawaii AAQS over the past several years have tended to follow revisions to the national AAQS, making several of the Hawaii AAQS the same as the national AAQS.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

The site of the proposed project is located near the midpoint of the western coast of the island of Hawaii. The topography of Hawaii Island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the

slopes of these mountains and of the broad saddles between them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Nearly the entire western coast of the island of Hawaii, however, is sheltered from the trade winds by high mountains, except when unusually strong trade winds sweep through the saddle between the Kohala Mountains and Mauna Kea and reach some areas to the lee. Due to wind shadow effects caused by the terrain, winds in the project area are predominantly light and variable. Local winds such as land/sea breezes and/or upslope/downslope winds dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or drainage winds that move downslope and out to sea. During winter, occasional strong winds from the south or southwest occur in association with the passage of winter storm systems.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas

exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's leeward location results in a larger temperature profile compared to windward locations at the same elevation. At the Old Kona Airport, located a few miles north of the project site, average daily minimum and maximum temperatures are 67°F and 83°F, respectively [1]. The extreme minimum temperature on record at this location is 47°F, and the extreme maximum is 93°F. Temperatures at the project site are similar.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 is the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Kona area, stability classes 5 or 6 typically occur during the nighttime or early morning hours when temperature inversions form due to radiational cooling or to drainage flow from the mountainous interior of the island. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can

become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3000 feet (1000 meters).

Rainfall can have a beneficial effect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The climate of the project area is somewhat wetter than might be expected for a leeward location. This is due to the persistent onshore and upslope movement of marine air caused by both eddie and seabreeze or mountain slope effects. Some of the rainfall occurs during summer afternoons and evenings as a result of this onshore and upslope movement of moisture-laden marine air, and some occurs in conjunction with winter storms. Historical data for Holualoa Beach (about 3 miles north of the project site) indicate that average annual rainfall amounts to about 28 inches with each month registering about 2 to 3 inches [1]. Rainfall at the project site is very similar.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 2 presents an air pollutant emission summary for the island of Hawaii for calendar year 1993. This has become somewhat dated but is the latest information available. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the manmade particulate emissions on Hawaii originate from area sources, such as the mineral products industry and agriculture. Manmade sulfur oxides are emitted almost exclusively by point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions emanate predominantly from area sources (mostly motor vehicle traffic), although industrial point sources contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources. Based on previous emission inventories that have been reported for Hawaii, emissions of particulate and nitrogen oxides may have increased during the past several years, while emissions of sulfur oxides, carbon monoxide and hydrocarbons probably have declined.

It should be noted that Hawaii Island is unique from the other islands in the state in terms of the natural volcanic air pollution emissions that occur. Volcanic emissions frequently plague the project area. This is especially so since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from the Hawaiian volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed

out as acid rain or gradually transformed into particulate sulfates or acid aerosols. Although emissions from Kilauea are vented on the other side of a mountain barrier more than 50 miles southeast of the project site, the prevailing wind patterns eventually carry some of the emissions into the Kona area. These emissions can be seen in the form of the volcanic haze (vog) which persistently hangs over the area.

The only major industrial source of air pollution in the project vicinity is Hawaii Electric Light Company’s Keahole Power Plant, which is located about 10 miles to the north. Air pollution emissions from Keahole Power Plant consist mostly of sulfur dioxide and oxides of nitrogen.

The project site is situated along Ali’i Drive, which sometimes carries moderate volumes of traffic. Emissions from motor vehicles traversing this roadway, primarily carbon monoxide and nitrogen oxides, may affect local air quality at times.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very limited data are available for Hawaii Island, and even less data are available for the Kona area specifically. During the most recent 5-year period for which data have been reported (2007-2011), the Department of Health operated an air quality monitoring site in the Kealakekua area for measuring sulfur dioxide. Particulate (PM 2.5) was also monitored at this site, but monitoring for this parameter was only initiated during 2008. As indicated in Table 3, measurements of sulfur dioxide concentrations at this location during the 2007-2011 monitoring

period were consistently low with annual average concentrations of 0.003 to 0.009 ppm, which represents about 30 percent or less of the state and national standard. The highest annual second-highest 3-hour and 24-hour concentrations (which are most relevant to the standards) for these five years were 0.112 and 0.042 ppm, respectively; these are about 22 to 30 percent of the applicable standards. No exceedances of the state/national 3-hour and 24-hour AAQS for sulfur dioxide were recorded.

The annual average particulate (PM 2.5) concentrations for the years 2008 through 2011 ranged from 12 to 21 $\mu g/m^3$. Except for the most recent year reported (2011), these values exceed the national annual standard which is set at 15 $\mu g/m^3$. The annual 98th percentile 24-hour concentration (which is most relevant to the national 24-hour standard) was reported to range from 21 to 37 $\mu g/m^3$ between 2008 and 2011. Except for 2011, these values are slightly above or equal to the national standard of 35 $\mu g/m^3$. These higher concentrations of fine particulate are primarily due to volcanic emissions.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems. Concentrations of lead and nitrogen dioxide generally have not been found to exceed AAQS elsewhere in the state. Ozone concentrations, on the other hand, have been found to exceed the state standard at times at Sand Island on Oahu. Carbon monoxide air pollution typically is a microscale problem caused by congested motor vehicular traffic. In traffic congested areas

such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Due to the generally lighter volumes of traffic in the project area, concentrations of carbon monoxide are likely within standards.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project demolition and construction activities. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts: (1) fugitive dust from vehicle movement, soil excavation and demolition activities; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting construction workers, and from the disruption of normal traffic flow caused by roadway lane closures.

Fugitive dust emissions may arise from building demolition work and from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from demolition/construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per

month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions at the project site could be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project demolition and construction phases is essential.

Preliminary plans for the project [4] call for the Keauhou Beach Resort structure to be demolished in a controlled manner from the top down. A form of “soft demolition” of the interior would first be initiated to remove all wood, plaster, glass, drywall, etc. leaving only the building’s exterior walls and structural members. The windows and exterior openings of the building will be sealed, and the interiors will be gutted floor-by-floor. Debris would be deposited in an enclosed chute directly discharging into a roll-off bin. After the interior demolition work is completed, the exterior building shell would then be removed by a large crushing machine working from the exterior inward. Heavy equipment would be used to load the crushed material into trucks for offsite disposal. Controlled watering would be used to reduce dust emissions during the crushing and removing of the building shell.

After the demolition phase of the project is complete, the redevelopment of the project site will involve constructing several new structures to support the new uses of the site. During the redevelopment phase of the project, adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in

construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions.

During both demolition and redevelopment phases of the project, control regulations stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the annual standard for nitrogen dioxide is not likely to be violated by short-term construction equipment emissions. Also, the new short-term (1-hour) standard for nitrogen dioxide is based on a three-year average; thus it is unlikely that relatively short-term construction emissions would exceed the standard. Carbon monoxide emissions from diesel engines are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project demolition and construction activities could obstruct the normal flow of traffic for short periods of times such that overall vehicular emissions in the project area could temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from the project site during periods of low traffic volume.

7.0 LONG-TERM IMPACTS OF PROJECT

After redevelopment is completed, motor vehicle traffic will access the project site on a long-term basis. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates. Redevelopment of the project site is expected to result in smaller volumes of traffic accessing the site compared to when the site was in resort use. Thus, any long-term impacts from project-related motor vehicle traffic compared to when the site was in resort use are not expected.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Existing air quality in the project area is impacted by emissions from Kilauea Volcano. Fine particulate measurements from the Department of Health monitoring station at Kealakekua indicate that the national standards for both the 24-hour and the annual averaging periods may be exceeded. While this phase of Kilauea's eruption has been occurring for more than 25 years and it is unknown when it will end, fine particulate concentrations will go down significantly when it does. Although only limited data are

available from the Department of Health, other air quality parameters are probably within standards in the project area.

The major potential short-term air quality impact of the project could occur from the emission of fugitive dust during demolition and construction phases. Uncontrolled fugitive dust emissions from demolition/construction activities could amount to about 1.2 tons per acre per month, depending on rainfall. The generally light winds in the project area should help to reduce the possibility of fugitive dust impacts.

As currently planned, demolition work will begin with the removal of interior components (drywall, plaster, glass, etc.) with the building sealed to contain dust. Exterior structures of the building will then be crushed from the top down with watering to control dust. These measures will likely be substantially effective in controlling dust emissions during the demolition phase.

To control dust during earth-moving activities associated with the construction of new facilities at the site, active work areas should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust.

During both demolition and construction phases, haul trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area.

Dust monitoring at the project boundaries could be considered as a means to measure and document the effectiveness of the project dust control program.

During demolition and construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After the proposed project is completed, any long-term impacts on air quality in the project area due to emissions from project-related motor vehicle traffic should be negligible. This is because traffic volumes are expected to be lower after the site is redeveloped compared to when it was in resort use.

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Figure 1 - Project Location

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	$\mu g/m^3$	Annual	-	-	50
		24 Hours	150[a]	150[a]	150[b]
Particulate Matter (<2.5 microns)	$\mu g/m^3$	Annual	15[c]	15[c]	-
		24 Hours	35[d]	35[d]	-
Sulfur Dioxide	ppm	Annual	-	-	0.03
		24 Hours	-	-	0.14[b]
		3 Hours	-	0.5[b]	0.5[b]
		1 Hour	0.075[e]	-	-
Nitrogen Dioxide	ppm	Annual	0.053	0.053	0.04
		1 Hour	0.100[f]	-	-
Carbon Monoxide	ppm	8 Hours	9[b]	-	4.4[b]
		1 Hour	35[b]	-	9[b]
Ozone	ppm	8 Hours	0.075[g]	0.075[g]	0.08[g]
Lead	$\mu g/m^3$	3 Months	0.15[h]	0.15[h]	-
		Quarter	1.5[i]	1.5[i]	1.5[i]
Hydrogen Sulfide	ppm	1 Hour	-	-	0.035[b]

[a] Not to be exceeded more than once per year on average over three years.
[b] Not to be exceeded more than once per year.
[c] Three-year average of the weighted annual arithmetic mean.
[d] 98th percentile value of the 24-hour concentrations averaged over three years.
[e] Three-year average of annual fourth-highest daily 1-hour maximum.
[f] 98th percentile value of the daily 1-hour maximum averaged over three years.
[g] Three-year average of annual fourth-highest daily 8-hour maximum.
[h] Rolling 3-month average.
[i] Quarterly average

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF HAWAII, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	30,311	9,157	39,468
Sulfur Oxides	9,345	nil	9,345
Nitrogen Oxides	4,054	8,858	12,912
Carbon Monoxide	3,357	23,934	27,291
Hydrocarbons	1,477	203	1,680

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 3

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST KAHALU'U MA KAI PROJECT

Parameter / Location	2007	2008	2009	2010	2011
Sulfur Dioxide / Kealakekua, Kona					
3-Hour Averaging Period:					
No. of Samples	2756	2445	2560	2625	2709
Highest Concentration (ppm)	0.034	0.124	0.130	0.150	0.065
2nd Highest Concentration (ppm)	0.025	0.112	0.111	0.095	0.053
No. of State AAQS Exceedances	0	0	0	0	0
24-Hour Averaging Period:					
No. of Samples	343	353	365	344	349
Highest Concentration (ppm)	0.011	0.054	0.045	0.039	0.019
2nd Highest Concentration (ppm)	0.011	0.038	0.042	0.034	0.018
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration (ppm)	0.004	0.009	0.004	0.006	0.003
Particulate (PM-2.5) / Kealakekua, Kona					
24-Hour Averaging Period:					
No. of Samples	-	292	352	359	355
Highest Concentration ($\mu g/m^3$)	-	44	61	63	28
98th Percentile Concentration ($\mu g/m^3$)	-	37	37	35	21
No. Occurrences Greater than 35 $\mu g/m^3$	-	10	8	6	0
Annual Average Concentration ($\mu g/m^3$)	-	21	16	18	12

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2007 - 2011"

Appendix E
Noise Study

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Environmental Noise Assessment Report
Keauhou Beach Resort Demolition and Kahalu'u Ma Kai Development
Keauhou, Island of Hawaii, Hawaii

March 2014

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1.0 EXECUTIVE SUMMARY

1.1 The Kahalu'u Ma Kai project is located on the Kahalu'u coastline of the Island of Hawaii south of Kahalu'u Bay. The project site consists of nearly 23 acres bordered by Kahalu'u Bay, Ali'i Drive, and the Keauhou-Kona Surf and Racquet Club. The purpose of the project is to provide a new educational complex and cultural center on the site of the former Keauhou Beach Resort property. This assessment focuses on evaluating noise impacts due to the demolition activities of the existing hotel structures and site features.

1.2 Ambient noise level measurements were conducted at the north and south ends of the project site near the Kahalu'u Beach Park and the Keauhou-Kona Surf and Racquet Club, respectively. The ambient sound levels near the Racquet Club are typical of a rural environment and vary with the time of day based on environmental noise sources (such as birds) and to a lesser extent, vehicular traffic volumes. The ambient sound levels near the beach park fluctuate based on environmental noise sources as well as noises from the park users at the beach and in the parking lot. Daytime noise levels measured at the project site range from 48 A-weighted decibels (dBA) to 64 dBA and nighttime levels range from 44 dBA to 56 dBA. The average day-night level, L_{dn}, on the project site is 58 dBA.

1.3 Construction noises from the demolition of the Keauhou Beach Resort Buildings, and other site demolition work must comply with the Hawai'i Department of Health (DOH) Community Noise Control Rule, which stipulates maximum permissible noise limits at the property line. However, noise levels during construction are expected to exceed these maximum permissible noise limits and a permit must be obtained from the DOH to allow the operation of construction equipment.

1.4 The redevelopment of the project site from resort to an educational complex and cultural center will involve several stages of construction, including establishing "Best Management Practices", abatement of the hotel and other buildings (including soft demolition), demolition of the buildings, and site demolition including finish grading and landscaping. Each of these general stages utilizes various types of construction equipment. Pneumatic jackhammers are anticipated during the building demolition stage and heavy earth moving equipment will be used during the site demolition stage. The actual sound levels that will be experienced in the vicinity of the project site will vary greatly during the project and are a function of the distance from the noise source, the duration of the construction activities, and the number of pieces of equipment used. Construction noise levels were predicted using a noise modeling software at noise receptor locations located adjacent to the project site including Kahalu'u Beach Park, Kahalu'u Bay Villas, Beach Villas at Kahalu'u, Keauhou-Kona Surf & Racquet Club, and Na Hale Keauhou.

1.5 It is anticipated that construction noise levels will exceed the existing ambient noise level at the receptor locations closest to the site. Intermittent construction noises will be clearly audible, especially during the building and site demolition stages. None of the intruding noise would be high enough to cause hearing loss for the nearby residents or park users. However, people may need to raise their voice or reduce the talker-to-listener distance in order to communicate effectively. The severity of the speech interference will depend on how close the residents or park users are to the project site as well as the location of the construction activities. Although this noise disruption would likely occur over the duration of the project's construction, the impact of these disruptions are minor and of a short term duration.

1.6 Noise mitigation for construction activities should be addressed using good management practices to control the noise source. Source control methods include scheduling, equipment selection, retrofitting equipment with mufflers or enclosures, and regular maintenance of equipment. Path control measures include temporary noise barriers or the noise monitoring system during activities located close to the property line.

2.0 PROJECT DESCRIPTION

The Kahalu'u Ma Kai project is located on the Kahalu'u coastline of the Island of Hawaii south of Kahalu'u Bay. The project site consists of nearly 23 acres bordered by Kahalu'u Bay, Ali'i Drive, and the Keauhou-Kona Surf and Racquet Club. The purpose of the project is to provide a new educational complex and cultural center on the site of the former Keauhou Beach Resort property and Kona Lagoons Hotel. While the main components of the project consist of the demolition of the existing hotel structures and site features, construction of the educational complex and cultural center, and landscape restoration, this assessment focuses on evaluating noise impacts due to the demolition activities.

3.0 NOISE STANDARDS

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. A brief description of common acoustic terminology used in these guidelines and standards is presented in Appendix A.

3.1 State of Hawaii, Community Noise Control (DOH)

The State of Hawaii Community Noise Control Rule [Reference 1] defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to *stationary* noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The Community Noise Control Rule does not address most *moving* sources, such as vehicular traffic noise, aircraft noise, or rail transit noise. However, the Community Noise Control Rule does regulate noise related to agricultural, construction, and industrial activities, which may not be stationary.

The maximum permissible noise levels for stationary mechanical equipment are enforced by the State DOH for any location at or beyond the property line and shall not be exceeded for more than 10 percent (%) of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in Figure 1. With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the background noise level is taken into account by DOH.

The criteria for *impulse* or impact noise is separate from stationary noise due to the nature of the sound. DOH defines impulse noise as " any sound with a rapid rise and decay of sound pressure level, lasting less than one second, caused by sudden contact between two or more surfaces…". Noise from pile driving is considered impulse noise and the maximum permissible noise level is 10 dB above the specified noise limits for stationary sources, as shown in Figure 1.

3.2 Federal Transit Administration (FTA)

Although the demolition of the former Keauhou Beach Resort and site construction activities are not associated with mass transit, the criteria developed by the FTA is presented here as a relevant guideline for assessing construction noise. In general, the DOH Community Noise Rule only assesses the impact of a construction project as it relates to nuisance and hours of allowed activity. Project construction noise criteria should take into account the existing noise environment, the equivalent sound levels, L_{eq}, during the construction activities, the duration of the construction activities, and the adjacent land use. While it is not the intention of the FTA to specify standardized criteria for construction noise impact, it has defined guidelines for assessment [Reference 2]. According to the FTA, if the criteria shown in Table 1 are exceeded, there may be adverse community reaction.

Table 1. Federal Transit Administration Construction Noise Impact Threshold

	8- Hour L_{eq} (dBA)	
Land Use	Day (7 AM – 10 PM)	Night (10 PM – 7 AM)
Residential	80	70
Commercial	85	85
Industrial	90	90

3.3 Community Response to Change in Noise Level

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, the average ability of an individual to perceive changes in noise levels is well documented and has been summarized in Table 2 [Reference 3, 4]. These guidelines permit direct estimation of an individual's probable perception of changes in noise levels.

Table 2. Average Ability to Perceive Changes in Noise Level

Sound Level Change (dB)	Human Perception of Sound
0	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	Two times (or 1/2) as loud
20	Four times (or 1/4) as loud

A commonly applied criterion for estimating a community's response to changes in noise level is the 'community response scale' proposed by the International Standards Organization (ISO) of the United Nations [Reference 5]. The scale shown in Table 3 relates changes in noise level to the degree of community response and allows for direct estimation of the probable response of a community to a predicted change in noise level.

Table 3. Community Response to Increases in Noise Levels

Sound Level Change (dB)	Category	Response Description
0	None	No observed reaction
5	Little	Sporadic Complaints
10	Medium	Widespread Complaints
15	Strong	Threats of Community Action
20	Very Strong	Vigorous Community Action

The values stated in Tables 2 and 3 should not be considered regulatory requirements because they are not associated with a specific governing document for this project. However, these tables are very useful in assessing the human perception to changes in sound levels and they are considered to be supplemental information to the governing State of Hawaii Community Noise Control Rule, which does not discuss community response to changes in noise levels.

4.0 EXISTING ACOUSTICAL ENVIRONMENT

Continuous long-term ambient noise level measurements were conducted to assess the existing acoustical environment in the vicinity of the project site. Long-term measurements (taken continuously over the course of multiple days) offer a baseline for establishing existing ambient noise levels in the area and are used for estimating future noise levels by adding the ambient levels to other noise levels generated from the proposed demolition project.

The methodology, location, and results for each of the measurements are described below and the measurement locations are illustrated in Figure 2. Photographs of the measurement locations can be viewed in Appendix B.

4.1 Long Term Noise Measurements

4.1.1 Long-Term Noise Measurement Procedure

Ambient noise level measurements were conducted in two different locations to assess the existing acoustical environment on or near the project site. Continuous, hourly equivalent sound levels, L_{eq}, were recorded for approximately 6 days at each location. The measurements were taken using a Larson-Davis, Model 831, Type 1 Sound Level Meter together with a Larson-Davis, Model 377B20 Type 1 Microphone. Calibration was checked before and after the measurements with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended 2-year calibration period. The microphone was mounted on a tripod, approximately 6 feet above grade. A windscreen covered the microphone during the entire measurement period. The sound level meter was secured in a weather-resistant case.

4.1.2 Long-Term Noise Measurement Locations

Location L1: The sound level meter was located at the south end of the project site near the Keauhou-Kona Surf and Racquet Club, approximately 90 feet from Ali'i Drive. Dominant noise sources included vehicular traffic from Ali'i Drive. Secondary noise sources included wind and birds. The measurement period was from October 11, 2013 to October 16, 2013.

Location L2: The sound level meter was located at the north end of the project site near the County of Hawaii Kahalu'u Beach Park. The dominant noise sources at this location were park users and the parking lot. Secondary noise sources included wind, birds, and surf. The measurement period was from December 6, 2013 to December 11, 2013.

4.1.3 Long-Term Noise Measurement Results

The measured L_{eq}, and the 90 percent exceedance level, L_{90}, in dBA are graphically presented in Figures 3 and 4 for each location. The ambient sound levels at L1 are typical of a rural environment and vary with the time of day based on environmental noise sources (such as birds) and to a lesser extent, vehicular traffic volumes. The ambient sound levels at L2 fluctuate based on environmental noise sources as well as noises from the park users at the beach and in the parking lot. The range of L_{eq} during the day (7:00 AM to 10:00 PM) and during the night (10:00 PM to 7:00 AM) and average calculated day-night level, L_{dn}, are summarized for each location below. Also included in the table is the range of L_{eq} during typical construction hours (7:00 AM to 6:00 PM).

Table 4. Summary of Noise Measurement Results (dBA)

Measurement Location	7 AM-10 PM L_{eq} Range	7 AM-6 PM L_{eq} Range	10 PM-7 AM L_{eq} Range	Average L_{dn}
L1 – Near Racquet Club	48 - 57	51-57	44 - 52	58
L2 – Near Kahalu'u Beach Park	48 - 64	49-60	46 - 56	58

5.0 POTENTIAL NOISE IMPACTS

5.1 Construction Noise

The demolition of the existing Keauhou Beach Resort and construction of the Kahalu'u Ma Kai educational complex and cultural center will involve several stages which utilize various types of construction equipment. The actual sound levels that will be experienced in the vicinity of the project site will vary greatly during the project and are a function of the distance from the noise source, the duration of the construction activities, and the number of pieces of equipment used. The CadnaA noise prediction software by Datakustik GMBH [Reference 6] was used to predict the likely construction noise effects to receptor locations surrounding the project site. The software is based on the international standard ISO 9613, Part 2, which is a standard for calculating outdoor noise propagation. The input parameters for the sound propagation model are summarized in Table 5 below.

Table 5. Sound Propagation Model Calculation Parameters

Input Parameter	Source
Calculation Standard	ISO-9613
Site Topography	State Office of Planning GIS Program Topographic contours provided by Belt Collins
Ground Absorption	Porous soil
Meteorological Conditions	Assumes downwind
Receiver Height	5 feet
Bitmap	Google Earth
Sound Sources	Summary of construction methodology provided by Belt Collins, Refer to Table 6

The various stages of construction and equipment that will be utilized are described in Table 6 below. The noise levels represent the maximum A-weighted sound pressure levels (L_{max}) measured at a distance of 50 feet from the construction equipment and were obtained from the Federal Highway Administration Roadway Construction Noise Model (RCNM) [Reference 1] database. The duration of each stage is included in the table; however, these estimations are based on the contractor's ability to work with minimal interruptions. The actual noise levels produced during construction of the proposed project will be a function of the methods employed during each stage of the construction process. Although the specific equipment and quantity that will be used for this project and quantity has not been finalized, the equipment described below represents a reasonable approximation of what will be used.

Table 6. General Construction Stages and Anticipated Equipment

Construction Stage (duration)	Expected Equipment	Acoustical Use Factor (%)[N1]	L_{max} at 50 feet (dBA)	Impact Device[N2]
A Mobilization and BMP[N3] (5 weeks)	Backhoe	40	80	No
	Front Loader	40	80	No
	Dump Truck	40	84	No
B Abatement (16 weeks)	Dump Truck	40	84	No
	Trash Container	N/A	N/A	No
	Boom Lift	20	85	No
C Building Demolition (17 weeks)	Crane	16	85	No
	Excavator	40	85	No
	Front Loader	40	80	No
	Dump Truck	40	84	No
	Concrete Saw	20	90	No
	Jack Hammer	20	85	Yes
	Chipping Gun	20	85	Yes
D Site Demolition (3 weeks)	Excavator	40	85	No
	Front Loader	40	80	No
	Dump Truck	40	84	No
	Grader	40	85	No
	Dozer	40	85	No

Notes:

N1. The acoustical usage factor is an estimate of the fraction of time each piece of construction equipment is operating at full power (i.e., the equipment will be operating in its loudest condition). The values are based on the RCNM database.

N2. Impact equipment is equipment that generates an impulsive noise produced by the periodic impact of a mass on a surface which is of short duration and high intensity, characterized by abrupt onset and rapid decay, and often rapidly changing spectral composition.

N3. BMP is Best Management Practices

Daytime and maximum construction noise levels for each stage of construction were calculated at five noise receptor locations in the vicinity of the project site: the Keauhou-Kona Surf and Racquet Club and Na Hale Keauhou to the south of the project site, and the Kahalu'u Beach Park, Beach Villas at Kahalu'u and Kahalu'u Bay Villas to the north of the project site. Maximum sound levels (L_{max}) were calculated assuming the construction equipment will run continuously. It is not expected that the equipment will be used continuously for extended periods. Therefore, daytime equivalent construction noise sound levels (L_{eq}) were also calculated and take into account usage factor based on an 11-hour work day (7:00 am to 6:00 pm, Monday through Friday). Worst-case conditions were assumed for each stage, i.e., all equipment operating simultaneously at full power near the project site boundary closest to the sensitive receptors. The analysis also assumed that all receptors have a line-of-sight to the project site, i.e., shielding from buildings or mitigation measures was not considered.

Table 6 below summarizes the results of the construction noise analysis. Figures 5 and 6 illustrate the projected maximum sound level contours due to the building and site demolition stages of construction at both the north and south ends of the project site in the vicinity of the noise receptor locations.

Table 7. Construction Noise Analysis Results

ID	Noise Receptor	Approx. Distance[N1] to Building/Site (ft)	Existing Ambient Noise[N2] (dBA)	Maximum Predicted Construction Noise per Stage[N3] (L_{max} dBA)				Hourly Equivalent Predicted Construction Noise per Stage[N4] ($L_{eq\ (11hr)}$ dBA)			
				A	B	C	D	A	B	C	D
R1	Kahalu'u Beach Park	250/100	49-60	64	70	70	73	59	65	64	69
R2	Kahalu'u Bay Villas	800/650	48-54	54	53	61	60	50	48	55	56
R3	Beach Villas at Kahalu'u	425/300	54-60	60	59	67	67	56	54	61	63
R4	Keauhou-Kona Surf & Racquet Club	1200/50	51-57	51	47	58	77	47	41	52	74
R5	Na Hale Keauhou	1400/450	48-54	49	45	56	60	45	40	50	56

Notes:

N1. The value is the approximate distance from the noise receptor to the location of the nearest proposed demolition work at the existing Keauhou Beach Resort building and to the nearest proposed site demolition work.

N2. Existing ambient noise is the range of L_{eq} measured at the project site for receptors R1 and R4 based on data collected from 7:00 AM to 6:00 PM which corresponds to the allowable construction hours under the Department of Health noise permit. Ambient noise at noise receptors R2, R3, and R5 were estimated based on noise levels measured at receptor R4 and corrected based on proximity to Ali'i Drive.

N3. The maximum construction noise levels are represented as L_{max} and were calculated for each stage of construction (as described in Table 6).

N4. The predicted daytime hourly construction noise levels are represented as L_{eq} and take into account the usage factor of each piece of equipment, assuming all construction activities occur during an 11 hour work day. The L_{eq} was calculated for each stage of construction (as described in Table 6).

The results of the construction noise analysis show that construction noise levels at all noise receptor locations are expected to be below the Federal Transit Authority's noise impact threshold of 80 dBA for residential land uses. Nevertheless, it is anticipated that construction noise levels will exceed the existing ambient noise level at the receptor locations closest to the site. Intermittent construction noises will be clearly audible, especially during the building and site demolition stages. None of the intruding noise would be high enough to cause hearing loss for the nearby residents or park users. However, people may need to raise their voice or reduce the talker-to-listener distance in order to communicate effectively. The severity of the speech interference will depend on how close the residents or park users are to the project site as well as the location of the construction activities. Although this noise disruption would likely occur over the duration of the project, the impact of these disruptions are minor and of a short term duration.

The demolition activities may cause insignificant, short-term impacts. The extent of these impacts at any of the receptor locations will vary depending on the stage of construction, specific equipment being used, the distance or range of distances to the receptor, and the duration of each activity. Therefore, the ability to control construction noise levels relates primarily to the duration and time of construction activity in any one day. Since construction noise levels will exceed maximum permissible noise limits specified in the Community Noise Rule, a permit must be obtained from the State DOH to allow the operation of construction equipment. The permit allows the operation of construction equipment but it is limited to daylight hours, as described in Section 6.1 below.

5.2 Transportation of Waste

A vehicular traffic noise analysis was not completed for this project. However, the dump trucks used for transporting waste material off site are a further potential source of noise. It is anticipated that traffic noise could potentially increase for residents adjacent to the haul route due to individual truck pass-bys. But the truck traffic volume is expected to be low on an hourly basis so an overall traffic noise impact is not expected.

5.3 Construction Noise vs. Vibration

Construction activities generate not only audible airborne sounds, but can also result in varying degrees of ground vibration depending on the equipment and methods employed. While the previous section of this report evaluates the airborne sound of construction activities at the project site, it does not assess human or structural responses to potential ground borne vibration due to these activities.

Vibration induced by the specific construction equipment utilized for this project would not usually result in adverse effects on people or structures. Jackhammering is the greatest source of vibration associated with the demolition of the buildings, however, these impact activities will be located a significant distance away from the nearest receiver. During the site demolition, noise from the earth-moving construction equipment will likely be more noticeable than any perceived vibration due to the close proximity of the construction site to the adjacent park and condominiums. Furthermore, ground vibration from construction activities would be temporary.

6.0 NOISE IMPACT MITIGATION

6.1 DOH Noise Permit

In cases where construction noise exceeds, or is expected to exceed the State's "maximum permissible" property line noise levels [Reference 1], a permit must be obtained from DOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit noise levels in excess of the "maximum permissible" levels.

In order for DOH to issue a construction noise permit, the contractor must submit a noise permit application to DOH, which describes the construction activities for the project. Prior

to issuing the noise permit, DOH may require action by the contractor to incorporate noise mitigation into the construction plan. DOH may also require the contractor to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. The contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. However, DOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities.

Specific permit restrictions for construction activities [Reference 1] are:

> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 AM and after 6:00 PM of the same day, Monday through Friday."
>
> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 AM and after 6:00 PM on Saturday."
>
> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

The use of pile drivers, hoe rams and jack hammers 25 pounds (lbs.) or larger, high pressure sprayers, and chain saws are restricted to 9:00 AM to 5:30 PM, Monday through Friday. In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds (lbs.), must be equipped with mufflers [Reference 1].

The DOH noise permit does not limit the noise level generated at the construction site, but rather the times at which noisy construction can take place. However, when considering a noise permit application, consideration is also given to any proposed noise mitigation for the project. Therefore, noise mitigation for construction activities should be addressed using project management and the source and path noise control measures discussed in Section 6.3 below.

6.2 DOH Noise Variance

In cases where nighttime construction is expected, a variance must be obtained from the State DOH to allow the operation of a noise source which emits noise levels in excess of the maximum permissible levels and which operation does not conform to the requirements of the noise permit (i.e., nighttime construction activities which occur between 6:00 p.m. and 7:00 a.m., Monday through Friday). However, nighttime construction is not anticipated for this project so a variance will not be required.

6.3 Mitigation of Construction Noise

6.3.1 Mitigation of Noise Source

Mitigating construction noise at the source is the most effective form of noise control. The source control methods listed in Table 7 below can be applied to most construction equipment.

Table 7. Construction Noise Source Control Methods

Scheduling	Limit activities that generate the most noise to less sensitive time periods (e.g. daytime hours).
Substitution	Use quieter methods/equipment when possible (e.g. low noise generators, smaller excavators, etc.).
Exhaust Mufflers	Install quality mufflers on equipment.
Reduced Power Options	Use smallest size and/or lowest power as required.
Quieter Backup Alarms	Install manual adjustable or ambient sensitive alarms. Do not use backup alarms during night work.
Motors	Insulate or enclose motors
Equipment Selection	Electric equipment is quieter than pneumatic equipment
Equipment Retrofit	Rubber chucks in jackhammers
Equipment Maintenance	Sharpen and balance tools, repair silencing equipment, replace worn parts and open airways
Staging Area	Maximize the distance between the construction staging areas and nearby receptors to the greatest extent possible

In general, a majority of the construction noise mitigation is in the form of scheduling, specifically, limiting the construction hours to the time frame specified by the State DOH. The jackhammer is expected to be the most disruptive piece of equipment used during the construction process so the allowable hours of operation are even more restrictive, as described in Section 6.1.

6.3.2 Mitigation of Noise Path

When source control measures are not sufficient to avoid a noise impact, path control measures must be considered. Non-permanent noise barriers or curtains and equipment enclosures could be installed at the construction site to reduce construction noise in noise sensitive locations. The general contractor could also conduct noise monitoring of construction during noisy or extensive activities at locations close to residential properties.

6.3.3 Mitigation of Traffic Noise

Ensure all dump trucks travelling to and from the project site are in good repair and fitted with functioning mufflers. Haul routes could be managed to avoid residential areas and travel limited to the daytime hours only.

REFERENCES

1. Chapter 46, *Community Noise Control*, Department of Health, State of Hawaii, Administrative Rules, Title 11, September 23, 1996.
2. U.S. Department of Transportation - Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, May 2006.
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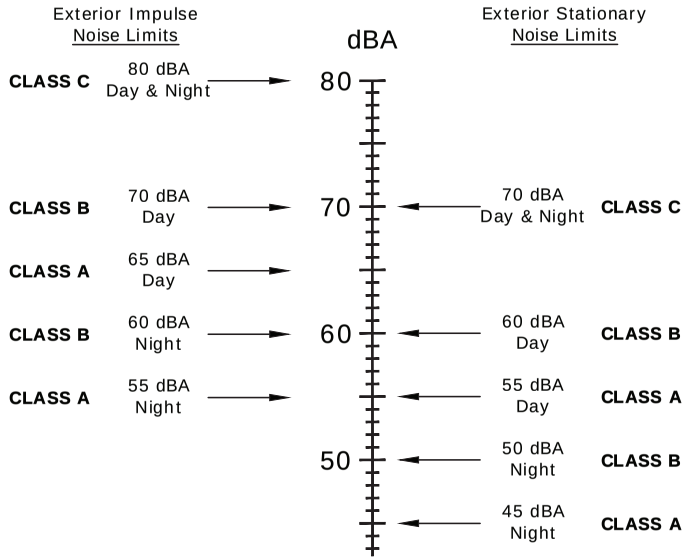
4. M. David Egan, *Architectural Acoustics*, McGraw-Hill Book Company, 1998
5. International Standards Organization ISO/TC 43, *Noise Assessment with Respect to Community Responses*, New York: United Nations, November 1969.
6. *DataKustik CadnaA software program*, Version 4.4; DataKustik GmbH, 2013.
7. *Federal Highway Administration's Roadway Construction Noise Model*, FHWA-HEP-05-054, U.S. Department of Transportation, February 2006.

HAWAII DEPARTMENT OF HEALTH MAXIMUM PERMISSIBLE SOUND LEVELS FOR VARIOUS ZONING DISTRICTS

Zoning District	Day Hours (7 AM to 10 PM)	Night Hours (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)

IMPULSE NOISE:

The maximum permissible noise limit for impulse noise is 10 dBA above the stationary noise limits.



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acoustics | performing arts | technology

PROJECT:		
Keauhou Beach Resort Demolition and Kahalu'u Ma Kai Development		
PROJECT NO: 13-41	DATE: March 2014	FIGURE: 1

Site Location and Noise Measurement Locations

Legend

Kamehameha Schools Kahalu'u Ma Kai Project Site

Noise Measurement Location

L1: 90 feet west of property line near Keauhou-Kona Surf & Racquet Club

L2: 120 feet south of property line near Kahalu'u Beach Park

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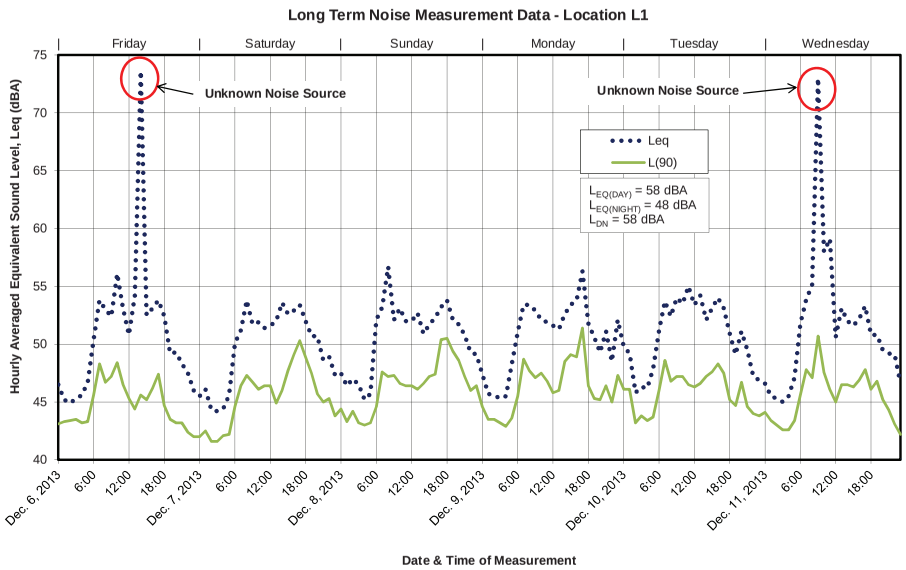
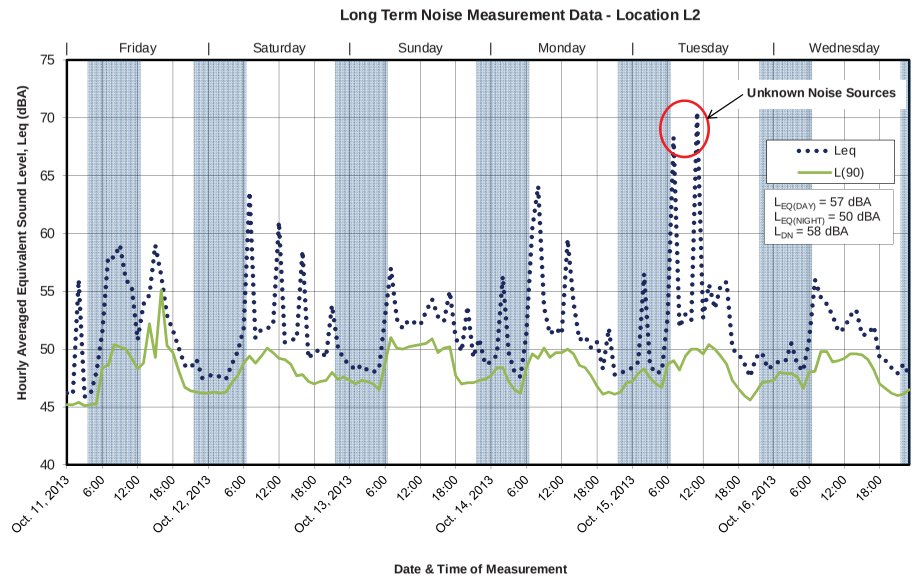
PROJECT:		
Keauhou Beach Resort Demolition and Kahalu'u Ma Kai Development		
PROJECT NO: 13-41	DATE: March 2014	FIGURE: 2





D. L. ADAMS ASSOCIATES acoustics | performing arts | technology	PROJECT: Keauhou Beach Resort Demolition and Kahalu'u Ma Kai Development		
	PROJECT NO: 13-41	DATE: March 2014	FIGURE: 3

D. L. ADAMS ASSOCIATES acoustics | performing arts | technology	PROJECT: Keauhou Beach Resort Demolition and Kahalu'u Ma Kai Development		
	PROJECT NO: 13-41	DATE: March 2014	FIGURE: 4

Keauhou Beach Resort Demolition and Kahalu'u Ma Kai Development

Keauhou, Hawaii

March 2014

Figure 5

Projected Maximum Sound Level Contours due to Building Demolition Activities

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970 N. Kalaniana'ole Ave.
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Kailua, HI 96734
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808.254.3318

= 40 dBA
= 45 dBA
= 50 dBA
= 55 dBA
= 60 dBA
= 65 dBA
= 70 dBA

Keauhou Beach Resort Demolition and Kahalu'u Ma Kai Development

Keauhou, Hawaii

March 2014

Figure 6

Projected Maximum Sound Level Contours due to Site Demolition Activities

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= 40 dBA
= 45 dBA
= 50 dBA
= 55 dBA
= 60 dBA
= 65 dBA
= 70 dBA

APPENDIX A

Acoustic Terminology

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as Aunwanted@ sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 µPa, which is approximately the lowest sound pressure that can be detected by the human ear. For example:

If P = 20 µPa, then SPL = 0 dB
If P = 200 µPa, then SPL = 20 dB
If P = 2000 µPa, then SPL = 40 dB

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines)[1] at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the human auditory system does. Thus the A-weighted sound level (read as "dBA") becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown in Figure A-1.

[1] D.W. Robinson and R.S. Dadson, AA Re-Determination of the Equal-Loudness Relations for Pure Tones,@ *British Journal of Applied Physics*, vol. 7, pp. 166 - 181, 1956. (Adopted by the International Standards Organization as Recommendation R-226.

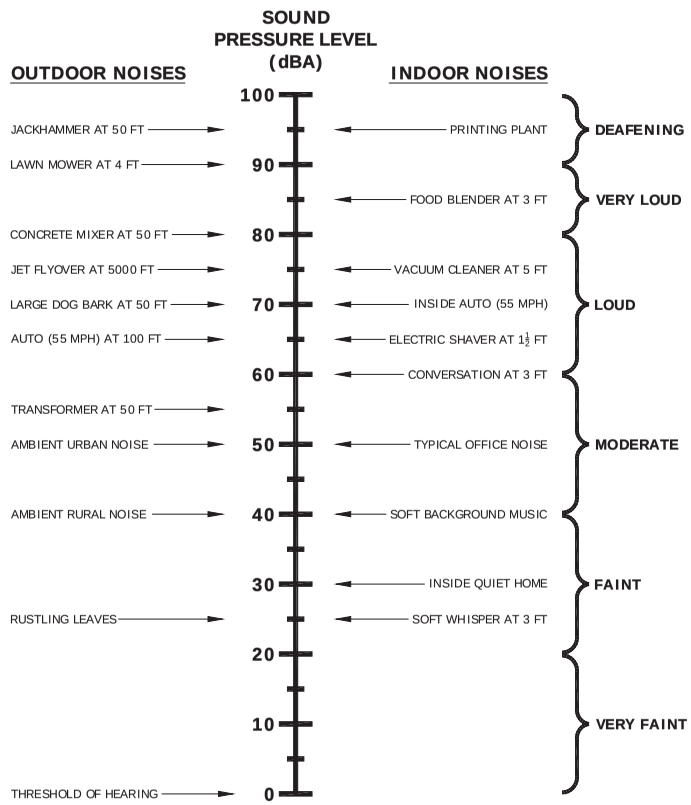

Figure A-1. Common Outdoor/Indoor Sound Levels

Equivalent Sound Level

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

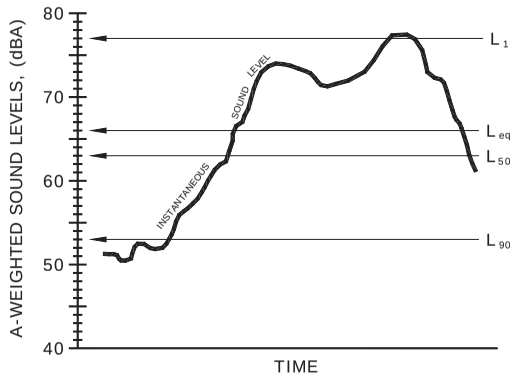

Figure A-2. Example Graph of Equivalent and Statistical Sound Levels

Statistical Sound Level

The sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedence Level, L_n. The L_n represents the sound level that is exceeded for n% of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Typically, in noise regulations and standards, the specified time period is one hour. Commonly used Exceedence Levels include L_{01}, L_{10}, L_{50}, and L_{90}, which are widely used to assess community and environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

Day-Night Equivalent Sound Level

The Day-Night Equivalent Sound Level, L_{dn}, is the Equivalent Sound Level, L_{eq}, measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 p.m. and 7 a.m. to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The L_{dn} is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

APPENDIX B

Photographs at Project Site

Location L1

Microphone mounted on a tripod near the south-east corner of the project site, approximately 90 feet west of the property line.

The building in the photograph is a condominium in the Keauhou-Kona Surf and Racquet Club complex.

Location L2

Microphone mounted on tripod near the north west corner of the project site, approximately 120 feet south of the property line.

The building in the photograph is the comfort station at the Kahalu'u Beach Park.

Appendix F

MARINE AND WATER QUALITY STUDY

ASSESSMENT OF THE MARINE WATER CHEMISTRY and BIOTIC COMMUNITY STRUCTURE

KAMEHAMEHA SCHOOLS
KAHALU'U MA KAI PROJECT

KEAUHOU, NORTH KONA, HAWAII

Prepared for:

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Revised
April 2014

I. INTRODUCTION AND PURPOSE

Planning is underway by Kamehameha Schools (KS) to establish an educational complex and cultural center on property located in the Kahalu'u Ahupua`a on the west coast of the Island of Hawaii. The roughly rectangular shaped 22.73 acre parcel is oriented with the long boundary parallel to the coastline, and stretches from Alii Drive to the shoreline, while the northern boundary is adjacent to Kahalu'u Bay and Beach Park (Figure 1).

Establishment of the complex will involve the demolition of the standing structure that was formerly the Keauhou Beach Resort (KBR), and remnant facilities of the demolished Kona Lagoon Hotel (KLH). The complex would include construction of several new structures on the property, new landscaping and preservation of historic sites. The project is referred to as "Kahalu'u Ma Kai." The project will change the primary use of the property from resort to an educational complex and cultural center supporting aina-based education and culture-based instruction. The redevelopment will not include the State owned parcel of 0.13 acres associated with the inland lagoon, which underlies part of the existing KBR hotel structure.

All planning and construction activities will place a high priority on maintaining the existing relatively pristine nature of the marine environment. As such, an important part of the redevelopment process is to address any potential impacts to the marine environment that may be associated with the planned project. None of the proposed land uses includes any direct alteration of the coastal areas or nearshore waters. The potential exists, however, for the project to affect such processes as the composition and volume of groundwater that flows beneath the project site, as well as surface runoff emanating from the project. As all groundwater that could be affected by the project subsequently reaches the ocean, it is recognized that there is potential for the project to affect the marine environment.

A unique feature of the project site is the existence of a series of salt-water tidepools that extend up to approximately 200 meters (m) inland from the shoreline. As mentioned above, the existing KBR structure overhangs the lagoon supported by concrete footings. Planned demolition of portions of the buildings over the lagoon will be conducted in such a fashion that debris will be contained to the extent possible. In addition, while these and other Best Management Practices (BMP's) will be in place, the close proximity of construction activities to marine resources adds unique considerations to identify potential impacts to the area.

In the interest of addressing these concerns and assuring maintenance of environmental quality, a baseline marine environmental assessment and potential impact analysis of the nearshore areas off the Kahalu'u Ma Kai project site was conducted in August 2013. The rationale of this assessment was to collect a set of baseline data to accurately depict both qualitatively and quantitatively the existing physical, chemical and biological setting of the marine areas that could be potentially affected by the planned re-development of the Kahalu'u Ma Kai project site. The assessment will include a determination of the contribution of groundwater to the marine environments in the vicinity of the project site, and to evaluate the effects that this input has on water quality at the present time, prior to the commencement of any new construction activities. Results of the evaluation will indicate if, and to what degree, there is the potential for negative effects to the aquatic environments from the proposed project.

II. METHODS

A. Water Chemistry

Three transect survey sites were established downslope of the Kahalu'u Ma Kai property. Transect 1 was located through the approximate center of the project site, originating at the most landward point of the tidepool-pond complex, and progressing through the tidepools seaward across the rocky shoreline and out into the coastal ocean to a distance deemed to beyond the influences of land (Figure 2). Transect 2 was located near the northern boundary of the property, originating at the most seaward point of the tidepool lagoon adjacent to the Keauhou Beach Resort structure. This transect bisected the tidepool complex to the rocky shoreline and extended into the coastal ocean (Figure 2). Transect site 3 was located near the southern of the project site and extended seaward from the highest wash of waves. No tidepools were included on Transect 3. In addition to the ocean transects, a sample was collected in Po'o Hawaii, which is a walled anchialine pond located between the KBR and Kahalu'u Beach Park (Figure 2).

Water quality was evaluated at stations spaced along each transect. Water samples were collected at 21 stations on Transect 1, 13 stations on Transect 2, and 5 stations on Transect 3. Where water depth exceeded 1 m (~3 feet), two samples were collected at each station, one sample from within 10 centimeters (cm) of the air-water interface, and 10 cm of the tidepool and ocean floor. Where water depth was less than 1 m, only a surface sample was collected. Locations of sampling stations were determined by hand-held differential GPS. Such a sampling scheme was designed to span the greatest range of salinity with respect to potential freshwater efflux at the shoreline, and subsequent mixing with ocean water. Sampling was more concentrated in the nearshore zone (tidepools) because this area is most likely to show the effects of shoreline modification.

In order to determine chemical concentrations in unaltered groundwater, samples were also collected from three wells (Kahalu'u 1, 2, 3) located upslope from the project site operated by the County of Hawaii. These data were taken from a report entitled "Potential Impact on Water Resources of the Proposed Development on Parcel 26, TMK 7-8-10:4 in North Kona, Hawaii" prepared by Tom Nance Water Resources Engineering in 2012.

Water quality parameters evaluated included the ten specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii Department of Health (DOH) Water Quality Standards. These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium nitrogen (NH_4^+), total phosphorus (TP), Chlorophyll a (Chl a), turbidity, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) were also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater mixing.

All fieldwork was conducted on April 23, 2013 by investigators working from shore and a 21-foot boat. Samples from the shore to 10 meters offshore were collected from shore; all other samples were collected using a Niskin-type oceanographic sampling bottle. The bottle is lowered to the desired sampling depth with spring-loaded endcaps held open so water can pass freely through the bottle. At the desired sampling depth, a weighted messenger released from the surface triggers closure of the endcaps, isolating a volume of water.
All water samples were collected in triple-rinsed one-liter linear polyethylene bottles. Subsamples

for nutrient analyses were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice. Analyses for Si, NH_4^+, PO_4^{3-}, and NO_3^- were performed on filtered samples with a Technicon Autoanalyzer using standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion following digestion. Total organic nitrogen (TON) and total organic phosphorus (TOP) were calculated as the difference between TN and dissolved inorganic N, and TP and dissolved inorganic P, respectively.

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. Chl a was measured by filtering 300 ml of water through glass-fiber filters; pigments on filters were extracted in 90% acetone in the dark at -20° C for 12-24 hours. Fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer. Salinity was determined using an AGE Model 2100 laboratory salinometer with a readability of 0.0001‰ (ppt). Turbidity was determined in the field using a 90-degree nephelometer, and reported in nephelometric turbidity units (NTU) (precision of 0.01 NTU).

In-situ field measurements of continuous vertical profiles of salinity were acquired using a RBR Model XR-640 CTD calibrated to factory standards (precision of 0.001 ppt).

All fieldwork was conducted by Dr. Steven Dollar. All laboratory analyses were conducted by Marine Analytical Specialists located in Honolulu, HI (Labcode: HI 00009). This analytical laboratory possesses acceptable ratings from EPA-compliant proficiency and quality control testing.

B. BIOTIC COMMUNITY STRUCTURE

As mentioned above, the project site is characterized by a relatively unique set of marine tidepools that occur mauka of the rocky shoreline. The nearshore marine biotic communities off the Kahalu'u Ma Kai property consist of a well-developed and relatively undisturbed Hawaiian coral reef habitat. The intent of the present study was to describe the overall physical and biotic setting, and to create a benthic habitat map that characterizes the offshore area of the marine environment. The survey area encompassed approximately 2.25 miles [3.62 km] of linear coastline, and extended from the shoreline to a water depth of approximately 65 ft (20 m). The resulting characterization is intended to provide an overview of the habitat characteristics of the region in order to provide information that might be of value relating to the future uses of the area. The purpose of the study was not to generate an exhaustive species list of all biota occupying the area.

Marine biota in tidepools was qualitatively assessed as the irregular size of the pools and patchiness of biotic distribution did not lend itself to standardized transect techniques. Biotic composition of the offshore marine environment was quantitative assessed using several methods. All methods utilized in this study to generate nearshore marine habitat maps followed standard procedures for processing coral reef remote sensing imagery (e.g., Andréfouët et al. 2003, Green et al. 2000, Mumby et al. 1998). The benthic habitat map was created based on commercially available satellite remote sensing imagery. A fully georeferenced WorldView-2 multispectral satellite image of the project area in North Kona was purchased from the Image Library at DigitalGlobe.com (image data originally acquired on August 16, 2010 at 11:06 AM

HST). The image had 2.0 m (6.6 ft) ground sample distance. The WorldView-2 image was processed to highlight submerged features, which revealed areas of different bottom composition.

All fieldwork was carried on June 10 and 11, 2013. Tidepools were assessed by investigators walking the shoreline, while offshore reef surveys were conducted by SCUBA divers working from a 21-ft. boat. Benthic substratum types were delineated using a method for ground truthing remote sensing data modified from Bainbridge and Reichelt (1988) and English et al. (1997).

Field operations consisted of assessing "calibration-validation" (cal/val) sites placed strategically throughout the survey areas. Calibration-validation sites were clustered in 26 "calibration/validation (cal/val) sites" which were located in representative habitats throughout the region of study. GPS waypoints serve as labels for each calibration-validation site. Locations of cal/val sites were selected in the field based on investigator knowledge and visual interpretation of existing satellite "true-color" imagery with the intent of maximizing coverage of all reef areas within the region of interest. In the present survey, cal/val sites were oriented along three offshore transects, each of which emanated from the shallowest accessible point reachable by divers out to a depth of approximately 20 m (65 feet). Each of the cal/val transects were located in the same area as the offshore water chemistry transects. Exact site locations were defined during the course of field work using a GPS with a presumed accuracy of <1 m.

At each geo-located site, cal/val data was obtained by digitally recording the composition of the benthic surface using an underwater camera. To ensure uniformity of the area of data collection, the camera was mounted on a platform centered over a PVC frame by four legs similar to a tripod. The base of the frame forms a quadrat with dimensions of 1 m x 0.66 m, which is the same proportion as a photographic frame. Each cal/val site consists of five photo-quadrats arranged in a "cross" pattern ~5 m in diagonal, resulting in total reef surface area of 3.33 m^2, which encompasses an area of approximately four pixels of remote sensing imagery. Inherent in the collection of cal/val photo-quadrat data was characterization of the effects of sediment discharge from upland streams on coral communities.

Following fieldwork, the digital images were analyzed by projecting a grid dividing the frame into 100 equal sized segments. Coral cover by species, as well as bottom cover of benthic algae, motile macro-benthos and non-living categories including sand, mud, bare limestone and rubble were estimated by the counting the number of segments covered by each class of bottom type. Zoom features of the software and the high resolution of the digital photographs (~10 megapixels) allowed delineation of corals to the level of distinguishing individual calices. Total cover of all five photographic frames constituted the cover estimates for each calibration/validation point. All photo-quadrats evaluated by segment counts are contained in Appendix A.

In the lab, survey points were located on the georeferenced satellite multispectral image which served as the basis for statistical image classification. "Training classes" (defined as the combination of geomorphologic zone and coral cover) were created by assigning a class label to a survey point using the ground truth data for context. To spectrally define a "region of interest" for a training class, 20-30 adjoining pixels were isolated and included in the class. Because the same zone-cover combination could occur at different depths, the final classes could exhibit several different multispectral patterns. Thus, it was often necessary to merge several independent training classes to the same final class label. After the merging procedure, all training classes with

the same spectral label were used to create the map showing the distribution of bottom cover over the reef. The resulting habitat maps are based on a class distribution summary as follows:

0% coral:
0% < coral ≤ 10%:
10% < coral ≤ 30%:
30% < coral ≤ 50%:
50% < coral ≤ 90%:
90% < coral ≤ 100%:

Full cross-validation was utilized to evaluate accuracy of the habitat classification. In cross-validation, all but one data point are used to build a classifier, and the classifier is tested on the withheld point. This process is repeated on every point in the data set. The result is a matrix of classification rates, with correct classifications on the diagonal and incorrect classification off-diagonal. Because each classifier is tested on a data point that was not used to build the classifier, the result is unbiased. Also, because the test classifiers use almost all the available data points, they more closely represent that classifier actually used to generate the image product (which used all data points).

The first matrix below is the number of classifications. Again, correct classifications are on the diagonal, and incorrect classifications are off-diagonal. The second matrix shows classification rates, which is simply each matrix element divided by its column's total.

Matrix 1.

		Actual Coral Cover					
		0–10	10–30	30–50	50–70	70–90	90–100
Predicted Coral Cover	0–10	55	0	0	0	0	0
	10–30	0	63	0	1	0	0
	30–50	0	0	37	0	0	0
	50–70	0	0	0	57	1	0
	70–90	0	0	0	0	444	4
	90–100	0	0	0	0	4	59

Matrix 2

		Actual Coral Cover					
		0–10	10–30	30–50	50–70	70–90	90–100
Predicted Coral Cover	0–10	100.0	0.0	0.0	0.0	0.0	0.0
	10–30	0.0	100.0	0.0	1.7	0.0	0.0
	30–50	0.0	0.0	100.0	0.0	0.0	0.0
	50–70	0.0	0.0	0.0	98.3	0.2	0.0
	70–90	0.0	0.0	0.0	0.0	98.9	6.3
	90–100	0.0	0.0	0.0	0.0	0.9	93.7

The overall accuracy of the classification (total correct classification divided by total number of data points) is excellent at 98.6%. Thus, according to the comparison between field data and remote sensing product, there is very little misclassification. The three classes encompassing 0-50% coral cover showed 100% accuracy, while the 70-90 and 90-100 classes exhibited 98.9 and 93.7% accuracy. Overall, the errors for all classifications are small, resulting in a highly accurate map of coral coverage of the reef area off the Kahalu'u Ma Kai project site.

Populations of reef fish were also evaluated in-situ. At each cal/val sampling point, a five minute stationary point count was conducted with all fish visible to the observed were enumerated and recorded on an underwater writing slate.

III. RESULTS

A. WATER CHEMISTRY

1. Overview of Water Chemistry - Horizontal Stratification

Tables 1 and 2 show results of all water chemistry analyses for samples collected off the Kahalu'u Ma Kai project site in April 2013. Table 1 shows concentrations of dissolved nutrients in micromolar (μM) units; Table 2 shows concentrations in micrograms per liter ($\mu g/L$). Concentrations of eight dissolved nutrient constituents in surface and deep samples are plotted as functions of distance from the shoreline in Figure 3. Values of salinity, turbidity, Chl *a*, and temperature as functions of distance from shore are shown in Figure 4.

Several patterns of distribution are evident in Tables 1 and 2 and Figures 3 and 4. It can be seen in Figure 3 that the dissolved nutrients Si, NO_3^-, PO_4^{3-}, TP and TN, as well as salinity (Figure 4), display substantial different patterns of horizontal stratification between the three survey transects. These differences are particularly evident in the sections of the transects that pass through the tidepool complex makai of the actual shoreline. On transect 1, located in the approximate center of the project site, concentrations of the nutrients listed above display only small decreases in concentrations with increasing distance seaward, with overall values not substantially higher than open ocean water. The minimum salinity on the transect (32.5‰) is only several parts per thousand lower than seawater. Such relatively slight horizontal gradients indicate relatively little groundwater is entering the tidepools at this location and mixing with seawater.

Contrary to the horizontal gradients that display on transect 1, the horizontal gradients on the makai half of transect 2 are substantially steeper for the dissolved nutrients Si, NO_3^-, PO_4^{3-}, TP and TN, as well as salinity (Figures 3 and 4). These steep gradients indicate that there is considerable groundwater input to the "lagoon" area fronting the Keauhou Beach Resort structure that extends from the most makai part of the lagoon to about 85 m from the shoreline (salinity of 15.4 to 29.6‰). From this point (the seaward edge of the lagoon) to the shoreline, water composition consists of marine water that is not substantially different in nutrient composition than offshore water.

Transect 3 was located along the southern end of the Kahalu'u Ma Kai property in an area without tidepools, with the shoreline consisting of a steeply sloping coarse sand beach. Horizontal gradients of Si, NO_3^-, PO_4^{3-}, TP and TN, indicate a sharply sloping decline within 5-10 meters

from shore, with a corresponding increase in salinity. These sloping gradients indicate a source of submarine groundwater input flowing into the nearshore zone from land along the beachfront (Figures 3 and 4). In many areas of the Hawaiian Islands, particularly off the coast of West Hawaii, such groundwater percolation results in steep horizontal gradients of increasing salinity and decreasing nutrients with distance from shore.

Water chemistry parameters that are not associated with groundwater input, particularly organic nutrients (NH_4^+, TON, TOP) do not show the same pattern of decreasing concentration with respect to distance from the shoreline as Si, NO_3^-, PO_4^{3-}, TP and TN. In particular, along Transect 1, gradients of organic nutrients exhibit peak values and steepest slopes within the tidepool zone. As noted above, inorganic nutrients along this transect were slight, indicating low levels of groundwater flux. However, the nearly uniform patterns of distribution of NH_4^+ along both Transects 1 and 2 suggests similar biotic regeneration organic materials by biotic processes within the tidepool complexes (Figures 3 and 4, Tables 1 and 2).

Similar to the patterns of dissolved inorganic nutrients, the distribution of Chl *a* also displays a distinct peak in the lagoon area of Transect 1, with steeply declining values to near oceanic values in the tidepools seaward of the lagoon (Figure 4, Table 1). The steep horizontal gradients of Chl *a* in the nearshore area of Transect 3 are also similar to the patterns of inorganic nutrients and the mirror image of salinity (Figure 4). Peak values of turbidity occur in the most landward areas of the marshy tidepools on Transect 1, while overall turbidity decreases in all tidepools with increasing proximity to the ocean. As with all other constituents, turbidity on Transect 3 is elevated in the nearshore zone relative to offshore values (Figure 4). pH varies considerably in the tidepools, but is overall lowest on Transect 1 (Figure 4).

A water sample was also collected from Po'o Hawaii, which is a walled anchialine pool on the northern edge of the Kahalu'u Ma Kai project site. Examination of water chemistry constituents in the pool indicate that concentrations of all nutrient and other water quality constituents (except salinity) are substantially higher than in any of the tidepool or ocean sampling sites (Tables 1 and 2). Salinity is substantially lower that at any of the tidepool or ocean sampling points. Such elevated concentrations of nutrients and particularly Chl a, are likely a result of the elongated residence time of groundwater in the pool. The relatively low salinity, as well as elevated nutrients, indicates that water in the pool consists of a higher percentage of groundwater than any of the other areas.

2. Vertical Stratification

The mix of groundwater and ocean water creates a buoyant surface lens of low salinity, high nutrient water that is evident throughout the nearshore waters fronting the Kahalu'u Ma Kai project site (Tables 1 and 2). With the relatively low level of physical mixing in terms of wind, waves and currents along the West Hawaii shoreline, the stratified water column persists along the entire length of the sampling transects off of the project site. It can be seen in Tables 1 and 2 that for the inorganic nutrients that displayed distinct horizontal gradients (particularly Si, and NO_3^-), there is also distinct variation between surface and deep samples. Surface values of Si and NO_3^- were slightly higher than deep values, while salinity was lower in surface samples relative to deep samples from the same location. While the difference between surface and deep samples was clearly evident for Si, NO_3^- and TN, there are no clearly distinguishable differences in surface and deep concentrations of PO_4^{3-}, NH_4^+, TP and TN. Likewise, turbidity and Chl a, also showed

no consistent trend with surface values not consistently elevated relative to bottom values (Figures 3 and 4, Tables 1 and 2).

3. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity (Officer 1979, Smith and Atkinson 1992, Dollar and Atkinson 1992). The concept of using such mixing models which scale nutrient concentrations to salinity has been recently used by the State of Hawaii Department of Health for establishing a unique set of water quality standards for the West Coast of the Island of Hawaii [Hawaii Administrative Rules, §11-54-06 (d)].

Comparison of the curves produced by the distribution of data with conservative mixing lines provides an indication of the origin and fate of the material in question. If the parameter in question displays purely conservative behavior (i.e., no input or removal from any process other than physical mixing), data points should fall on, or near, the conservative mixing line. If however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as biological uptake, data points will fall below the mixing line.

Figure 5 shows plots of the concentrations of Si, NO_3^-, PO_4^{3-}, and NH_4^+ as functions of salinity for the samples collected at each sampling station. Each graph also shows conservative mixing lines constructed by connecting the end-member concentrations of open ocean water collected at the same time as the other water samples, and average groundwater concentration from the three DWS Kahalu'u potable wells located upslope of the project area.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 5 that data points for all three transect sites fall in a linear array on the conservative mixing line. Linear regression of the concentrations of Si as a function of salinity indicates that for all three transects, there is a highly significant R^2 (proportion of variation explained) of 0.97 indicating that the concentration of Si is dependant on salinity. The Y-intercept of the regression of Si as a function of salinity can be interpreted as the expected concentration at a salinity of zero. As groundwater has salinity close to zero, the Y-intercept can be used to evaluate the relationship between upslope groundwater and groundwater that is entering the ocean at the shoreline. For the potable wells sampled upslope of Kahalu'u Ma Kai, the average concentration of Si is 751 μM. The upper and lower 95% confidence limits of the Y-intercepts of the regression lines of Si vs. salinity for the three transects are 512-560 μM. Hence, it can be determined that for the three transects there is an alteration of groundwater Si relative to potable water, with removal of Si. Examination of Figure 5 indicates the most of the removal appears to take place within the tidepools of Transect 2 and the nearshore ocean of Transect 3.

The plots of NO_3^- versus salinity show a slightly different distribution as Si. In general, most of the data points for the three transects fall in a linear array along the conservative mixing line. Linear

regression of these data indicate a significant R^2 of 0.98 for all data points indicating that the concentrations of NO_3^- are dependent on salinity. The upper and lower confidence limits of the Y-intercepts for the three transects are 85-91 μM, while the average concentration of NO_3^- in upslope potable water is 84 μM. Hence for the pooled three transects, there is a slight subsidy of NO_3^- in groundwater entering the ocean. When looking at each transect separately, the upper and lower confidence limits of the Y-intercept of Transect 1 are 61-85 µM, 88-92 μM on Transect 2, and 55-77 µM on Transect 3. From these analyses, it appears that there is a small subsidy of NO_3^- from activities on land inland from Transects 1 and 2, but not Transect 3.

PO_4^{3-} is also a major component of fertilizer and sewage. However, PO_4^{-3} is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in soils or rock. It can be seen in Figure 5 that most of the PO_4^{3-} data points at salinities less than 34‰ fall in a linear array below the mixing line. The R^2 of regression of PO_4^{3-} vs. salinity is significant at a value of 0.66. The average well water concentration of PO_4^{3-} in well water is 4.3 µM, while the confidence limits of the Y-intercepts for the pooled three transects are 0.81-1.16 µM, while for the individual transects, the maximum confidence limit is 2.16 µM. Hence, contrary to NO_3^- there are no subsidies of PO_4^{3-} entering the nearshore environment from sources other than naturally occurring groundwater. Rather, on all transects there is removal of PO_4^{3-} relative to what would be expected from simple mixing of upslope groundwater and ocean water.

The other form of dissolved inorganic nitrogen, NH_4^+, shows a different relationship than Si, NO_3^- and PO_4^{-3}. The mixing line for NH_4^+ is considerably different than the other inorganic nutrients in that there is no indication of overall linearity. Plots of concentrations of NH_4^+ versus salinity exhibit no linear trends with respect to salinity (Figure 5). Linear regression of concentrations of NH_4^+ vs. salinity result in a considerably lower R^2 (0.14) than the other inorganic nutrients. The highest values of NH_4^+ occur an values of approximately 34‰ in the tidepools of Transect 1. This pattern suggests that the source of most of the NH_4^+ in the tidepools is not from the land but rather from biological processes occurring in the marine environment.

4. Compliance with DOH Criteria

The West Coast of the Island of Hawaii has area specific Water Quality Standards (Chapter §11-54-6 (B)(3)(d) HAR). In areas where nearshore marine water salinity is greater than 32‰ Specific criteria for geometric means apply (Tables 1 and 2). As geometric means require multiple samplings at the same location, it is not technically possible to use the single sample set shown in this report to evaluate compliance of water quality off the Kahalu'u Ma Kai with area specific DOH standards. However, comparison of the values shown in Tables 1 and 2 for the single sampling event off the project provide an estimate of compliance with area specific DOH water quality standards.

The latest version of Chapter §11-54, HAR (August 2004) also contains a set of criteria specifically applied to the West Coast of the Island of Hawaii [§11-54-06 6 (B) (3) (d)]. These conditions contain a linear regression based on scaling nutrient (NO_3^-, TN, PO_4^+, and TP) concentrations to salinity for samples with salinities below 32‰. These criteria for the four nutrients are shown in Table 4. Compliance with the DOH criteria is defined by slope of the regression line of the nutrient concentration as a function of salinity. Slopes greater than the "not to exceed" values stated in the standards are deemed out of compliance. The prerequisite of the special conditions are partially met, as several samples had measured salinity less than 32‰.

However, the standards also stipulate that the sampling protocol shall be replicated not less than three times on different days over a period not to exceed fourteen days during dry weather conditions. This criterion was not met for the present program as only one sample set was collected. In addition, it is not clearly stated in the standards whether water bodies present in the survey area defined as "tidepools" located behind the actual shoreline are included in the class of "coastal ocean waters."

With these caveats, linear regression analyses were performed on the water chemistry values, with the results shown in Table 4. The regression slope of NO_3^- exceeded the specific criterion (-31.9) on Transects 2, while the slope for TN exceeded the standard criterion (-40.4) on Transect 1. The slopes of TP and PO_4^+ were below the DOH criteria on all three transects, indicating that concentrations of these constituents exceeded DOH standards.

Therefore, at the present time, while replicate data sets have not been collected in order to explicitly follow area specific DOH standards, it appears that existing baseline conditions of water quality off the Kahalu'u Ma Kai site exceed DOH water quality standards for NO_3^- and TN at separate areas, but do not exceed the standards at any location for TP and PO_4^+. Should future sampling require compliance with the specific criteria specified for West Hawaii, the data collected during this baseline assessment can provide an indication of existing conditions prior to any construction activity related to the Kahalu'u Ma Kai project.

B. MARINE BIOLOGICAL COMMUNITY STRUCTURE

1. Descriptions of the Survey Areas

The main structural composition of the shoreline off of Kahalu'u Ma Kai consists of a broad basaltic bench up to approximately 220 m wide that extends from the fast land to the outer shoreline cliff face. The elevation of the bench is approximately at sea-level, resulting in the flooding of low areas to form a complex of tidepools fed primarily by incoming flow of seawater through the action of tides and waves. The largest tidepool, often termed a "lagoon" is located near the northern end of the property, and is overhung by the makai end of the Keauhou Beach Resort Structure. In the approximate center of the property, the tidepools extend inland beyond the basalt bench into areas bounded by shrubbery, resulting in marshy estuarine habitats. Along the southern end of the property, the bench disappears, and the shoreline consists of a steeply sloping coarse sand beach (Figures 6-10).

The basaltic bench terminates in a steeply sloping shoreline cliff approximately 3 m in height, which separates the basaltic bench from the open ocean. Physical and biotic zonation of the offshore marine environment at Kahalu'u Ma Kai generally conforms to the pattern that has been documented as characterizing much of the west coast of the Island of Hawaii (Dollar 1982, Dollar and Tribble 1992). The zonation scheme consists of three predominant regions. Beginning at the shoreline and moving seaward, the shallowest zone beyond the shoreline is comprised of a seaward extension of the basaltic shoreline benches and cliff, along with rounded basaltic boulders that have entered the ocean after breaking off from the shoreline (11). This nearshore zone is typically the most physically stressed area on the reef as it absorbs the majority of impact from breaking waves. Coral cover in this zone is generally limited to flat encrustations of *Porites*, and sturdy hemispherical colonies of *Pocillopora meandrina*. These species and growth

forms are able to flourish in areas that are physically too harsh for most other species, particularly due to wave stress.

Seaward of the nearshore boulder zone, bottom structure is composed predominantly of a wide, gently sloping reef bench, or platform that is composed primarily of accreted colonies of a several species of a single genera of coral (*Porites lobata, P. lutea and P. evermanni)* (Figures 11-12). Several colonies of *Porites* were observed up to 3 m in diameter, suggesting an age on the order of a century (Figure 12). Over parts of the reef platform, colonies of *P. lobata* have merged together, creating fused "supra-colonies" that completely cover the reef surface over areas of hundreds of square meters (Figures 11-12). As wave stress in this region is substantially less than in the shallower areas, and suitable hard substrata abound, the area provides an ideal locale for colonization of reef corals, and the large size of individual colonies and Near complete cover of the reef surface with living corals indicates that the area has not experienced a large-scale disturbance (destructive storm waves) in many decades. As a result, the area is essentially a climax community with near complete coverage by a single competitively superior species. generally the widest assortment of species and growth forms are encountered in this region.

At the outer boundary of the reef platform bottom composition grades into a steeply sloping shelf break at a depth of approximately 20 m (66 feet). Above and below the shelf break, bottom cover is a mix of large lobed colonies of *P. lobata*, and an interconnected framework consisting of colonies of *Porites compressa* (finger coral) (Figure2 12-13). These mats of finger coral extend into the rubble and sand plains at a depth of about 25 m (80 feet). Of interest is that the entire reef platform, including both the reef platform and the reef slope zones show no evidence of recent damaging effects of storm waves, and as a result are essentially completely covered with living coral colonies. As no major storm events have occurred in Hawaii since Hurricane Iniki in 1992, about 19 years ago, coral communities have had a chance to proceed toward a climax successional stage, which can be considered nearly complete at the present time.

Biotic composition of the tidepools showed a marked gradation from the landward to seaward regions. The landward areas, including the large open pool forming the lagoon fronting the Keauhou Beach Resort structure are essentially barren of macrobenthos, with bottom composition consisting of bare rocks, and a layer of fine sediment (Figures 7 and 8). This barren area corresponds to the locations of water sampling transect 2 where salinity was depressed at inland distances greater than approximately 100 m from the shoreline. Similar barren tidepools were encountered on Transect 1 about an equal distance from shore.

At the approximate center of the basalt bench, corals began appearing in tidepools, with increasing density with distance seaward. The predominant corals in the tidepools were *Porites lobata, P. lutea,* and *Pocillopora meandrina*. Other species observed in tidepools was *Montipora flabellate, M. patula* and *Pavona varians*. Of note was the occurrence of several donut shaped "microatolls" consisting of circular colonies of *Porites* (Figure 9). As the water depth in the tidepools is shallow, often less than one meter, growing corals are restricted in upward growth, with the tops of the colonies killed likely from exposure to light, air and extreme high temperatures. However, lateral growth of these colonies continues, forming the characteristic round colonies with vertical sides and dead center portions.

Other dominant biota in the tide pools consisted primarily of a variety of sea urchins, particularly the long-spined Echinothrix diadema (Figure 9). No dominant macroalgae were observed in the tidepools.

The distinct gradation of biotic composition of the tidepools and lagoon is likely a response to several water quality constituents, which also show a distinct gradation in the area. Owing to input from groundwater and shallow depth, it is likely that the lagoon area is too "fresh" for most marine species. Wave driven flushing of the ocean side of the basaltic bench appears to diminish rapidly with distance shoreward so that the most interior areas of the basaltic bench are subjected to limited water exchange. As a result temperature of the shallow water in the back bench areas may exceed the tolerance levels of marine organisms. In the marshy back bench areas of Transect 1, an additional factor that may restrict the colonization by marine organisms may be the preponderance of soft muddy floors of the tidepools.

2. Quantitative Analysis of Coral Reef Community Structure

Table 5 shows a summary of the data generated from analysis of the calibration validation sites shown in Figure 14. Appendix A shows cal/val counts from each photoquadrat, while Appendix B shows all photoquadrats that make up the cal/val data set. Eight species of coral were identified in photo-quadrats taken at the cal/val sites, with a total coral cover of the bottom of about 58%. Considering individual species, *Porites lobata* comprised the highest cover (34% bottom cover, 58% coral cover), while *Porites compressa* accounted for 15% of bottom cover and 26% of coral cover. The third most abundant species was *Porites lutea*, accounting for 9% of bottom cover and 15% of coral cover. Hence, these three species of *Porites*, which are typically the most abundant on all Hawaiian reefs, accounted for about 57% of bottom cover and 98% of coral cover. When considering non-coral bottom cover, the most abundant classes were bare limestone (21%), rubble (10%) and crustose coralline algae (2.6%). In total, about 42% of the bottom cover in the photo-quadrats consisted of non-coral classes, while about 58% consisted of living coral (Table 5).

Table 6 shows quantitative estimates of reef community structure based on the classification scheme generated by converting the spectral signatures of satellite images into classes of coral cover. The left frame of Table 6 shows the area coverage (in square meters) of each of the seven classes of coral cover. The right frame shows how the area of each class converts to percentage of bottom cover. Figure 15 is a map color-coded to show seven combinations of the coral abundance classes shown in Table 6.

Of the total mapped area of about 1.6 million square meters (387 acres), the largest single bottom cover type consists of coral cover of 70-90% of bottom cover, comprising about 57% of the area. The next most abundant size class is 10-30% coral cover which occupies about 14% of the bottom. The class of bottom cover containing no coral occupies only about 2.76% of the bottom, while the highest cover class of 90-100% cover occupies about 5% of the bottom.

3. Motile Benthic Macrofauna

The dominant group of motile macroinvertebrates observed on the reef are the sea urchins (Class Echinoidea). The most common urchin is *Echinometra matheai*, which occurred in all reef zones. *E. matheai* are small urchins that are generally found within interstitial spaces bored into basaltic and limestone substrata. *E. matheai* were most abundant at the mid-reef. *Echinostrephus aciculatus* is another small urchin with thin spines that is found in bored holes on the reef surface. *Tripneustes gratilla*, *Echinothrix diadema* and *Heterocentrotus mammillatus* are other species of urchins that occurred across the reef platform. All of these urchins occur as larger individuals (compared with *E. matheai*) that are generally found on the reef surface, rather than within interstitial spaces.

Sea cucumbers (Holothurians) observed during the survey consisted of three species, *Holothuria atra, H. nobilis*, and *Actinopyga obesa*. Individuals of these species were distributed sporadically across the mid-reef and deep reef zones. The most common starfish (Asteroidea) observed on the reef surface were *Linckia* spp. Several crown-of-thorns starfish (*Acanthaster planci*) were observed during field studies.

The most common algae observed on the reef off Kahalu'u Ma Kai were the encrusting red calcareous algae (e.g., *Porolithon spp., Peysonellia rubra, Hydrolithon* spp.). These algae were abundant on bared limestone surfaces, and on the nonliving parts of coral colonies Based on calibration-validation photoquadrat analysis, crustose calcareous algae covered about 9% of the reef surface. Total algae cover comprised about 2.6% of the reef surface based on mapping procedures using satellite images. While crustose algae were abundant, frondose algae were essentially absent from the reef surface in all zones. The Near complete absence of frondose algae noted at the Kahalu'u Ma Kai site is typical of reefs of West Hawaii.

The design of the reef survey was such that no cryptic organisms or species living within interstitial spaces of the reef surface were enumerated. However, no dominant communities of these classes of biota were observed during the reef surveys at any of the study stations.

4. Reef Fish Community Structure

The reef fish community off Kahalu'u Ma Kai is typical of that found along most of the Kona Coast, as described by Hobson (1974), and Walsh (1984). Reef fish were quantitatively evaluated at each cal/val site shown in Figure 14, and the resulting counts are listed in Table 7. A total of 854 fish, distributed among 24 species, were observed. The two most numerous families were the Pomocentridae (damselfish) and Acanthuridae (surgeonfish) which comprised about 80% of the fish population. Labrids (wrasses) and Chaetodonts (butterflyfish) were the next most abundant families comprising about 8% of the fish. Hence, these four families accounted for about 88% of the fish observed. The most common individual species were the damselfish (*Chromis ovalis, C. vanderbilti*), yellow tank (*Zebrasoma flavescens*), and the goldring (*Ctenochaetus strigosus*).

Distribution of reef fish community structure indicated that abundance was not largely determined by the topography and composition of the benthos. With respect to fish abundance per sampling site, the number of species ranged from 4 to 8. The number of individuals per site ranged from 14 (site 229) to 96 (site 243). As all of the sites contained substantial topographical relief in terms of coral structures and/or hard bottom, fish distribution was not distinguishably different anywhere across the reef track. The highest individual fish counts were attributable to the observance of large schools of an individual species, particularly the damselfish *Chromis ovalis*.

Fish community structure along the West Hawaii coastline can be divided into six general categories: juveniles, planktivorous damselfishes, herbivores, rubble-dwelling fish, swarming tetrodonts, and surge-zone fish. Juvenile fish belonged mostly to the family Acanthuridae (surgeon fish), with representatives from the families Labridae (wrasses), Mullidae (goat fish) and Chaetodontidae (butterfly fish). Juveniles were most abundant in areas dominated by finger coral (*P. compressa*), or basalt boulders. The complex habitat created by the spreading growth form of *P. compressa* provides shelter for small fish. Planktivorous damselfish, principally of the genus *Chromis* were abundant in all areas surveyed. Agile chromis (*Chromis agilis*) were very abundant along the outer edge of the shelf and in deeper water, whereas blackfin chromis (*C. vanderbilti*) was the primary shallow water species.

Herbivores, primarily the yellow tang (lau'i-pala, *Zebrasoma flavescens*) and goldring surgeonfish (kole, *Ctenochaetus strigosus*) were also abundant. On the shallower reef terrace, adult whitebar surgeonfish (maikoiko, *Acanthurus leucopareius*), orangeband surgeonfish (na'ena'e, *A. olivaceus*), brown surgeonfish (ma'i'i'i, *A. nigrofuscus*) and parrotfish (uhu, *Scarus* spp.) were also observed occasionally. The inner surge zone along the wave-swept basalt terraces supported a large number of fish, principally herbivores such as surgeonfish (*Acanthurus* spp.), and unicornfish (mostly umaumalei, *Naso lituratus*). Saddle wrasses (hinalea lau-wili, *Thalassoma duperrey*) were also abundant throughout all zones of the reef. Black durgons (humuhumu-ele'ele, *Melanichthys niger*) and pinktail durgons (humuhumu-hi'u-kole, *M. vidula*) were also observed congregating in the water column over the reef platform.

Overall, fish community structure at Kahalu'u Ma Kai is fairly typical of the assemblages found in undisturbed Hawaiian reef environments. However, the lack of fish species that are prized as food fish suggests that the area has been subjected to significant amounts of fishing pressure.

5. Endangered and Protected Species

Several species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly along the Kona Coast, and turtles are frequently observed on beaches throughout the area. The endangered hawksbill turtle (*Eretmochelys imbricata*) is known infrequently from waters off the Kona Coast. Several green sea turtles were observed during the course of underwater surveys for the present report.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) winter in the Hawaiian Islands from December to April. The present survey was conducted in June, when whales are not present in Hawaiian waters. The Hawaiian Monk Seal, (*Monachus schauinslandi*), is an endangered earless seal that is endemic to the waters off of the Hawaiian Islands. Monk seals commonly haul out of the water onto sandy beaches to rest. Hence, while there is no

greater potential for haul out to the beaches at Kahalu'u Ma Kai than any other area, there is a probability that seals will haul out on these beaches. No individuals were observed on the beach or in the water during the course of the present survey. As there are no plans for any modification of the shoreline, there are should be no physical factors that will result in modification of seal behavior.

IV. DISCUSSION and CONCLUSIONS

The purpose of this assessment is to assemble the information to make valid evaluations of the potential for impact to the marine environments from the proposed Kahalu'u Ma Kai project. The information collected in this study provides the basis to understand the processes that are operating in the nearshore ocean, so as to be able to address any concerns that might be raised

The proposed Kahalu'u Ma Kai project does not include plans for any direct alteration of the shoreline or offshore areas. Therefore, potential impacts to the marine environment that are considered are demolition of existing structures, construction of new structures, and delivery of materials (primarily fresh water and nutrients) to the ocean through infiltration to groundwater on land with subsequent discharge to the ocean, and surface runoff.

A Report Prepared by Belt Collins Hawaii LLC in 2014, entitled "Kahalu'u Ma Kai Preliminary Engineering Report" provides detailed assessments of the existing utility (sewer, water, drainage) services, and the potential impacts and mitigations to accommodate the Project. While this report does not include quantitative estimates of changes to groundwater and surface water composition that will discharge to the ocean from the re-development of the site, it does provide information that can be used to qualitatively estimate the magnitude of changes to the marine system. These potential changes are described below.

Changes to water chemistry of the nearshore area from altered land uses could result from application of fertilizers and irrigation waters, as well as surface drainage. With respect to sewage treatment, the intent of the proposed treatment system to be constructed for the project is to reuse all wastewater on-site with zero discharge of wastewater. Secondary treatment of the primary effluent will be accomplished with a subsurface-flow constructed wetland. Primary effluent will flow beneath the ground surface into wetland cells with native Hawaiian plants treating the primary effluent. Discharge from the wetland cells or secondary effluent will then flow to tertiary treatment consisting of 5-micron cartridge filters and UV disinfection. As the plants in the wetland cells will likely take up most or all of the effluent, there is little potential for large changes in nutrient loading to the ocean from the proposed project.

Greywater from outdoor showers will be treated with planted, shallow absorption beds before ground infiltration. The beds will be planted native Hawaiian plants. Design flows for the redevelopment project that will be lower than from the former KBR Hotel and Kona Lagoon, as well as construction of an on-site wastewater system will result in lower wastewater demands, and lower potential impact to the tidepools and ocean.

With respect to surface drainage, the project site is bordered by Kahalu'u Beach Park to the northeast, Ali'I Drive to the east, Kona Surf and Racquet Club to the south, and the ocean along the northwest and west. The site generally slopes from Ali'i Drive toward the shoreline. Several

lower lying areas are located throughout the property, and a small spring is located to the south of the hotel. Storm water runoff generated on the site generally sheet flows to lower lying areas, infiltrates into the ground in some locations, and eventually discharges into the ocean at the shoreline. Three existing drain inlets and a 16-inch diameter drain line collect storm water runoff from portions of the KBR parking lot and cul-de-sac located adjacent to the hotel. The drain line discharges into a seepage pit located within a landscape area to the south of the hotel.

A condition of the project is that storm water runoff will be reduced to pre-developed conditions, (i.e., prior to the development of the existing hotel and parking areas). To accommodate the reduction in storm water runoff, several concepts will be utilized:

1) Seepage pits will be incorporated into the Project's design to infiltrate excess storm water runoff into the ground.

2) Rain gardens, also referred as bioretention basins, are engineered shallow depressions that collect and filter storm water runoff using vegetation and conditioned planting soil beds. The filtered runoff gradually infiltrates through the basin invert and into the soil matrix.

3) Bioretention swales are shallow linear channels with a planting bed and covered with turf or other surface material (other than mulch or plants). Runoff filters through the planting bed, is collected in an underdrain system and discharged at the downstream end of the swale.

4) Rainwater harvesting is the collection and temporary storage of roof runoff in rain barrels or cisterns for subsequent landscape irrigation.

The proposed improvements would not significantly alter the existing topography of the site. However, grading would be required to provide level building pad areas. Additionally, the site will be graded such that surface storm water runoff is directed into rain gardens, bioretention areas, bioretention swales, and grass swales. Seepage pits (shallow sumps) will be incorporated into the Project as needed to control storm water runoff. As a result, all of these factors should result in no significant changes to surface water discharge that will increase flow to the ocean.

During demolition and construction activities Best Management Practices (BMPs) will be utilized for both land based areas and areas within the ocean. The procedures and BMP details will be verified with the selected contractor, but are expected to include the following:

• BMPs for work over the lagoon (tide pools):

1) Installing a floating boom outside of the "fall zone" for dust and particle control.
2) Installing silt curtains in the ocean as needed.
3) Installing a platform that serves as a debris catchment system, plywood, or netting with a filter cloth beneath the work area.

• Procedures for work in the ocean:

1) Work will be done at low tide and when winds are calm.
2) Install floating booms and silt curtains as needed.
3) Large debris will be removed as soon as possible.

4) Waste hauling will follow the shortest and most direct path to the shoreline.
5) Water contaminated with fine particles will be removed by bailing within the work area barrier and disposed in an area similar to a construction site concrete washout area.

The implementation of these BMP's should limit or eliminate any introduction of materials emanating from the existing structures to the marine environment. If mitigation includes time-course monitoring during the demolition and construction activity, results will validate the effectiveness of the BMP's. If monitoring indicates that there are detectable changes to conditions of the marine setting owing to redevelopment activities, alterations can be made to BMP's to alleviate the problem.

Hence, based on the projected demolition and construction of the Kahalu'u Ma Kai project, there is no reason to expect that there would be changes to groundwater, surface water, and the marine envrionment as a result of the planned project. Results of the survey indicate that at the present time there are slight detectable changes to marine ecosystems that can be attributable to human activities. While slight subsidies of nitrate nitrogen can be detected, the levels of such subsidies are well within the envelope of natural variability found on the west coast of Hawaii. Overall, there are no activities associated with the re-development to a cultural education center that should change this scenario. Demolition methods and Best Management Practices have already been identified to minimize the potential impacts from this activity.

All of these considerations indicate that the proposed Kahalu'u Ma Kai project should not have any significant negative effect on water quality and biotic community structure in the tidepools and coastal ocean offshore of the property.

V. SUMMARY of FINDINGS

1. Evaluation of the nearshore marine and tidepool environments off of the Kahalu'u Ma Kai coastal area in North Kona were carried out in 2013. The purpose of the evaluation was to characterize offshore areas that may be influenced by the proposed re-development of the former Keauhou Beach Resort and Kona Lagoon Hotel properties by Kamehameha Schools to a facility designed to implement Hawaiian cultural education programs. As there is presently substantial shoreline and upslope development in the area, the evaluation characterizes the existing condition of the area integrating the effects present land uses.

2. Assessment of nearshore water chemistry was carried out by evaluating fifty water samples that were collected along three transects spaced along the shoreline of the property. Water samples were collected on transects roughly perpendicular to shore, extending from the most landward areas where water occurred on a wide basaltic bench behind the shoreline, and into the coastal ocean for a total transect distance of up to approximately 330 m. Analysis of twelve water chemistry constituents included specific constituents in DOH water quality standards. Water samples were also collected in available potable wells upslope from the property, as well as from a walled anchialine pool.

3. Dissolved inorganic nutrients (Si, NO_3^-, PO_4^{3-} and TN) displayed strong horizontal gradients along the transect that bisected the tide pool that forms the "lagoon" fronting the Keauhou Beach Resort structure. Correspondingly, salinity was lowest closest to the shoreline, and increased with

distance from shore through the lagoon. These patterns are indicative of groundwater efflux at the shoreline of the lagoon transect, producing a zone of mixing where nearshore waters are a combination of ocean water and groundwater. Similar gradients were not detected along the transect which bisected the central region of the property site, which originated in the marshy environments within the inland portion of the basaltic bench. The absence of strong gradients of nutrients and salinity in the central portion of the property indicate little mixing of groundwater and ocean water in this region. It is evident in the patterns of nutrient and salinity gradients that water chemistry composition in the tidepools is in direct response to the degree of flushing of the area with ocean water driven across the basaltic bench by wave action at the shoreline.

4. Although not usually found in elevated concentrations in groundwater, NH_4^+, TON and TOP also displayed distinct horizontal gradients on inland portions of both transects that bisected the basaltic bench. Such elevated values are likely the result of biotic activity in the tidepools, particularly in the back shore region where flushing with wave-driven ocean water is restricted. Similarly, values of Chl *a*, and turbidity were elevated in nearshore samples with decreasing values moving seaward.

5. Application of a hydrographic mixing model to the water chemistry data was used to indicate if increased nutrient concentrations in nearshore waters are the result of mixing of natural groundwater with oceanic water, or are the result of inputs from activities on land. The model indicates that at the time of sampling there were small, but detectable subsidies of NO_3^- nitrogen to the tidepools and ocean that could be attributable to upslope anthropogenic activities. However, the magnitude of these subsidies was well within the envelope of natural variability found in the coastal areas of West Hawaii.

6. Evaluating water chemistry from the single sampling using DOH area specific criteria for West Hawaii indicates several of the measurements exceed the criterion. However, as replicate surveys were not a component of the present survey, and it is not clear whether tidepools located behind the shoreline are considered "open coastal waters" there is no stringent indication that water quality at the Kahalu'u Ma Kai site presently exceeds water quality standards. However, the present sampling protocol provides a baseline for future sampling, should it be required to evaluate compliance with State of Hawaii water quality standards.

7. Water quality in the walled anchialine pool Po'o Hawaii display elevated nutrients and Chlorophyll values, and depressed salinity relative to all other sampling points. These differences are likely a result of elevated fluxes of groundwater into the pool, and restricted circulation relative to the neighboring tidepool areas.

8. Qualitative characterization of biotic composition of the tidepools indicated a distinct gradient in community structure related to dynamics of groundwater and ocean water mixing. The landward portions of the tidepools where residence time was long owing to reduced wave action contained essentially no macrobiota, likely in response to elevated temperatures, depressed salinity, and lack of solid surfaces. The lagoon area off the Keauhou Beach Resort structure is included in this region of limited to no colonization by macrobenthos.

9. Tidepools in the seaward portions of the basaltic bench contained viable communities of corals and associated marine macrobenthos (particularly sea urchins). While very shallow, these areas

apparently receive sufficient exchange of seawater to provide suitable conditions for marine organisms.

10. Composition of the physical and biotic structure of the offshore marine habitats conforms with the typical zonation pattern that characterized the shoreline of West Hawaii. The nearshore area is composed of a vertical cliff face bordering a nearshore boulder zone. The major reef environment consists of a gently sloping basalt platform that extends several hundred meters offshore and terminates in a sharp shelf break. Beneath the shelf break, bottom topography consists of a sloping sand-rubble plain that extends to abyssal depths.

11. Coral coverage on the reef platform is extensive with about 58% bottom cover consisting of living corals, primarily consisting of well developed colonies of *Porites* spp. The nearly complete cover of the bottom by living corals of a single genus indicates that the area is in a near climax phase, with little indication of impacts from recent storm events.

12. Characterization of the existing marine communities was carried out using a fully georeferenced WorldView-2 multispectral satellite image of the Kahalu'u coastal area purchased from the Image Library at Spatial Solutions. Calibration-validation ground-truth data collected with a photo-mosaic technique at 28 points provided the input to create a benthic habitat map of the Kahalu'u Ma Kai area based on occurrence of living coral cover.

13. Analysis of spectral data within the satellite image classified with ground truthing covered an area of about 1.6 million square meters, or 387 acres. Error analysis of the resulting map was high (~98%) indicating a good degree of reliability of the resulting mapped data. The largest single bottom cover type consists of coral cover of 70-90% of bottom cover, comprising about 57% of the area. The next most abundant size class is 10-30% coral cover which occupies about 14% of the bottom. The class of bottom cover containing no coral occupies only about 2.76% of the bottom, while the highest cover class of 90-100% cover occupies about 5% of the bottom. The highest density of coral coverage occurred on the nearshore reef platform, consisting primarily of large colonies of a single species (*Porites lobata*).

14. Motile macro-invertebrates on the reef consist primarily of several species of sea urchins. These species include the bio-eroding burrowing urchins *Echinometra matheai* and *Echinostrephus aciculatus*, and the larger slate pencil urchin (*Heterocentrotus mammilatus*), the collector urchin (*Tripneustes gratilla*) and the long-spined urchin (*Echinothrix diadema*). Other macrobenthos observed consisted of sea cucumbers and starfish. The coral-eating crown-of-thorns starfish (*Acanthaster planci*) was observed in the study area.

15. Populations of reef fish in the area also appeared typical of West Hawaii reefs. The most abundant families consisted of damselfish and surgeonfish, followed by butterflyfish and wrasses. As is generally the case, density of fish was a function of vertical complexity of the benthic surface. The lack of observations of abundant fish species considered prized by fishermen indicates that the area is subjected to a high degree of fishing pressure.

16. Overall, results of the water chemistry and biotic community analyses indicate that the Kahalu'u Ma Kai area is not presently affected to a significant extent by existing land uses. The redevelopment plan will likely result in lower production of wastewater than the original hotel scenario. In addition all wastewater and greywater will be reused through applications to

constructed wetlands and absorption beds planted with native Hawaiian species. Demolition and construction at locations over and adjacent to the marine tidepools will employ a variety of Best Management Practices to ensure that no materials from these activities enters the ocean. Based on these measures, there are no expectations that the proposed project will result in changes to water quality or the biotic composition of the offshore marine area to any discernible extent.

17. The studies conducted for this report, particularly the water quality analyses, can serve as an initial baseline for any monitoring programs that may be required for any projected changes to land uses at Kahalu'u Ma Kai.

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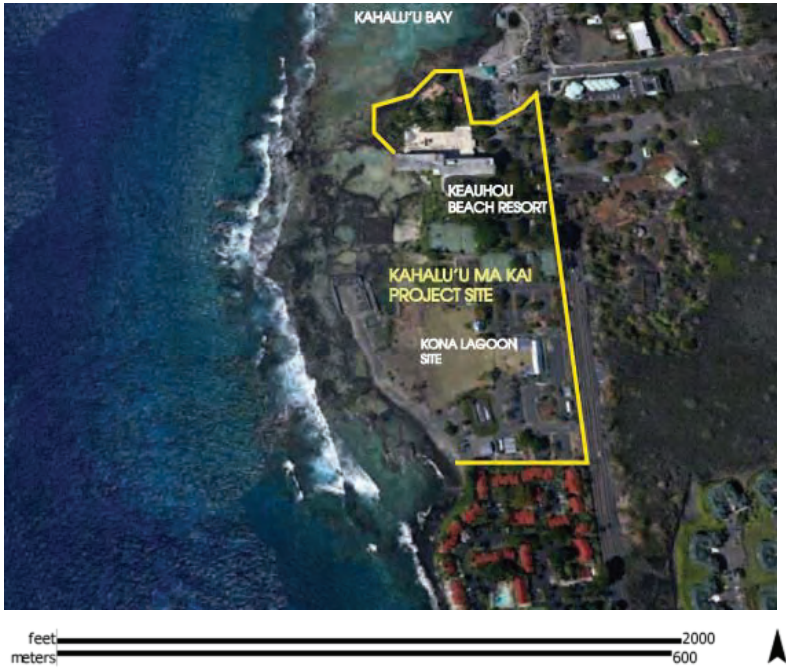


FIGURE 1. Aerial photograph of Keauhou area of North Kona showing boundaries of Kahalu'u Ma Kai Project. Locations of Kahalu'u Bay as well as existing Keauhou Beach Resort structure and demolished Kona Lagoon Hotel are also shown.

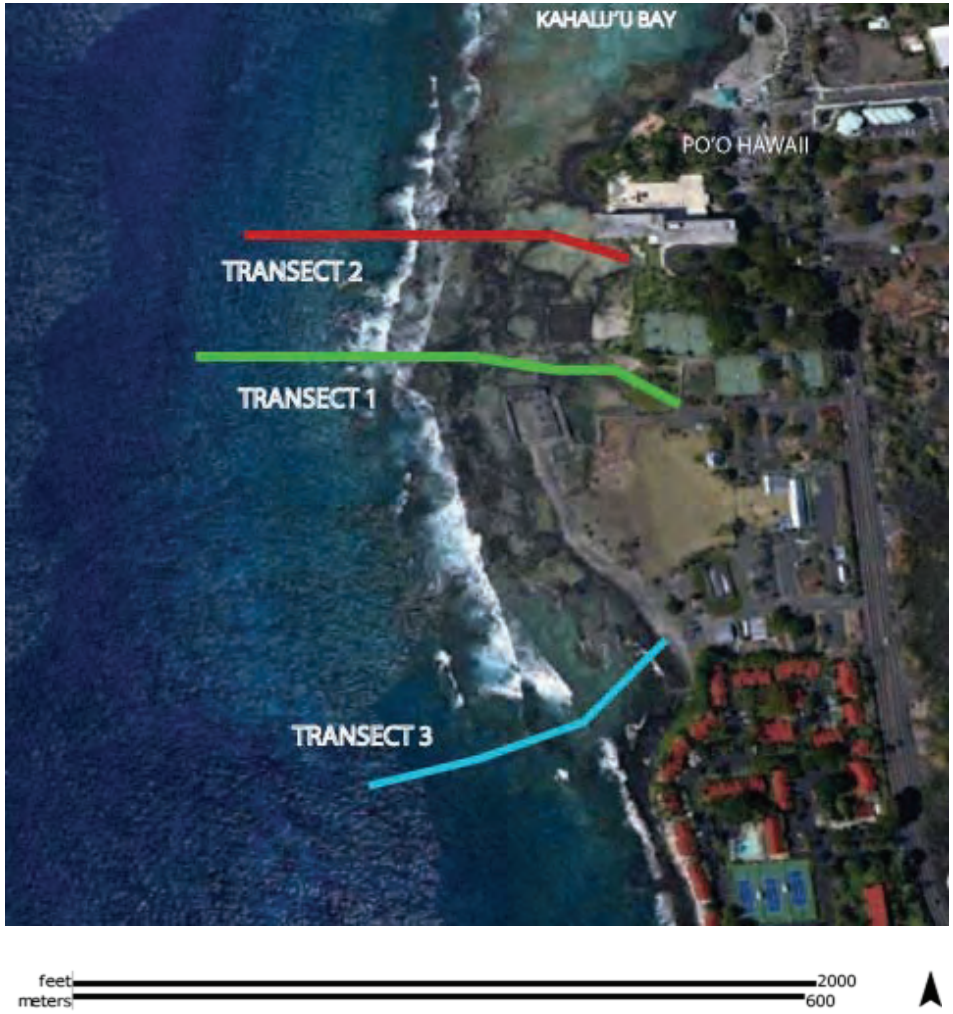


FIGURE 2. Aerial photograph showing three transect lines along which samples were collected for evaluation of water chemistry off the Kamehameha Schools Kahalu'u Ma Kai Project site in Keauhou, Island of Hawaii. Transects 1 and 2 extend from the most inland reach of tide pools to the open coastal ocean. Also shown is location of

TABLE 1. Results of water chemistry sampling along transects fronting the Kahaluu Ma Kai Project. Concentrations of nutrients are shown as micromoles (μM). "DFS" represents distance from shore with negative values indicating distance inland from the shoreline, and positive values indicating distance seaward from the shoreline. "S" indicates surface sample; "B" indicates near-bottom sample. For locations of sampling transects, see Figure 1.

	Station	DFS(m)	PO_4^{3-} (μM)	NO_3^- (μM)	NH_4^+ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	TURB (ntu)	SALT (o/oo)	pH (rel)	Chl-a (μg/l)
Transect 1	1S	-220	0.06	3.67	2.71	47.71	0.41	14.74	0.47	21.12	0.99	32.539	8.004	0.147
	2S	-200	0.09	3.81	1.35	37.78	0.41	13.44	0.50	18.60	0.40	33.189	7.995	0.420
	3S	-195	0.11	4.12	1.53	37.95	0.46	14.18	0.57	19.83	0.38	33.203	8.004	0.483
	4S	-175	0.12	4.08	0.94	40.19	0.41	11.76	0.53	16.78	0.27	33.073	8.002	0.283
	5S	-160	0.12	3.60	1.10	34.00	0.36	10.69	0.48	15.39	0.31	33.497	8.030	0.241
	6S	-145	0.12	3.42	0.90	29.89	0.35	11.09	0.47	15.41	0.24	33.826	8.089	0.252
	7S	-150	0.15	3.26	2.15	28.73	0.35	10.63	0.50	16.04	0.60	33.935	8.079	0.115
	8S	-145	0.15	3.33	1.96	29.86	0.37	10.79	0.52	16.08	0.86	33.974	8.084	0.210
	9S	-135	0.16	6.03	1.03	46.04	0.36	10.53	0.52	17.59	0.37	33.237	8.117	0.535
	10S	-145	0.28	2.61	1.39	22.01	0.38	11.23	0.66	15.23	0.36	34.336	8.102	0.315
	10B	-145	0.07	1.55	1.10	15.20	0.42	10.32	0.49	12.97	0.57	34.621	8.074	0.850
	11S	-130	0.06	2.28	0.88	20.38	0.41	10.10	0.47	13.26	0.51	34.380	8.095	0.231
	11B	-130	0.07	1.87	1.12	13.98	0.37	10.68	0.44	13.67	0.37	34.664	8.064	0.283
	12S	-95	0.07	0.37	0.45	5.53	0.33	8.73	0.40	9.55	0.21	34.972	8.005	0.283
	12B	-95	0.06	0.33	0.33	5.58	0.32	8.39	0.38	9.05	0.23	34.965	8.002	0.199
	13S	-60	0.12	0.53	0.31	3.40	0.28	8.07	0.40	8.91	0.18	35.048	8.005	0.178
	14S	-30	0.15	0.50	0.42	3.40	0.25	7.47	0.40	8.39	0.15	35.033	7.980	0.189
	15S	-15	0.17	0.35	0.18	3.99	0.23	7.12	0.40	7.65	0.11	35.029	8.124	0.178
	16S	0	0.13	0.15	0.16	4.00	0.25	7.31	0.38	7.62	0.10	34.973	8.135	0.094
	17S	5	0.12	0.18	0.19	4.11	0.25	7.15	0.37	7.52	0.08	34.968	8.114	0.084
	18S	10	0.05	0.25	0.20	4.47	0.25	6.55	0.30	7.00	0.06	34.957	8.110	0.115
	19S	20	0.04	0.18	0.22	5.05	0.26	6.90	0.30	7.30	0.08	34.955	8.129	0.073
	19B	20	0.05	0.14	0.19	4.59	0.27	6.70	0.32	7.03	0.09	34.959	8.124	0.063
	20S	50	0.12	0.54	0.12	9.48	0.30	7.44	0.42	8.10	0.07	34.766	8.104	0.084
	20B	50	0.13	0.05	0.09	3.37	0.36	6.67	0.49	6.81	0.07	34.987	8.117	0.073
	21S	100	0.16	0.85	0.08	12.83	0.37	7.35	0.53	8.28	0.07	34.604	8.097	0.063
	21B	100	0.14	0.04	0.11	3.15	0.37	6.32	0.51	6.47	0.10	34.999	8.114	0.052
TRANSECT 2	22S	-160	0.38	49.00	1.65	270.66	0.19	7.48	0.57	58.13	0.31	15.407	8.189	1.028
	23S	-140	0.56	37.10	1.09	241.92	0.22	9.20	0.78	47.39	0.44	20.965	8.072	0.839
	24S	-125	0.24	18.69	1.24	132.42	0.33	9.62	0.57	29.55	0.52	27.828	7.989	0.755
	25S	-110	0.55	33.27	0.55	215.26	0.20	7.66	0.75	41.48	0.23	23.169	7.992	0.147
	25B	-110	0.06	5.57	0.90	43.71	0.33	8.39	0.39	14.86	0.25	32.811	7.974	0.199
	26S	-100	0.03	0.17	0.49	3.19	0.26	7.43	0.29	8.09	0.16	35.103	8.007	0.126
	26B	-100	0.03	0.17	0.73	3.70	0.28	8.13	0.31	9.03	0.22	35.087	8.000	0.168
	27S	-85	0.16	14.75	0.72	103.32	0.28	7.65	0.44	23.12	0.15	29.638	8.037	0.105
	28S	-70	0.07	0.64	0.58	5.84	0.29	7.28	0.36	8.50	0.07	34.898	8.129	0.115
	28B	-70	0.04	0.43	0.79	4.36	0.35	7.35	0.39	8.57	0.08	34.962	8.142	0.262
	29S	-40	0.03	0.23	0.46	3.64	0.30	6.34	0.33	7.03	0.05	34.986	8.139	0.220
	29B	-40	0.04	0.21	0.44	3.54	0.27	6.76	0.31	7.41	0.09	34.992	8.142	0.126
	30S	-10	0.03	0.12	0.40	3.84	0.27	7.90	0.30	8.42	0.11	34.996	8.147	0.147
	31S	0	0.04	0.12	0.39	3.45	0.28	6.06	0.32	6.57	0.06	35.007	8.134	0.136
	32S	10	0.11	0.81	0.32	11.85	0.26	6.68	0.37	7.81	0.08	34.655	8.094	0.094
	32B	10	0.09	0.16	0.62	3.70	0.25	6.32	0.34	7.10	0.06	34.991	8.112	0.105
	33S	50	0.08	0.58	0.46	9.22	0.25	6.30	0.33	7.34	0.08	34.767	8.097	0.168
	33B	50	0.05	0.10	0.25	3.78	0.27	6.68	0.32	7.03	0.09	35.002	8.105	0.094
	34S	100	0.05	1.27	0.44	17.10	0.29	6.73	0.34	8.44	0.07	34.462	8.094	0.105
	34B	100	0.05	0.07	0.22	3.78	0.24	7.15	0.29	7.44	0.07	34.985	8.112	0.063
TRANSECT 3	35S	0	0.453	13.55	0.895	85.90	0.02	6.63	0.48	21.07	0.57	28.723	8.183	0.434
	36S	2	0.333	10.43	0.743	64.34	0.03	6.59	0.34	16.54	0.43	29.430	8.13	0.328
	37S	5	0.187	5.79	0.64	42.62	0.05	6.55	0.24	12.98	0.73	30.823	8.182	0.276
	38S	10	0.13	0.16	0.11	4.05	0.37	6.64	0.50	6.91	0.03	34.997	8.120	0.094
	38B	10	0.16	0.15	0.14	3.46	0.50	5.76	0.66	6.05	0.05	35.011	8.110	0.168
	39S	50	0.11	0.21	0.11	4.87	0.59	7.40	0.70	7.72	0.04	34.966	8.119	0.084
	39B	50	0.12	0.05	0.10	2.94	0.52	7.00	0.64	7.15	0.03	35.049	8.117	0.042
	40S	100	0.13	0.85	0.10	12.62	0.52	6.16	0.65	7.11	0.09	34.620	8.095	0.136
	40B	100	0.06	0.04	0.13	2.16	0.33	6.26	0.39	6.43	0.09	35.053	8.114	0.094
PO'O HAWAII			2.66	90.52	6.85	620.29	0.36	13.86	3.01	111.23	1.18	8.943	7.639	10.223

TABLE 2. Results of water chemistry sampling along transects fronting the Kahaluu Ma Kai Project. Concentrations of nutrients are shown as micrograms per liter (μg/L). "DFS" represents distance from shore with negative values indicating distance inland from the shoreline, and positive values indicating distance seaward from the shoreline. "S" indicates surface sample; "B" indicates near-bottom sample. For locations of sampling transects, see Figure 1.

	Station	DFS(m)	PO_4^{3-} (μg/L)	NO_3^- (μg/L)	NH_4^+ (μg/L)	Si (μg/L)	TOP (μg/L)	TON (μg/L)	TP (μg/L)	TN (μg/L)	TURB (ntu)	SALT (o/oo)	pH (rel)	Chl-a (μg/l)
Transect 1	1S	-220	1.86	51.38	37.94	1335.88	12.71	206.36	14.57	295.68	0.99	32.539	8.004	0.147
	2S	-200	2.79	53.34	18.90	1057.84	12.71	188.16	15.50	260.40	0.40	33.189	7.995	0.420
	3S	-195	3.41	57.68	21.42	1062.60	14.26	198.52	17.67	277.62	0.38	33.203	8.004	0.483
	4S	-175	3.72	57.12	13.16	1125.32	12.71	164.64	16.43	234.92	0.27	33.073	8.002	0.283
	5S	-160	3.72	50.40	15.40	952.00	11.16	149.66	14.88	215.46	0.31	33.497	8.030	0.241
	6S	-145	3.72	47.88	12.60	836.92	10.85	155.26	14.57	215.74	0.24	33.826	8.089	0.252
	7S	-150	4.65	45.64	30.10	804.44	10.85	148.82	15.50	224.56	0.60	33.935	8.079	0.115
	8S	-145	4.65	46.62	27.44	836.08	11.47	151.06	16.12	225.12	0.86	33.974	8.084	0.210
	9S	-135	4.96	84.42	14.42	1289.12	11.16	147.42	16.12	246.26	0.37	33.237	8.117	0.535
	10S	-145	8.68	36.54	19.46	616.28	11.78	157.22	20.46	213.22	0.36	34.336	8.102	0.315
	10B	-145	2.17	21.70	15.40	425.60	13.02	144.48	15.19	181.58	0.57	34.621	8.074	0.850
	11S	-130	1.86	31.92	12.32	570.64	12.71	141.40	14.57	185.64	0.51	34.380	8.095	0.231
	11B	-130	2.17	26.18	15.68	391.44	11.47	149.52	13.64	191.38	0.37	34.664	8.064	0.283
	12S	-95	2.17	5.18	6.30	154.84	10.23	122.22	12.40	133.70	0.21	34.972	8.005	0.283
	12B	-95	1.86	4.62	4.62	156.24	9.92	117.46	11.78	126.70	0.23	34.965	8.002	0.199
	13S	-60	3.72	7.42	4.34	95.20	8.68	112.98	12.40	124.74	0.18	35.048	8.005	0.178
	14S	-30	4.65	7.00	5.88	95.20	7.75	104.58	12.40	117.46	0.15	35.033	7.980	0.189
	15S	-15	5.27	4.90	2.52	111.72	7.13	99.68	12.40	107.10	0.11	35.029	8.124	0.178
	16S	0	4.03	2.10	2.24	112.00	7.75	102.34	11.78	106.68	0.10	34.973	8.135	0.094
	17S	5	3.72	2.52	2.66	115.08	7.75	100.10	11.47	105.28	0.08	34.968	8.114	0.084
	18S	10	1.55	3.50	2.80	125.16	7.75	91.70	9.30	98.00	0.06	34.957	8.110	0.115
	19S	20	1.24	2.52	3.08	141.40	8.06	96.60	9.30	102.20	0.08	34.955	8.129	0.073
	19B	20	1.55	1.96	2.66	128.52	8.37	93.80	9.92	98.42	0.09	34.959	8.124	0.063
	20S	50	3.72	7.56	1.68	265.44	9.30	104.16	13.02	113.40	0.07	34.766	8.104	0.084
	20B	50	4.03	0.70	1.26	94.36	11.16	93.38	15.19	95.34	0.07	34.987	8.117	0.073
	21S	100	4.96	11.90	1.12	359.24	11.47	102.90	16.43	115.92	0.07	34.604	8.097	0.063
	21B	100	4.34	0.56	1.54	88.20	11.47	88.48	15.81	90.58	0.10	34.999	8.114	0.052
TRANSECT 2	22S	-160	11.78	686.00	23.10	7578.48	5.89	104.72	17.67	813.82	0.31	15.407	8.189	1.028
	23S	-140	17.36	519.40	15.26	6773.76	6.82	128.80	24.18	663.46	0.44	20.965	8.072	0.839
	24S	-125	7.44	261.66	17.36	3707.76	10.23	134.68	17.67	413.70	0.52	27.828	7.989	0.755
	25S	-110	17.05	465.78	7.70	6027.28	6.20	107.24	23.25	580.72	0.23	23.169	7.992	0.147
	25B	-110	1.86	77.98	12.60	1223.88	10.23	117.46	12.09	208.04	0.25	32.811	7.974	0.199
	26S	-100	0.93	2.38	6.86	89.32	8.06	104.02	8.99	113.26	0.16	35.103	8.007	0.126
	26B	-100	0.93	2.38	10.22	103.60	8.68	113.82	9.61	126.42	0.22	35.087	8.000	0.168
	27S	-85	4.96	206.50	10.08	2892.96	8.68	107.10	13.64	323.68	0.15	29.638	8.037	0.105
	28S	-70	2.17	8.96	8.12	163.52	8.99	101.92	11.16	119.00	0.07	34.898	8.129	0.115
	28B	-70	1.24	6.02	11.06	122.08	10.85	102.90	12.09	119.98	0.08	34.962	8.142	0.262
	29S	-40	0.93	3.22	6.44	101.92	9.30	88.76	10.23	98.42	0.05	34.986	8.139	0.220
	29B	-40	1.24	2.94	6.16	99.12	8.37	94.64	9.61	103.74	0.09	34.992	8.142	0.126
	30S	-10	0.93	1.68	5.60	107.52	8.37	110.60	9.30	117.88	0.11	34.996	8.147	0.147
	31S	0	1.24	1.68	5.46	96.60	8.68	84.84	9.92	91.98	0.06	35.007	8.134	0.136
	32S	10	3.41	11.34	4.48	331.80	8.06	93.52	11.47	109.34	0.08	34.655	8.094	0.094
	32B	10	2.79	2.24	8.68	103.60	7.75	88.48	10.54	99.40	0.06	34.991	8.112	0.105
	33S	50	2.48	8.12	6.44	258.16	7.75	88.20	10.23	102.76	0.08	34.767	8.097	0.168
	33B	50	1.55	1.40	3.50	105.84	8.37	93.52	9.92	98.42	0.09	35.002	8.105	0.094
	34S	100	1.55	17.78	6.16	478.80	8.99	94.22	10.54	118.16	0.07	34.462	8.094	0.105
	34B	100	1.55	0.98	3.08	105.84	7.44	100.10	8.99	104.16	0.07	34.985	8.112	0.063
TRANSECT 3	35S	0	14.04	189.67	12.53	2405	0.71	92.83	14.76	295.04	0.57	28.723	8.183	0.434
	36S	2	10.32	146.02	10.40	1802	0.93	92.26	10.54	231.56	0.43	29.430	8.13	0.328
	37S	5	5.80	81.06	8.96	1193	1.55	91.70	7.35	181.72	0.73	30.823	8.182	0.276
	38S	10	4.03	2.24	1.54	113.40	11.47	92.96	15.50	96.74	0.03	34.997	8.120	0.094
	38B	10	4.96	2.10	1.96	96.88	15.50	80.64	20.46	84.70	0.05	35.011	8.110	0.168
	39S	50	3.41	2.94	1.54	136.36	18.29	103.60	21.70	108.08	0.04	34.966	8.119	0.084
	39B	50	3.72	0.70	1.40	82.32	16.12	98.00	19.84	100.10	0.03	35.049	8.117	0.042
	40S	100	4.03	11.90	1.40	353.36	16.12	86.24	20.15	99.54	0.09	34.620	8.095	0.136
	40B	100	1.86	0.56	1.82	60.48	10.23	87.64	12.09	90.02	0.09	35.053	8.114	0.094
PO'O HAWAII			82.31	1267.31	95.84	17368	11.10	194.04	93.40	1557.19	1.18	8.943	7.639	10.223

TABLE 3. Nutrient and salinity concentrations in County of Hawaii Dept. of Water Supply Keauhou wells located upslope of Keauhou Resort area. Top panel shows nutrient concentrations in micromolar (μM) units. Bottom panel shows nutrient concentrations in units of milligrams per Liter (mg/L).

WELL ID	PO_4^{3-} (μM)	NO_3^- (μM)	NH_4^+ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	SALT (o/oo)
DWS KEAUHOU A	4.20	82.00	0.70	751.00	1.10	4.50	5.30	87.20	0.329
DWS KEAUHOU A	4.20	84.00	2.20	744.00	0.50	3.20	4.70	89.40	0.422
DWS KEAUHOU B	4.30	86.20	0.20	750.00	1.00	3.10	5.30	89.50	0.209
DWS KEAUHOU C	4.20	84.20	0.50	750.00	1.10	5.20	5.30	89.90	0.409
DWS KEAUHOU C	4.70	85.00	1.90	759.00	0.60	11.10	5.30	98.00	0.407
AVERAGE	4.32	84.28	1.10	750.80	0.86	5.42	5.18	90.80	0.36

WELL ID	PO_4^{3-} (mg/L)	NO_3^- (mg/L)	NH_4^+ (mg/L)	Si (mg/L)	TOP (mg/L)	TON (mg/L)	TP (mg/L)	TN (mg/L)	SALT (o/oo)
DWS KEAUHOU A	0.13	1.15	0.01	21.03	0.03	0.06	0.16	1.22	0.329
DWS KEAUHOU A	0.13	1.18	0.03	20.83	0.02	0.04	0.15	1.25	0.329
DWS KEAUHOU B	0.13	1.21	0.00	21.00	0.03	0.04	0.16	1.25	0.329
DWS KEAUHOU C	0.13	1.18	0.01	21.00	0.03	0.07	0.16	1.26	0.329
DWS KEAUHOU C	0.15	1.19	0.03	21.25	0.02	0.16	0.16	1.37	0.329
AVERAGE	0.13	1.18	0.02	21.02	0.03	0.08	0.16	1.27	0.329

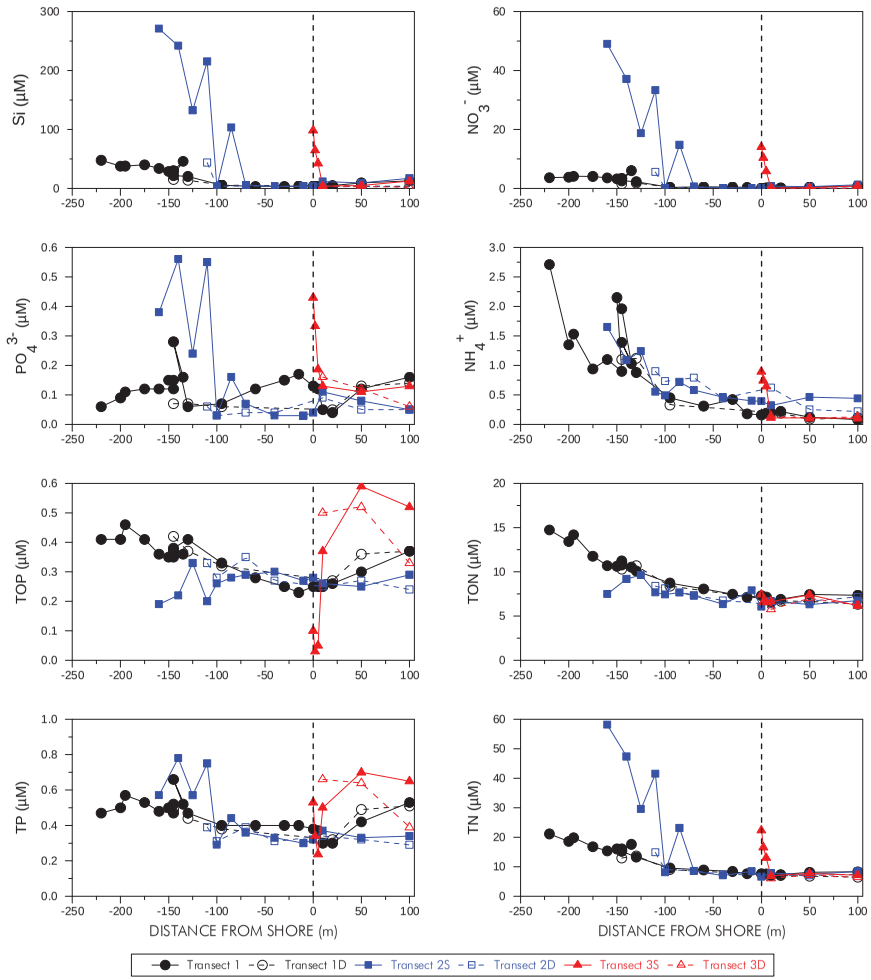


FIGURE 3. Plots of dissolved nutrients in surface (S) and deep (D) samples collected along three transects off the Kahaluu Ma Kai Project site in Keauhou, North Kona, Hawaii as a function of distance from the shoreline. Negative distances are inland from the shoreline in a series of tidepools. Positive distances extend from the shoreline seaward. For transect locations, see Figure 1.

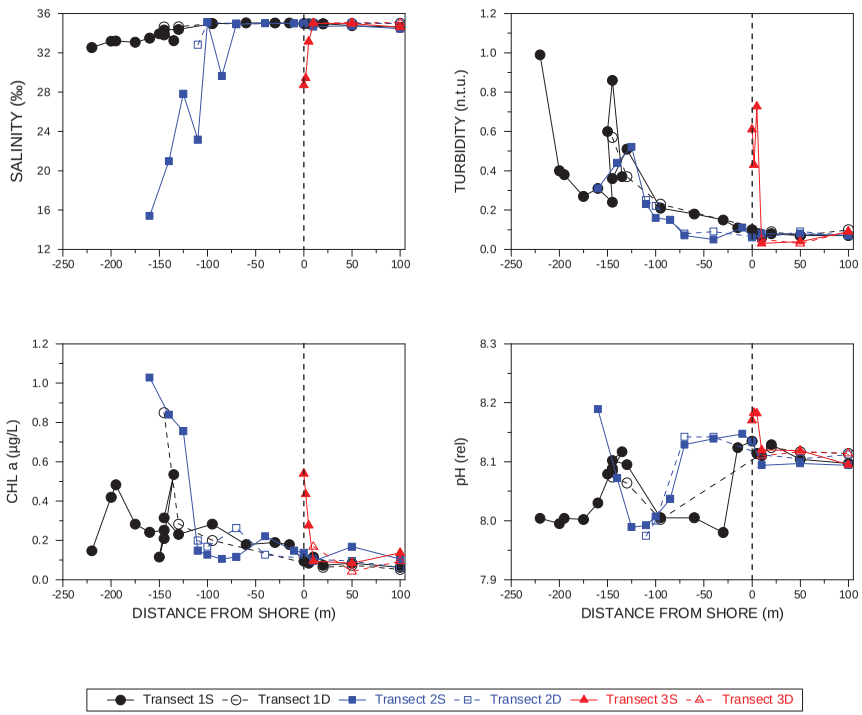


FIGURE 4. Plots of water chemistry constiituents in surface (S) and deep (D) samples collected along three transects off the Kahaluu Ma Kai project site in Keauhou, North Kona, Hawaii as a function of distance from the shoreline. Negative distances are inland from the shoreline through a series of tidepools. Positive distances extend from the shoreline seaward. For transect locations, see Figure 1.

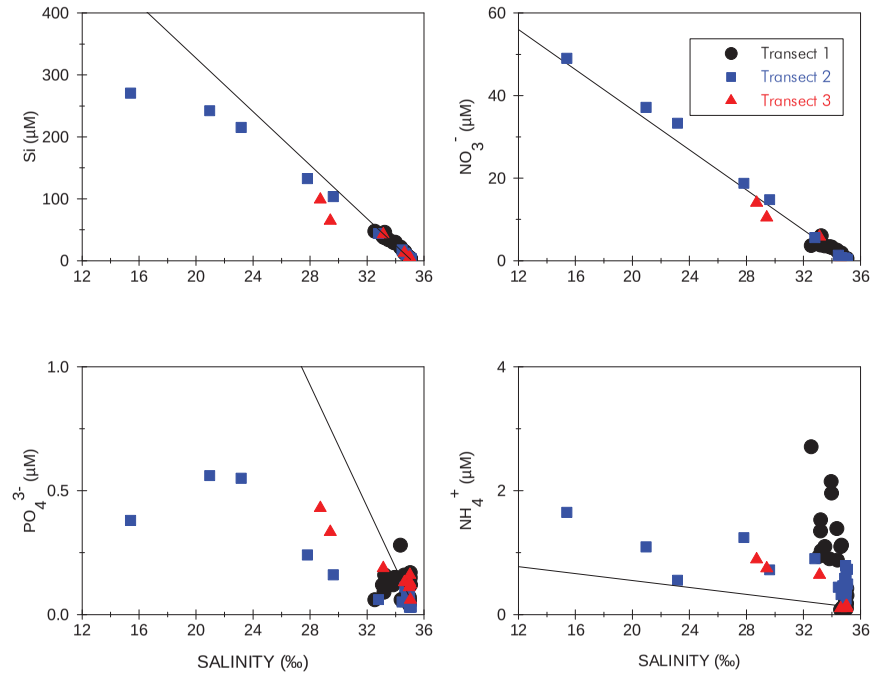


FIGURE 5. Mixing diagram showing concentration of dissolved nutrients from samples collected along three transects in the off the Kahaluu Ma Kai project site in Keauhou, North Kona. Straight lines in each plot are conservative mixing lines constructed by connecting the concentrations in open ocean water with water from three groudwater wells upslope of the sampling area. For transect locations, see Figure 1.

TABLE 4. Upper and lower 95% confidence limits of slopes of linear regressions of geometric mean values of NO_3^-, TN, PO_4^{3-} and TP as functions of salinity from three ocean transects offshore of the Kahalu'u Ma Kai site in North Kona Hawaii. Also shown are slopes specified in DOH Water Quality Standards for West Hawaii as limiting criteria. Shaded slopes indicate that the absolute value of the upper confidence limit exceed the DOH WH compliance slope.

		NO_3^-	TN	PO_4^{3-}	TP
DOH WH stds		-31.9	-40.4	-3.2	-2.9
T-1	upper 95%	-24.1	-67.4	0.7	-0.8
	lower 95%	-34.3	-91.3	-1.0	-3.1
T-2	upper 95%	-35.3	-36.5	-0.7	-0.5
	lower 95%	-37.1	-39.5	-1.0	-0.9
T-3	upper 95%	-31.0	-32.7	-0.8	2.4
	lower 95%	-22.1	-21.9	-1.8	-0.1

TABLE 5. Summary table of percent cover of benthos from calibration/validation photos of surveys off the Kahalu'u Ma Kai project site. Each value represents the mean of values from five photographs. Code key for each bottom cover type is shown at bottom. Locations of survey sites are shown in Figure x. See Appendix A for individual photo counts, and Appendix B for photographs.

SITE	*Mc*	*Mp*	*Pc*	*Pe*	*Pl*	*Pm*	*Pv*	*Zo*	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
217	0	0	0	2.4	3.6	7.6	0	0	13.6	0	7.2	0	1.0	21.0	0	0	0	48.4	0	8.8	100
218	0	0	0	5.0	52.2	1.8	0	0	59.0	1.4	2.0	0	0	23.0	0	0.8	0	11.4	0	2.4	100
219	0	0	0	11.6	63.4	0	0	0	75.2	0	0	0	0	23.6	0	0	0	1.0	0	0.2	100
220	0	0	4.0	27.0	62.8	0.2	0	0	94.0	0	0	0	0	6.0	0	0	0	0	0	0	100
221	0	0	0.2	0.4	0.2	0	0	0	0.8	0	0.0	0	32.2	3.2	0	38.0	0	0	25.8	0	100
222	0	0	62.8	1.8	22.4	0	0	0	87.0	0	4.0	0	0	8.0	0	0.6	0	0	0	1.0	100
223	0.8	0.4	3.6	6.0	72.0	2.4	0	0	85.4	0	0.6	0	0	9.0	0	0	0	5.0	0	0	100
224	0	0	56.0	0	0	0	0	0	56.0	0	10.0	0	0	34.0	0	0	0	0	0	0	100
225	0.2	0	0	0.2	1.2	0	0	0	1.6	0	0	0	3.4	29.4	0	64.2	0	0	0	1.4	100
226	0	0	0	0	40.8	5.4	0	0	46.2	0	0	0	0	52.4	0	0	0	0.6	0	0.8	100
227	0.2	0	0	6.4	64.6	0	0	0	71.2	0	0.4	0	0	28.0	0	0	0	0	0	0.4	100
228	0	0	0	62.6	32.4	0	0	0	95.0	0	0	0	0	4.6	0	0	0	0	0	0.4	100
229	0	0	0.8	32.4	48.0	0	0	0	81.2	0	0	0	0	18.6	0	0	0	0	0	0.2	100
231	0	0	0	1.6	5.6	0	0	0	7.2	0	0	0	1.6	42.8	10.0	36.6	0	0	0	1.8	100
232	0	0	58.4	0	26.0	0.4	0	0	84.8	0	2.0	0.2	0	13.0	0	0	0	0	0	0	100
233	0	0	27.4	3.0	55.2	1.6	0	0	87.2	0	0	0	0.2	12.6	0	0	0	0	0	0	100
234	0	0	67.8	0	21.0	0	0	0	88.8	0	3.0	0	0	8.2	0	0	0	0	0	0	100
235	0	0	37.2	1.6	30.6	0	0	0	69.4	0	3.6	0	4.0	22.0	0	1.0	0	0	0	0	100
237	0	0	0	0.2	34.0	0	0	0	34.2	0	4.4	0	1.0	7.6	51.6	0.8	0	0	0	0.4	100
238	0	0	0	2.6	76.0	0	0	0	78.6	0	0	0	0	19.6	0	0	0	0	0	1.8	100
239	0.2	0	2.0	17.0	69.4	0	0	0	88.6	0	0	0	0	10.4	0	0	0	0	0	1.0	100
240	0	0	5.0	35.8	42.0	0	0	0	82.8	0	2.0	0	0	14.0	0	0	0	0.8	0	0.4	100
241	0	0	0	3.0	13.2	0	0	0.2	16.4	1.6	2.6	0	2.0	23.0	0	54.0	0.2	0	0	0.2	100
242	0	0	60.0	0.8	28.0	0	0.6	0	89.4	0	1.0	0	0	9.6	0	0	0	0	0	0	100
243	0.2	0	3.4	1.8	10.8	0	0	0	16.2	0.2	0	0	0	58.2	0	23.0	0	0	0	2.4	100
244	0.6	0	0.2	0.2	2.4	0	0	0	3.4	0.6	0.6	0	1.6	45.4	0	46.6	0	0	0	1.8	100
AVE.	0.1	0	15.0	8.6	33.8	0.7	0	0	58.2	0.1	1.7	0	1.8	21.0	2.4	10.2	0.0	2.6	1.0	1.0	100

Mc = "*Montipora capitata*"
Mp = "*Montipora patula*"
Pc = "*Porites compressa*"
Pd = "*Pocillipora damicornis*"
Pe = "*Porites lutea*"
A = "Algae"
TUR = "Turf"
SP = "Sponge"
SA = "Sand"
LS = "Limestone"
Pl = "*Porites lobata*"
Pm = "*Pocillopora meandrina*"
Pv = "*Pavona varians*"
Zo = "*Zoaanthid*"
TC = "Total Coral Cover"
R = "Rock"
RU = "Rubble"
DC = "Dead coral"
CCA = "Crustose Corraline Algae"
TBS = "Turf-Bound-Sediment"
INV = "Invertebrate"

TABLE 6. Coverage of reef by living corals derived from in situ cal/val data and satellite imagery. Coral coverage is binned into 7 classes ranging from zero cover to greater than 90% cover. Based on summation of class cover, about 73% of the reef surface contains coral cover greater than 30%.

% Cover Class	Area Class Cover	% Class Cover
$p = 0$	43,208 m^2	2.76
$0 < p \leq 10$	165,244 m^2	10.54
$10 < p \leq 30$	212,400 m^2	13.55
$30 < p \leq 50$	64,572 m^2	4.12
$50 < p \leq 70$	118,276 m^2	7.55
$70 < p \leq 90$	890,192 m^2	56.80
$90 < p \leq 100$	73,232 m^2	4.67
TOTAL	1,567,124 m^2	100.00

TABLE 7. Counts of reef fish at each cal/val survey site off Kahalu'u Ma Kai project site.

Station	217-21	219	220	221	222	223	224	225	227	228	229	230	231	232	233	234	235	237	238	239	240	241	242	243	244	TOTAL
Depth (feet)	10	20	26	34	38	40	45	50	15	23	23	24	32	38	44	50	60	15	20	22	25	33	40	45	54	
Butterflyfishes																										
Chaetodon lunula					8																				2	10
C. multicinctus					2					2			1	1	2		2			2	1					13
C. ornatissimus		1		1		2			2									2					1			7
Damselfishes																										
Chromis ovalis					14	2	40	10						8	30	50+	10					2		50+	50+	266
C. vanderbilti		20	36	10						15		25						3	8	40	10		10			111
Plectogyphidodon johnstonia	2		1																	1						1
Stegastes marginatus		5																			1					1
Goatfishes																										
Parupeneus multifasciatus									1														2		2	5
Hawkfishes																										
Paracirrhites arcatus					1					1					1	1						1				5
Parrotfishes																										
Chlorurus spilurus	2													1									1			2
Scarus psittacus														1												1
Surgeonfishes																										
Acanthurus nigrofuscus				4					8									4	4							16
Ctenochaetus strigosus	10	10		28	12		7	2	2	6	3	4			1	2	8			2	9	5	22	24		109
Naso hexacanthus					6	20																				26
Zebrasoma flavescens	18	14	3	24		2	15	5	4		4	1	12	12	3	4	8		5	2	10	8	26	19	16	156
Triggerfishes																										
Melichthys vidua		1	10						28		6							1	12	15	11					73
Sufflamen bursa									1				1					1				1				4
Wrasses																										
Coris venusta						1																				1
Gomphosus varius		1	1	1				1											1						1	3
Labroides pthirophagus												2												1		3
Thallosoma duperrey	3	5	4	4	9	1	1			3	1		1	1		1	1	2	3	1		2	1			28
Others																										
Centropyge potteri					1																					1
Cephalopholis argus							1					1		2			3							2		9
Zanclus cornutus														2					1							3
TOTAL INDIVIDUALS	**35**	**57**	**55**	**72**	**53**	**28**	**64**	**18**	**46**	**27**	**14**	**33**	**15**	**28**	**37**	**58**	**32**	**13**	**34**	**63**	**42**	**19**	**63**	**96**	**71**	**854**
TOTAL SPECOES	**5**	**8**	**6**	**7**	**8**	**6**	**5**	**4**	**7**	**5**	**4**	**5**	**4**	**8**	**5**	**4**	**6**	**6**	**7**	**7**	**6**	**6**	**7**	**4**	**4**	**24**

FIGURE 6. Top photo shows origin of water chemistry Transect 1, located in the approximate center of the Kahalu'u Ma Kai project site. Bottom photo shows origin of Transect 2, located at shoreward end of tidepool "lagoon." The seaward end of the Keauhou Beach Resort structure, built over the lagoon, appears in the upper right corner.

FIGURE 7. Top photo shows steeply sloping coarse sand beach abutting rocky intertidal bench off the southern portion of the Kahalu'u Ma Kai project site. Bottom photo shows shallow tidepools fronting the Hapaiai'a Heiau off the center of the project site.

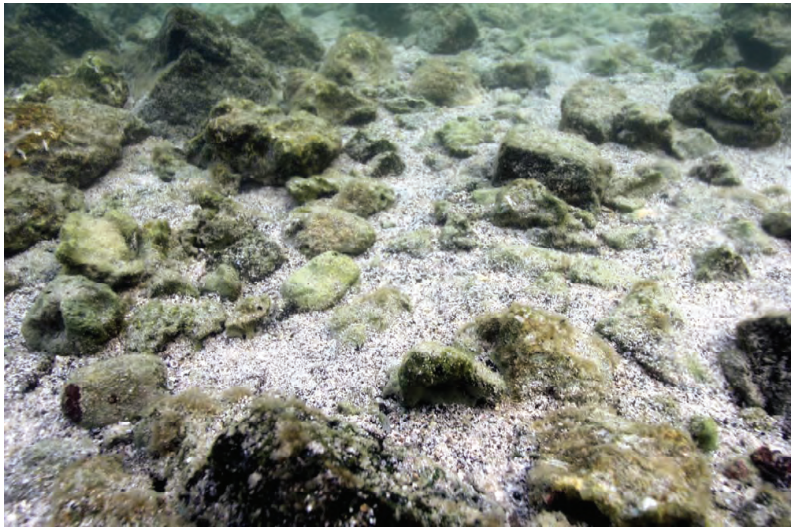
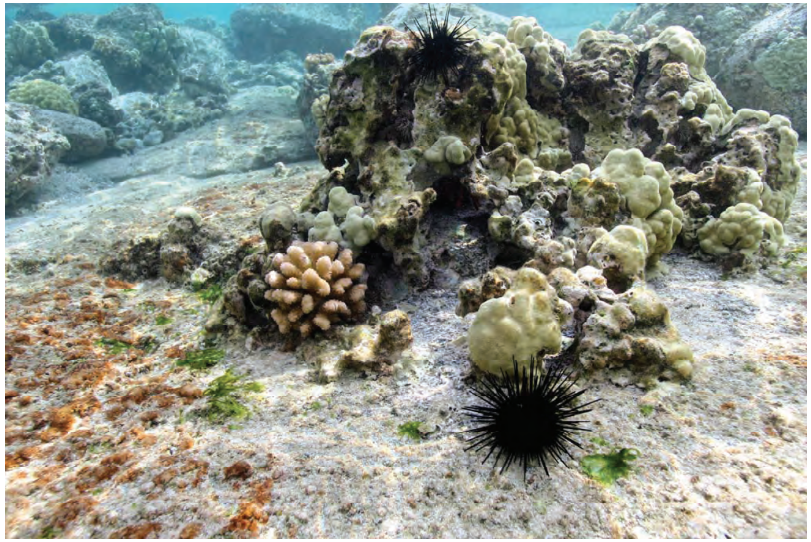


FIGURE 8. Top photo shows bottom of tidepool "lagoon" consisting of coarse sand and rocks covered with a green film of microalgae. Bottom photo shows surface of walled anchialine pond (Po'o Hawaii) located on the northern end of Kahalu'u Ma Kai project site between the Keauhou Beach Resort structure and Kahalu'u Beach Park.



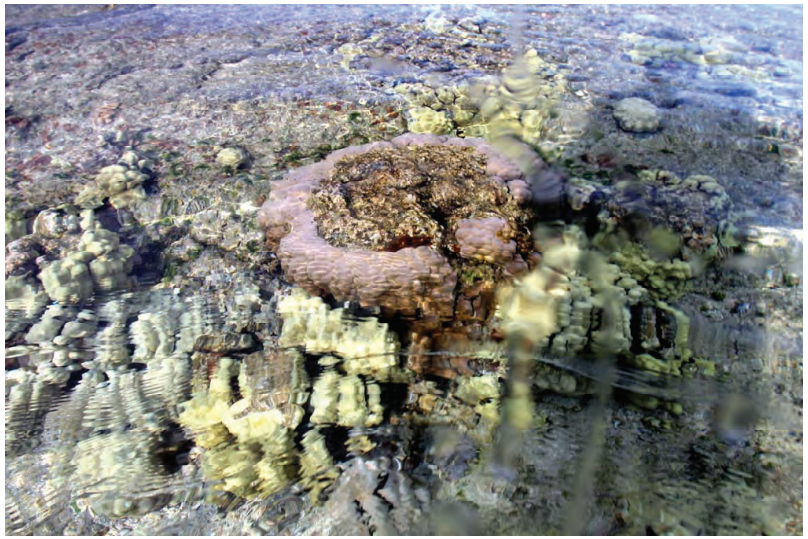


FIGURE 9. Two photos of bottom of tidepools on outer section of basalt shoreline platform fronting the Kahalu'u Ma Kai project site. Both photos show living colonies of reef corals, primarily of the green-colored *Porites lobata*. Top photo also shows long-spined sea urchins *Echinothrix diadema*. Bottom photo shows circular "microatoll" forming from a large colony of *Porites* forming as a result of limitation on upward growth in shallow water. Water depth in both photos is 1-2 feet.

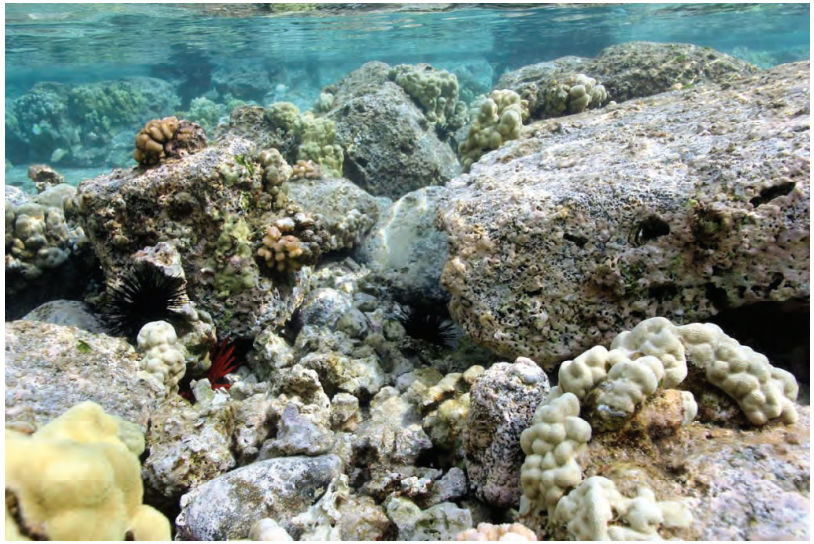
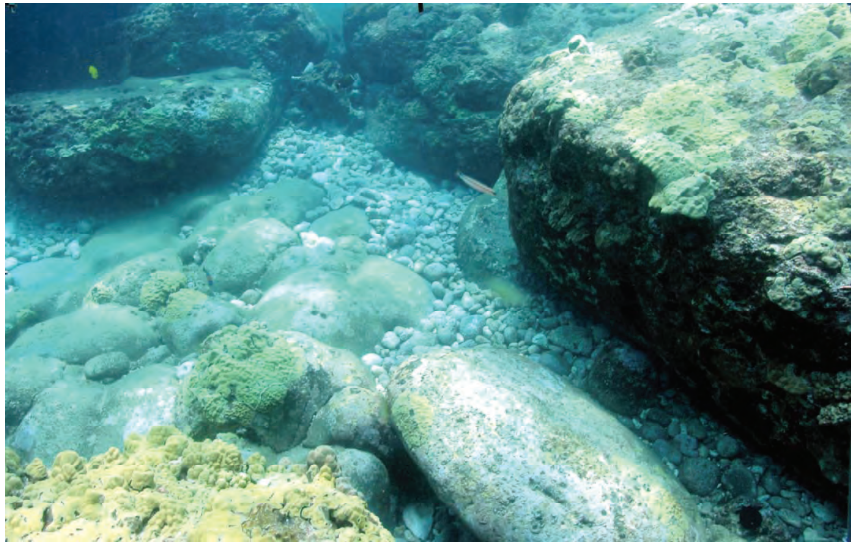


FIGURE 10. Top photos shows coral colonization of bottom of tidepools on outer section of basalt shoreline platform fronting the Kahalu'u Ma Kai project site. Bottom photo shows water surface illustrating flushing of tidepools with open ocean water carried across the shoreline by wave wash. Rock structures seen in center of bottom photo serve as effective barrier to penetration of wave propelled seawater into back lagoon area fronting the Keauhou Beach Resort.



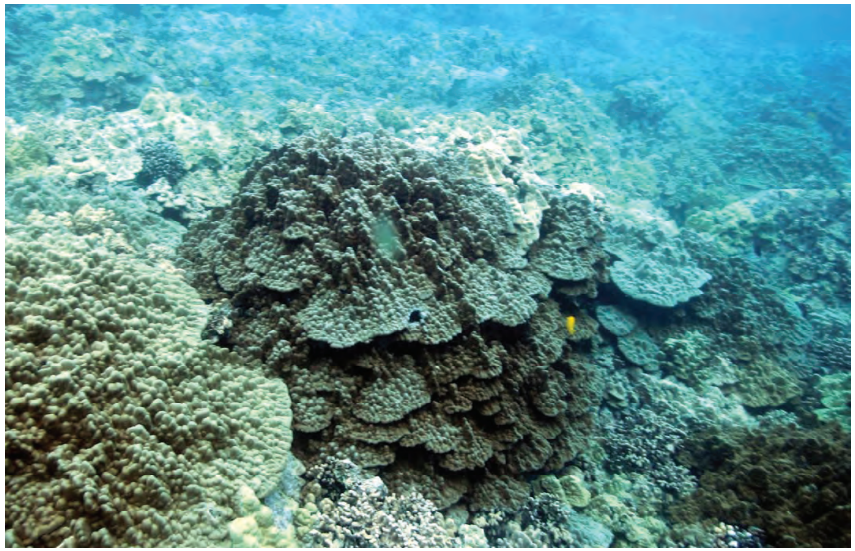


FIGURE 11. Top photo shows nearshore boulder zone on the ocean side of the shelf break of the basalt shoreline platform fronting the Kahalu'u Ma Kai project site. Bottom photo shows mid-depth area of reef platform with near total bottom cover of living corals, primarily of *Porites lobata* and *P. lutea*. Water depth in top phot is approximately 18 feet; depth in bottom photo is approximately 25 feet.

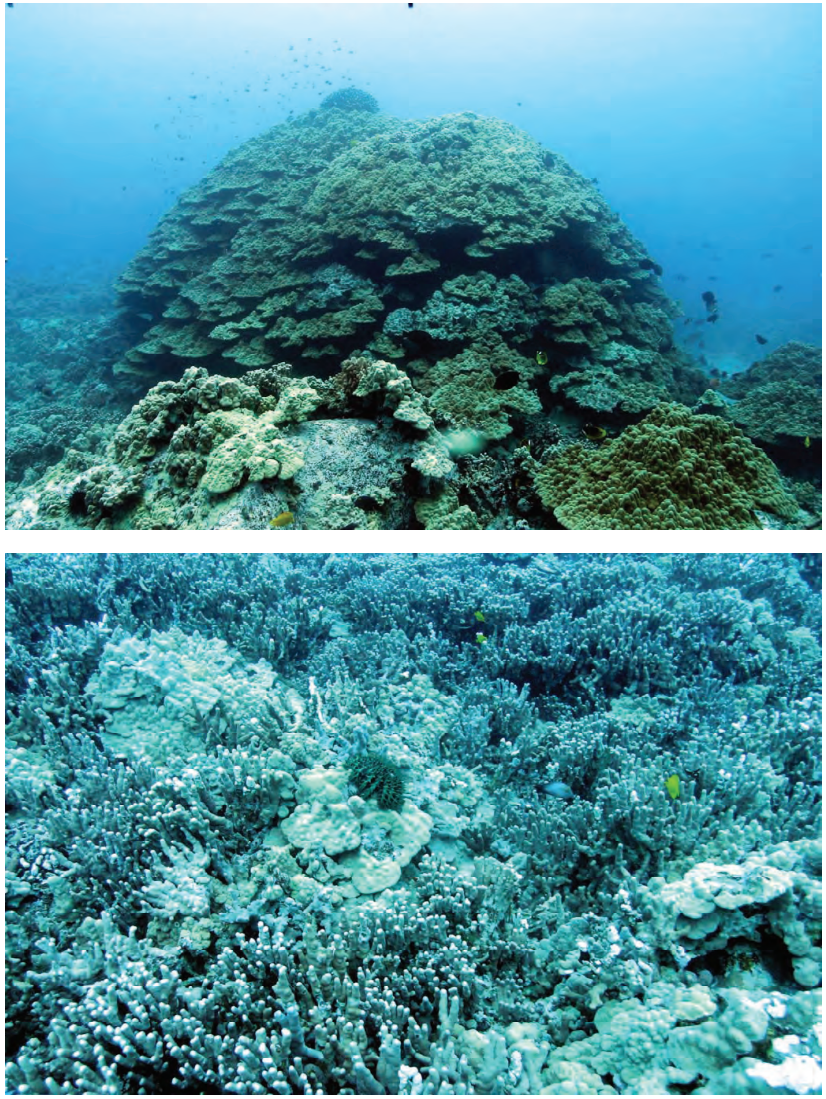


FIGURE 12. Top photo shows large colony of *Porites lobata* on reef platform fronting the Kahalu'u Ma Kai project site. Bottom photo shows outer area of reef platform terrace with near total bottom cover of living corals, with cover split between lobata colonies of *Porites lobata* and branching colonies of *Porites compressa*. Water depth in top photo is approximately 25 feet; depth in bottom photo is approximately 30 feet.

FIGURE 12. Top photo shows large colony of *Porites lobata* on reef platform fronting the Kahalu'u Ma Kai project site. Bottom photo shows outer area of reef platform terrace with near total bottom cover of living corals, with cover split between lobata colonies of *Porites lobata* and branching colonies of *Porites compressa*. Water depth in top photo is approximately 25 feet; depth in bottom photo is approximately 30 feet.

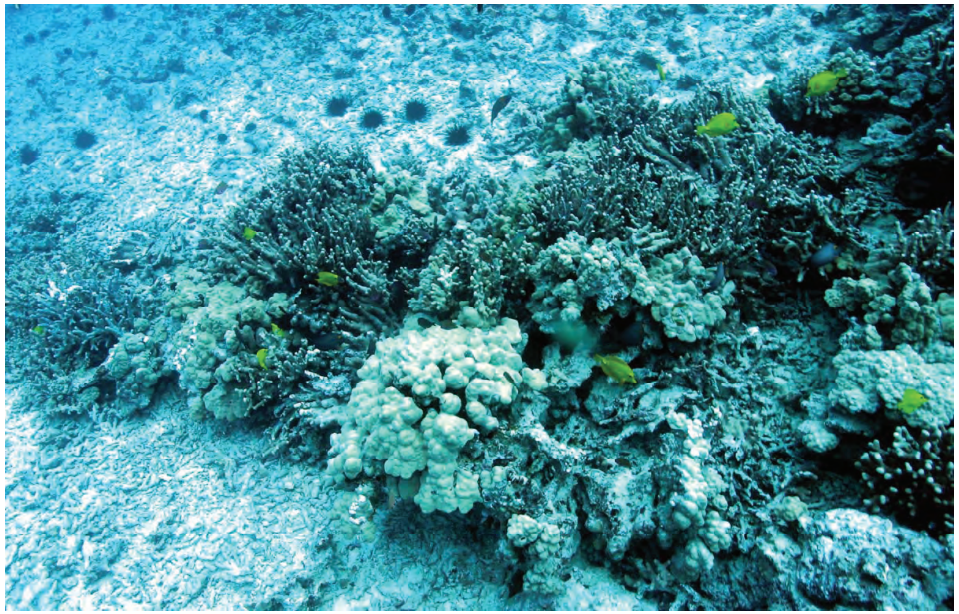


FIGURE 13. Finger of mixed *Porites lobata* and *P. compressa* extending into the reef slope rubble zone fronting the Kahalu'u Ma Kai project site. Water depth in top photo is approximately 60 feet.

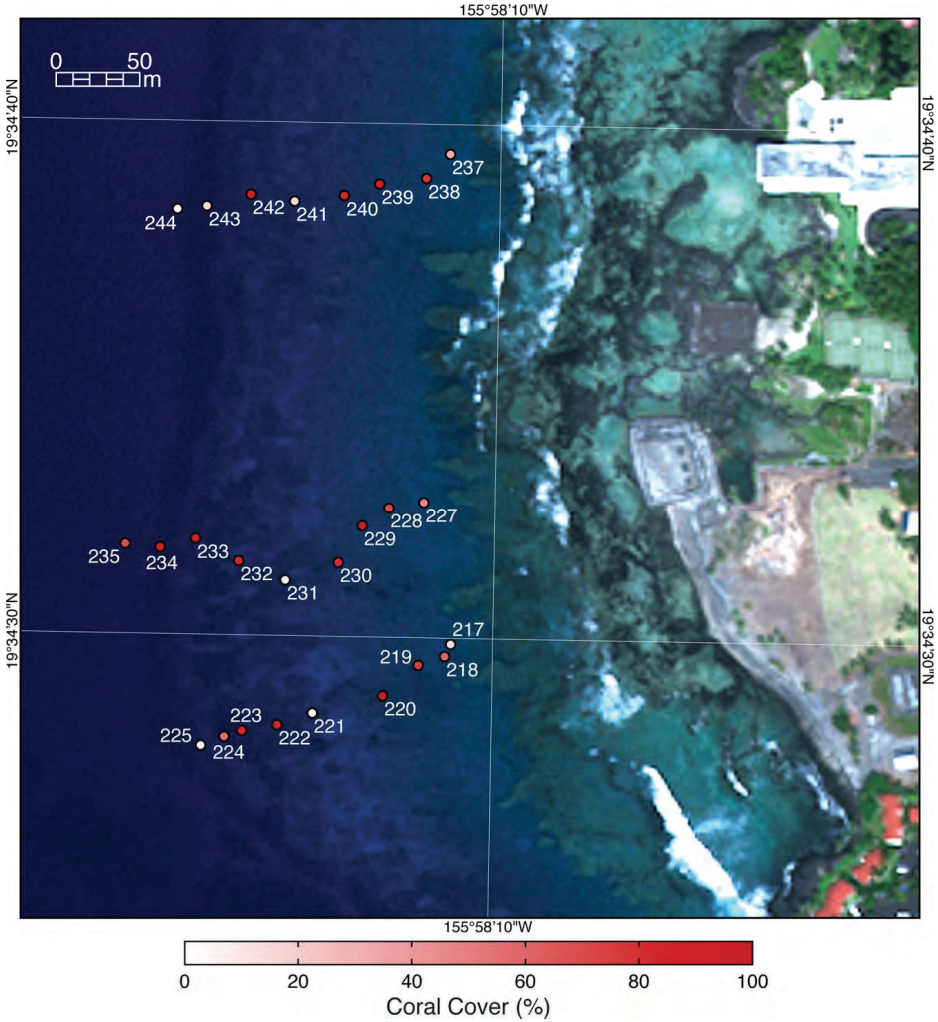


FIGURE 14. Satellite image of Kahalu'u Ma Kai project site and offshore marine habitats showing locations of 26 calibration/validation sites used to construct coral map. Intensity of red color within dots indicates percentage cover of live corals (see scale).

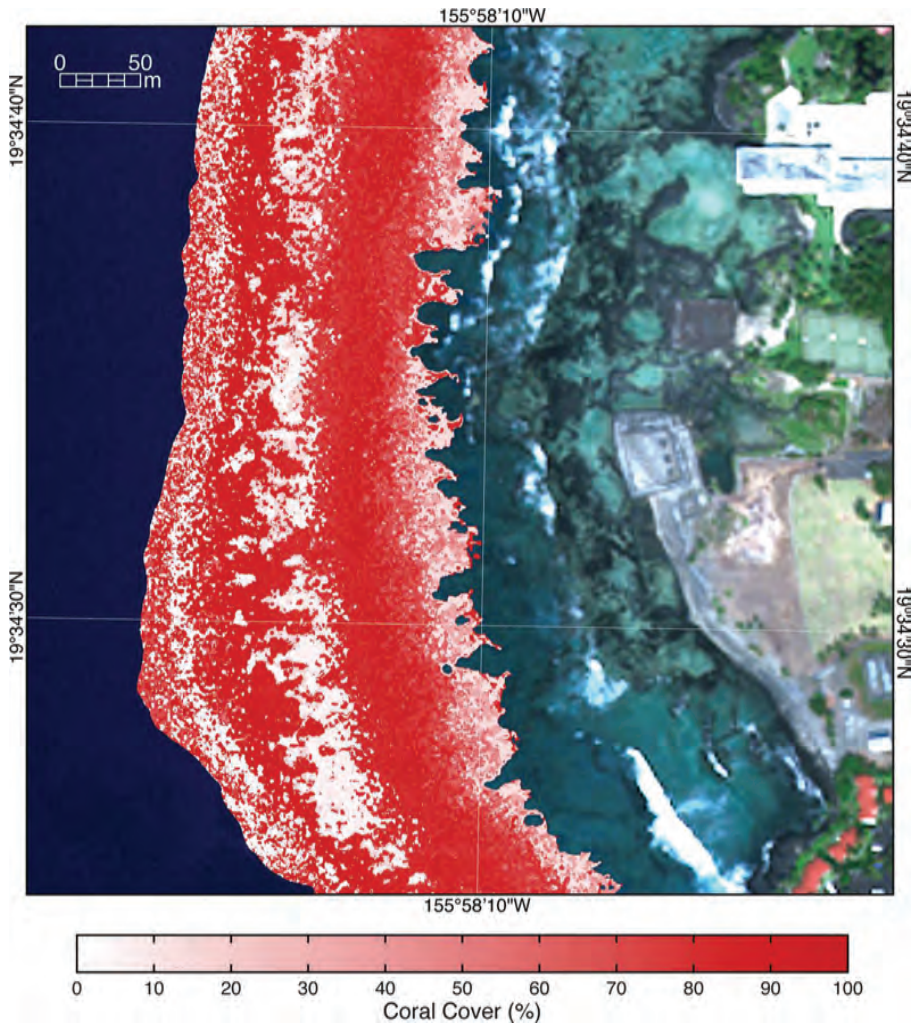


FIGURE 15. Satellite image of Kahalu'u Ma Kai project site and adjacent ocean overlain with map showing percent cover of living coral. Intensity of red color indicates degree of coral cover. Highest cover occurs across the center of the offshore reef platform where colonies of lobate Porites cover nearly the entire bottom. Light colored areas indicate occurrence of sand and rubble patches on the outer platform.

APPENDIX A. Percent cover of benthos from calibration/validation photos of surveys off the Kahalu'u Ma Kai project site. See Appendix B for photographs.

SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
217	8027	0	0	0	0	3	10	0	0	0	13	0	8	0	0	25	0	0	0	44	0	10	100
	8028	0	0	0	0	1	8	10	0	0	19	0	5	0	0	25	0	0	0	41	0	10	100
	8029	0	0	0	0	8	0	10	0	0	18	0	10	0	5	15	0	0	0	46	0	6	100
	8030	0	0	0	0	0	0	10	0	0	10	0	5	0	0	25	0	0	0	50	0	10	100
	8031	0	0	0	0	0	0	8	0	0	8	0	8	0	0	15	0	0	0	61	0	8	100
	MEAN	**0**	**0**	**0**	**0**	**2.4**	**3.6**	**7.6**	**0**	**0**	**13.6**	**0**	**7.2**	**0**	**1**	**21**	**0**	**0**	**0**	**48.4**	**0**	**8.8**	**100**
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
218	8035	0	0	0	0	0	60	0	0	0	60	7	0	0	0	0	0	0	0	25	0	8	100
	8036	0	0	0	0	5	77	0	0	0	82	0	0	0	0	5	0	4	0	6	0	3	100
	8037	0	0	0	0	5	49	0	0	0	54	0	0	0	0	40	0	0	0	5	0	1	100
	8038	0	0	0	0	5	22	5	0	0	32	0	2	0	0	60	0	0	0	6	0	0	100
	8039	0	0	0	0	10	53	4	0	0	67	0	8	0	0	10	0	0	0	15	0	0	100
	MEAN	**0**	**0**	**0**	**0**	**5**	**52.2**	**1.8**	**0**	**0**	**59**	**1.4**	**2**	**0**	**0**	**23**	**0**	**0.8**	**0**	**11.4**	**0**	**2.4**	**100**
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
219	8045	0	0	0	0	6	68	0	0	0	74	0	0	0	0	25	0	0	0	0	0	1	100
	8046	0	0	0	0	20	55	0	0	0	75	0	0	0	0	25	0	0	0	0	0	0	100
	8047	0	0	0	0	10	55	0	0	0	65	0	0	0	0	30	0	0	0	5	0	0	100
	8048	0	0	0	0	12	79	0	0	1	92	0	0	0	0	8	0	0	0	0	0	0	100
	8049	0	0	0	0	10	60	0	0	0	70	0	0	0	0	30	0	0	0	0	0	0	100
	MEAN	**0**	**0**	**0**	**0**	**12**	**63.4**	**0**	**0**	**0.2**	**75.2**	**0**	**0**	**0**	**0**	**23.6**	**0**	**0**	**0**	**1**	**0**	**0.2**	**100**
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
220	8054	0	0	2	0	0	92	0	0	0	94	0	0	0	0	6	0	0	0	0	0	0	100
	8055	0	0	2	0	0	91	1	0	0	94	0	0	0	0	6	0	0	0	0	0	0	100
	8056	0	0	8	0	10	74	0	0	0	92	0	0	0	0	8	0	0	0	0	0	0	100
	8057	0	0	8	0	40	42	0	0	0	90	0	0	0	0	10	0	0	0	0	0	0	100
	8058	0	0	0	0	85	15	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	100
	MEAN	**0**	**0**	**4**	**0**	**27**	**62.8**	**0.2**	**0**	**0**	**94**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**100**
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
221	8067	0	0	0	0	0	0	0	0	0	0	0	0	0	96	4	0	0	0	0	0	0	100
	8068	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	75	0	0	0	0	100
	8069	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	80	0	0	0	0	100
	8070	0	0	1	0	1	0	0	0	0	2	0	0	0	5	0	0	20	0	0	73	0	100
	8071	0	0	0	0	1	1	0	0	0	2	0	0	0	15	12	0	15	0	0	56	0	100
	MEAN	**0**	**0**	**0.2**	**0**	**0.4**	**0.2**	**0**	**0**	**0**	**0.8**	**0**	**0**	**0**	**32.2**	**3.2**	**0**	**38**	**0**	**0**	**25.8**	**0**	**100**
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
222	8079	0	0	81	0	0	4	0	0	0	85	0	15	0	0	0	0	0	0	0	0		100
	8080	0	0	65	0	6	15	0	0	0	86	0	5	0	0	5	0	3	0	0	0	1	100
	8081	0	0	78	0	3	8	0	0	0	89	0	0	0	0	10	0	0	0	0	0	1	100
	8082	0	0	60	0	0	25	0	0	0	85	0	0	0	0	15	0	0	0	0	0		100
	8083	0	0	30	0	0	60	0	0	0	90	0	0	0	0	10	0	0	0	0	0		100
	MEAN	**0**	**0**	**62.8**	**0**	**1.8**	**22.4**	**0**	**0**	**0**	**87**	**0**	**4**	**0**	**0**	**8**	**0**	**0.6**	**0**	**0**	**0**	**1**	**100**
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
223	8087	4	2	8	0	15	56	0	0	0	85	0	0	0	0	10	0	0	0	5	0	0	100
	8088	0	0	1	0	10	74	0	0	0	85	0	0	0	0	15	0	0	0	0	0	0	100
	8089	0	0	6	0	5	88	0	1	0	100	0	0	0	0	0	0	0	0	0	0	0	100
	8090	0	0	3	0	0	63	6	0	0	72	0	3	0	0	10	0	0	0	15	0	0	100
	8091	0	0	0	0	0	79	6	0	0	85	0	0	0	0	10	0	0	0	5	0	0	100
	MEAN	**0.8**	**0.4**	**3.6**	**0**	**6**	**72**	**2.4**	**0.2**	**0**	**85.4**	**0**	**0.6**	**0**	**0**	**9**	**0**	**0**	**0**	**5**	**0**	**0**	**100**
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
224	8095	0	0	40	0	0	0	0	0	0	40	0	10	0	0	50	0	0	0	0	0	0	100
	8096	0	0	60	0	0	0	0	0	0	60	0	10	0	0	30	0	0	0	0	0	0	100
	8097	0	0	60	0	0	0	0	0	0	60	0	10	0	0	30	0	0	0	0	0	0	100
	8099	0	0	60	0	0	0	0	0	0	60	0	10	0	0	30	0	0	0	0	0	0	100
	8100	0	0	60	0	0	0	0	0	0	60	0	10	0	0	30	0	0	0	0	0	0	100
	MEAN	**0**	**0**	**56**	**0**	**0**	**0**	**0**	**0**	**0**	**56**	**0**	**10**	**0**	**0**	**34**	**0**	**0**	**0**	**0**	**0**	**0**	**100**
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
225	8103	0	0	0	0	1	2	0	0	0	3	0	0	0	5	15	0	75	0	0	0	2	100
	8104	0	0	0	0	0	1	0	0	0	1	0	0	0	12	10	0	76	0	0	0	1	100
	8106	1	0	0	0	0	3	0	0	0	4	0	0	0	0	87	0	5	0	0	0	4	100
	8107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	80	0	0	0	0	100
	8108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	85	0	0	0	0	100
	MEAN	**0.2**	**0**	**0**	**0**	**0.2**	**1.2**	**0**	**0**	**0**	**1.6**	**0**	**0**	**0**	**3.4**	**29.4**	**0**	**64.2**	**0**	**0**	**0**	**1.4**	**100**

SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
227	8113	0	0	0	0	0	35	17	0	0	52	0	0	0	0	45	0	0	0	3	0	0	100
	8114	0	0	0	0	0	30	0	0	0	30	0	0	0	0	69	0	0	0	0	0	1	100
	8115	0	0	0	0	0	20	0	0	0	20	0	0	0	0	79	0	0	0	0	0	1	100
	8116	0	0	0	0	0	55	0	0	0	55	0	0	0	0	44	0	0	0	0	0	1	100
	8117	0	0	0	0	0	64	10	0	0	74	0	0	0	0	25	0	0	0	0	0	1	100
	MEAN	0	0	0	0	0	40.8	5.4	0	0	46.2	0	0	0	0	52.4	0	0	0	0.6	0	0.8	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
228	8124	0	0	0	0	6	43	0	0	0	49	0	0	0	0	50	0	0	0	0	0	1	100
	8125	0	0	0	0	6	74	0	0	0	80	0	0	0	0	20	0	0	0	0	0	0	100
	8126	0	0	0	0	12	63	0	0	0	75	0	0	0	0	25	0	0	0	0	0	0	100
	8127	1	0	0	0	6	68	0	0	0	75	0	0	0	0	25	0	0	0	0	0	0	100
	8128	0	0	0	0	2	75	0	0	0	77	0	2	0	0	20	0	0	0	0	0	1	100
	MEAN	0.2	0	0	0	6.4	64.6	0	0	0	71.2	0	0.4	0	0	28	0	0	0	0	0	0.4	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
229	8134	0	0	0	0	62	30	0	0	0	92	0	0	0	0	8	0	0	0	0	0	0	100
	8135	0	0	0	0	91	6	0	0	0	97	0	0	0	0	3	0	0	0	0	0	0	100
	8136	0	0	0	0	40	58	0	0	0	98	0	0	0	0	1	0	0	0	0	0	1	100
	8137	0	0	0	0	60	30	0	0	0	90	0	0	0	0	10	0	0	0	0	0	0	100
	8138	0	0	0	0	60	38	0	0	0	98	0	0	0	0	1	0	0	0	0	0	1	100
	MEAN	0	0	0	0	63	32.4	0	0	0	95	0	0	0	0	4.6	0	0	0	0	0	0.4	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
230	8143	0	0	0	0	25	75	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	100
	8144	0	0	0	0	87	10	0	0	0	97	0	0	0	0	3	0	0	0	0	0	0	100
	8145	0	0	3	0	45	47	0	0	0	95	0	0	0	0	5	0	0	0	0	0	0	100
	8146	0	0	1	0	3	46	0	0	0	50	0	0	0	0	50	0	0	0	0	0	0	100
	8147	0	0	0	0	2	62	0	0	0	64	0	0	0	0	35	0	0	0	0	0	1	100
	MEAN	0	0	0.8	0	32	48	0	0	0	81.2	0	0	0	0	18.6	0	0	0	0	0	0.2	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
231	8150	0	0	0	0	0	1	0	0	0	1	0	0	0	0	30	10	57	0	0	0	2	100
	8151	0	0	0	0	2	0	0	0	0	2	0	0	0	0	86	0	10	0	0	0	2	100
	8152	0	0	0	0	0	2	0	0	0	2	0	0	0	3	68	0	25	0	0	0	2	100
	8153	0	0	0	0	6	25	0	0	0	31	0	0	0	0	30	0	37	0	0	0	2	100
	8154	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	40	54	0	0	0	1	100
	MEAN	0	0	0	0	1.6	5.6	0	0	0	7.2	0	0	0	1.6	42.8	10	36.6	0	0	0	1.8	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
232	8159	0	0	61	0	0	8	0	0	0	69	0	5	1	0	25	0	0	0	0	0	0	100
	8160	0	0	60	0	0	25	0	0	0	85	0	0	0	0	15	0	0	0	0	0	0	100
	8161	0	0	60	0	0	30	0	0	0	90	0	0	0	0	10	0	0	0	0	0	0	100
	8162	0	0	53	0	0	42	0	0	0	95	0	0	0	0	5	0	0	0	0	0	0	100
	8163	0	0	58	0	0	25	2	0	0	85	0	5	0	0	10	0	0	0	0	0	0	100
	MEAN	0	0	58.4	0	0	26	0.4	0	0	84.8	0	2	0	0	13	0	0	0	0	0	0	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
233	8167	0	0	40	0	5	45	0	0	0	90	0	0	0	0	10	0	0	0	0	0	0	100
	8168	0	0	12	0	3	77	0	0	0	92	0	0	0	0	8	0	0	0	0	0	0	100
	8169	0	0	40	0	1	48	0	0	0	89	0	0	0	1	10	0	0	0	0	0	0	100
	8170	0	0	20	0	6	56	8	0	0	90	0	0	0	0	10	0	0	0	0	0	0	100
	8171	0	0	25	0	0	50	0	0	0	75	0	0	0	0	25	0	0	0	0	0	0	100
	MEAN	0	0	27.4	0	3	55.2	1.6	0	0	87.2	0	0	0	0.2	12.6	0	0	0	0	0	0	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
234	8175	0	0	52	0	0	35	0	0	0	87	0	5	0	0	8	0	0	0	0	0	0	100
	8176	0	0	75	0	0	15	0	0	0	90	0	5	0	0	5	0	0	0	0	0	0	100
	8177	0	0	60	0	0	30	0	0	0	90	0	5	0	0	5	0	0	0	0	0	0	100
	8178	0	0	80	0	0	5	0	0	0	85	0	0	0	0	15	0	0	0	0	0	0	100
	8179	0	0	72	0	0	20	0	0	0	92	0	0	0	0	8	0	0	0	0	0	0	100
	MEAN	0	0	67.8	0	0	21	0	0	0	88.8	0	3	0	0	8.2	0	0	0	0	0	0	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
235	8186	0	0	73	0	0	12	0	0	0	85	0	5	0	0	10	0	0	0	0	0	0	100
	8187	0	0	47	0	0	30	0	0	0	77	0	8	0	0	15	0	0	0	0	0	0	100
	8188	0	0	6	0	0	69	0	0	0	75	0	5	0	0	20	0	0	0	0	0	0	100
	8189	0	0	25	0	8	27	0	0	0	60	0	0	0	15	20	0	5	0	0	0	0	100
	8191	0	0	35	0	0	15	0	0	0	50	0	0	0	5	45	0	0	0	0	0	0	100
	MEAN	0	0	37.2	0	1.6	30.6	0	0	0	69.4	0	3.6	0	4	22	0	1	0	0	0	0	100

SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
237	8198	0	0	0	0	0	30	0	0	0	30	0	8	0	0	0	61	0	0	0	0	1	100
	8199	0	0	0	0	0	10	0	0	0	10	0	0	0	0	0	90	0	0	0	0	0	100
	8200	0	0	0	0	0	50	0	0	0	50	0	5	0	5	0	40	0	0	0	0	0	100
	8201	0	0	0	0	1	25	0	0	0	26	0	6	0	0	0	67	0	0	0	0	1	100
	8202	0	0	0	0	0	55	0	0	0	55	0	3	0	0	38	0	4	0	0	0	0	100
	MEAN	0	0	0	0	0.2	34	0	0	0	34.2	0	4.4	0	1	7.6	52	0.8	0	0	0	0.4	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
238	8205	0	0	0	0	0	91	0	0	0	91	0	0	0	0	8	0	0	0	0	0	1	100
	8206	0	0	0	0	0	82	0	0	0	82	0	0	0	0	15	0	0	0	0	0	3	100
	8207	0	0	0	0	0	77	0	0	0	77	0	0	0	0	20	0	0	0	0	0	3	100
	8208	0	0	0	0	10	59	0	0	0	69	0	0	0	0	30	0	0	0	0	0	1	100
	8209	0	0	0	0	3	71	0	0	0	74	0	0	0	0	25	0	0	0	0	0	1	100
	MEAN	0	0	0	0	2.6	76	0	0	0	78.6	0	0	0	0	19.6	0	0	0	0	0	1.8	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
239	8213	0	0	0	0	0	86	0	0	0	86	0	0	0	0	12	0	0	0	0	0	2	100
	8214	1	0	0	0	8	73	0	0	0	82	0	0	0	0	17	0	0	0	0	0	1	100
	8215	0	0	8	0	10	66	0	0	0	84	0	0	0	0	15	0	0	0	0	0	1	100
	8216	0	0	0	0	12	82	0	0	0	94	0	0	0	0	5	0	0	0	0	0	1	100
	8217	0	0	2	0	55	40	0	0	0	97	0	0	0	0	3	0	0	0	0	0	0	100
	MEAN	0.2	0	2	0	17	69.4	0	0	0	88.6	0	0	0	0	10.4	0	0	0	0	0	1	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
240	8224	0	0	4	0	25	60	0	0	0	89	0	0	0	0	10	0	0	0	0	0	1	100
	8225	0	0	12	0	71	12	0	0	0	95	0	0	0	0	5	0	0	0	0	0	0	100
	8226	0	0	5	0	18	51	0	0	0	74	0	0	0	0	25	0	0	0	0	0	1	100
	8227	0	0	0	0	35	41	0	0	0	76	0	5	0	0	15	0	0	0	4	0	0	100
	8228	0	0	4	0	30	46	0	0	0	80	0	5	0	0	15	0	0	0	0	0	0	100
	MEAN	0	0	5	0	36	42	0	0	0	82.8	0	2	0	0	14	0	0	0	0.8	0	0.4	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
241	8232	0	0	0	0	8	20	0	0	1	29	0	5	0	0	31	0	35	0	0	0	0	100
	8233	0	0	0	0	1	5	0	0	0	6	0	8	0	5	24	0	55	1	0	0	1	100
	8234	0	0	0	0	1	1	0	0	0	2	5	0	0	5	0	0	88	0	0	0	0	100
	8235	0	0	0	0	0	30	0	0	0	30	3	0	0	0	25	0	42	0	0	0	0	100
	8236	0	0	0	0	5	10	0	0	0	15	0	0	0	0	35	0	50	0	0	0	0	100
	MEAN	0	0	0	0	3	13.2	0	0	0.2	16.4	1.6	2.6	0	2	23	0	54	0.2	0	0	0.2	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
242	8240	0	0	35	0	0	57	0	0	0	92	0	0	0	0	8	0	0	0	0	0	0	100
	8241	0	0	84	0	2	4	0	0	0	90	0	0	0	0	10	0	0	0	0	0	0	100
	8242	0	0	80	0	1	4	0	0	0	85	0	0	0	0	15	0	0	0	0	0	0	100
	8243	0	0	68	0	1	25	0	1	0	95	0	0	0	0	5	0	0	0	0	0	0	100
	8244	0	0	33	0	0	50	0	2	0	85	0	5	0	0	10	0	0	0	0	0	0	100
	MEAN	0	0	60	0	0.8	28	0	0.6	0	89.4	0	1	0	0	9.6	0	0	0	0	0	0	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
243	8248	1	0	2	0	1	2	0	0	0	6	0	0	0	0	58	0	35	0	0	0	1	100
	8249	0	0	3	0	3	3	0	0	0	9	0	0	0	0	51	0	35	0	0	0	5	100
	8250	0	0	1	0	1	6	0	0	0	8	1	0	0	0	69	0	20	0	0	0	2	100
	8251	0	0	8	0	4	27	0	0	0	39	0	0	0	0	60	0	0	0	0	0	1	100
	8252	0	0	3	0	0	16	0	0	0	19	0	0	0	0	53	0	25	0	0	0	3	100
	MEAN	0.2	0	3.4	0	1.8	10.8	0	0	0	16.2	0.2	0	0	0	58.2	0	23	0	0	0	2.4	100
SITE	PHOTO	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	LS	R	RU	DC	CCA	TBS	INV	TOTAL
244	8256	1	0	0	0	0	2	0	0	0	3	0	0	0	0	12	0	82	0	0	0	3	100
	8257	1	0	0	0	0	2	0	0	0	3	0	0	0	0	20	0	77	0	0	0	0	100
	8258	1	0	1	0	0	2	0	0	0	4	3	0	0	4	25	0	64	0	0	0	0	100
	8259	0	0	0	0	0	3	0	0	0	3	0	0	0	4	87	0	0	0	0	0	6	100
	8260	0	0	0	0	1	3	0	0	0	4	0	3	0	0	83	0	10	0	0	0	0	100
	MEAN	0.6	0	0.2	0	0.2	2.4	0	0	0	3.4	0.6	0.6	0	1.6	45.4	0	46.6	0	0	0	1.8	100

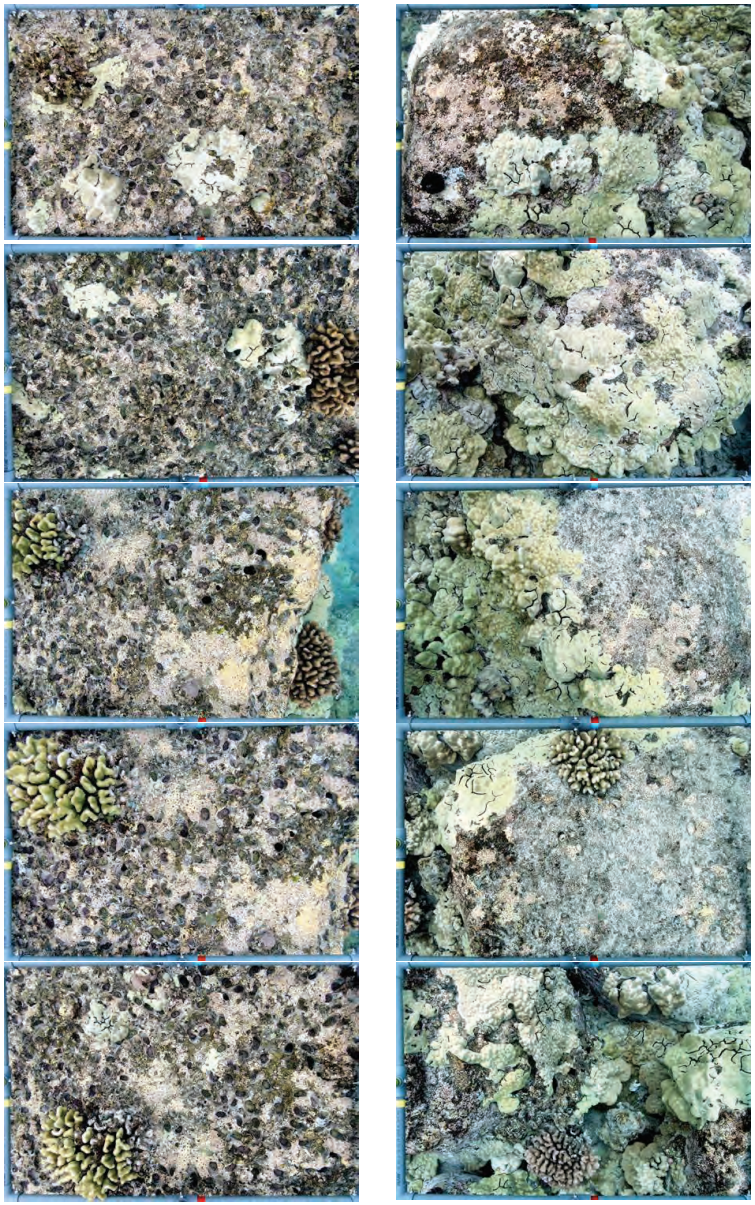
Mc = "Montipora capitata"
Mp = "Montipora patula"
Pc = "Porites compressa"
Pd = "Pocillipora damicornis"
Pe = "Porites lutea"
A = "Algae"
TUR = "Turf"
SP = "Sponge"
SA = "Sand"
LS = "Limestone"
Pl = "Porites lobata"
Pm = "Pocillopora meandrina"
Pv = "Pavona varians"
Zo = "Zooanthid"
TC = "Total Coral Cover"
R = "Rock"
RU = "Rubble"
DC = "Dead coral"
CCA = "Crustose Corraline Algae"
TBS = "Turf-Bound-Sediment"
INV = "Invertebrate"

APPENDIX B

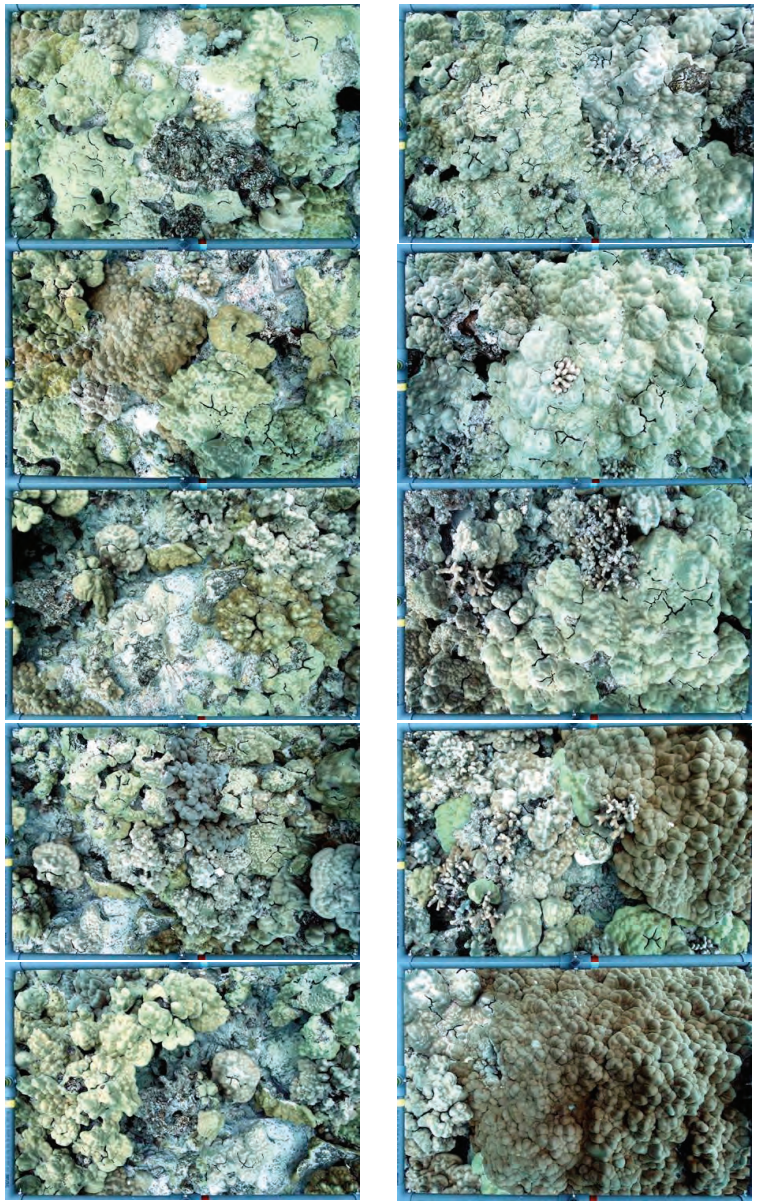
Benthic Calibration Validation Photoquadrats

Kamehameha Schools
Kahalu‘u Ma Kai Project

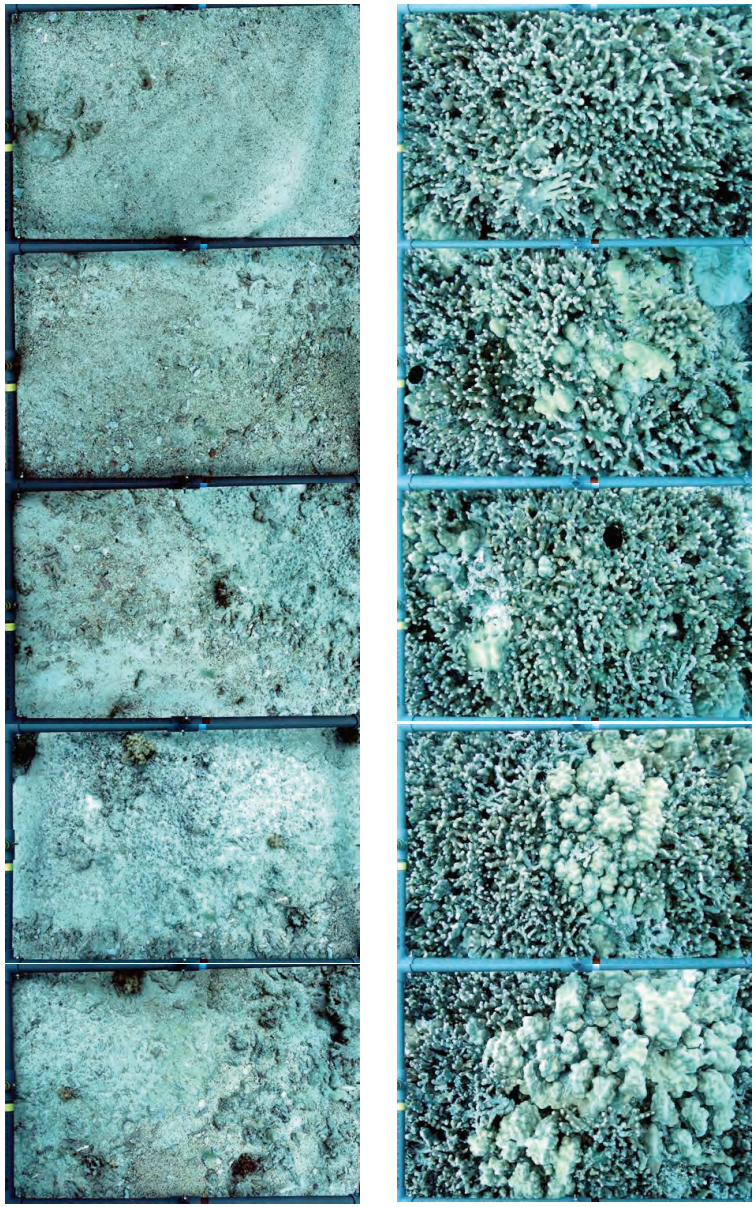
North Kona Hawaii



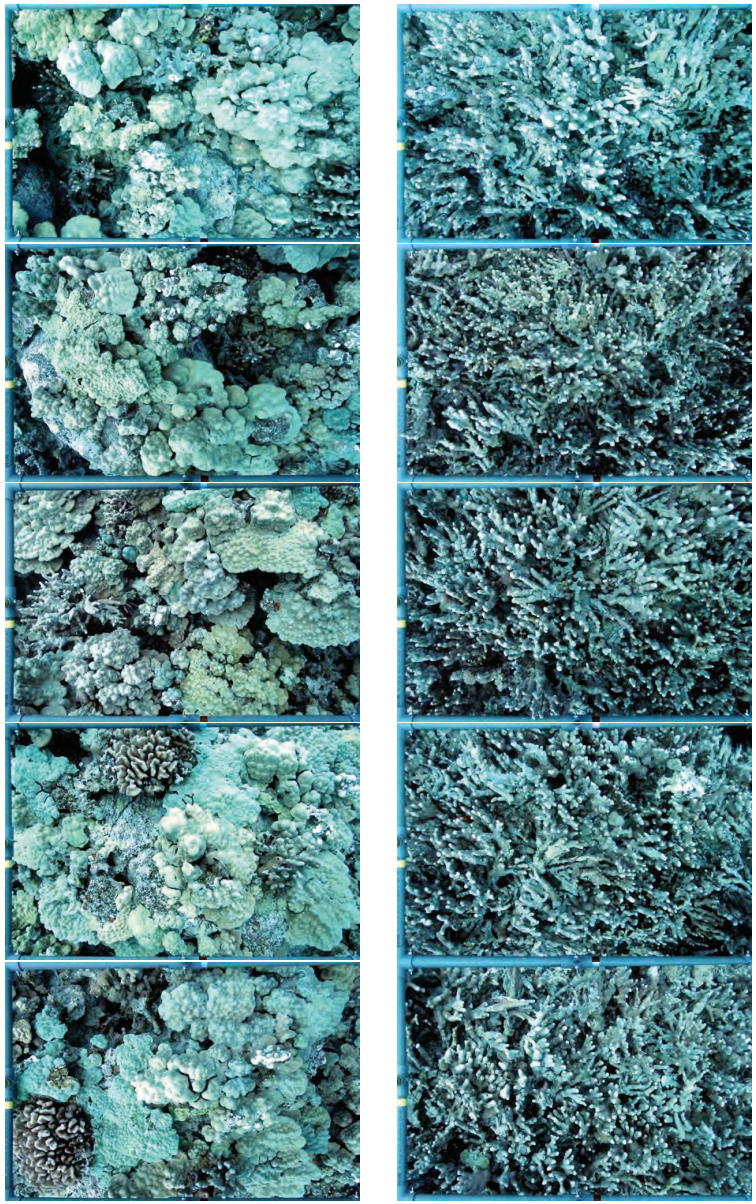
Keauhou Beach Resort Redevelopment 2013, Sites 217 and 218



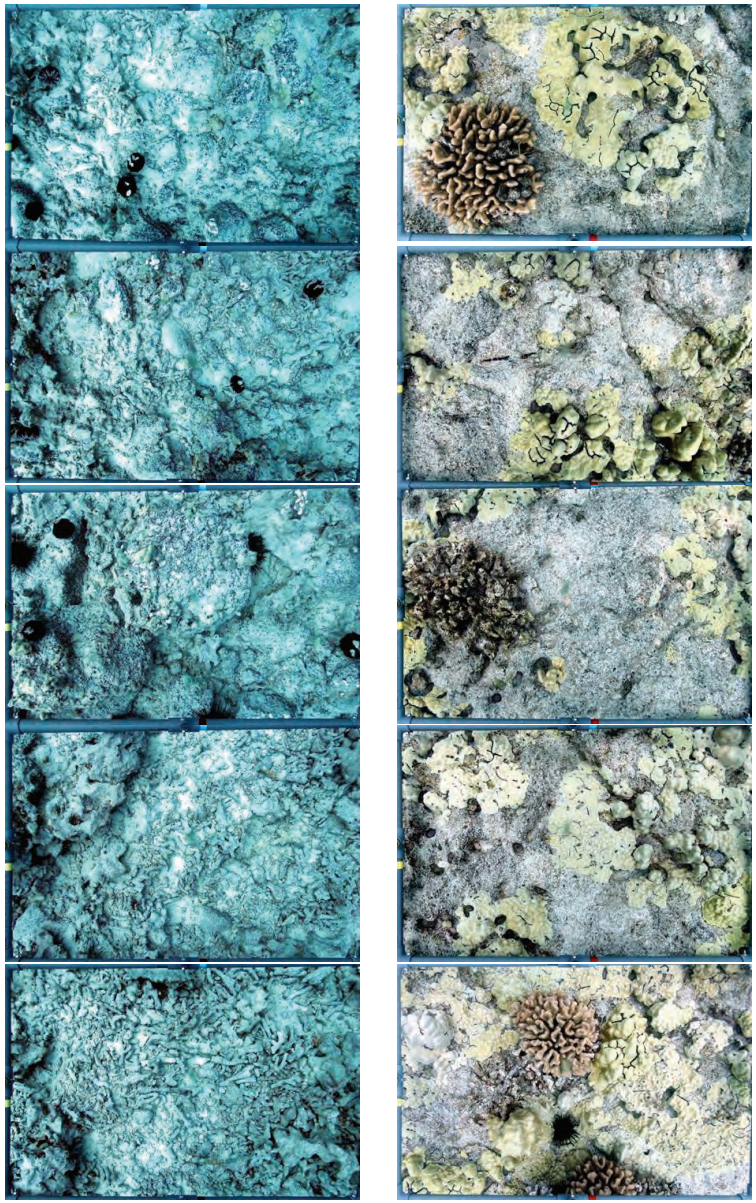
Keauhou Beach Resort Redevelopment 2013, Sites 219 and 220



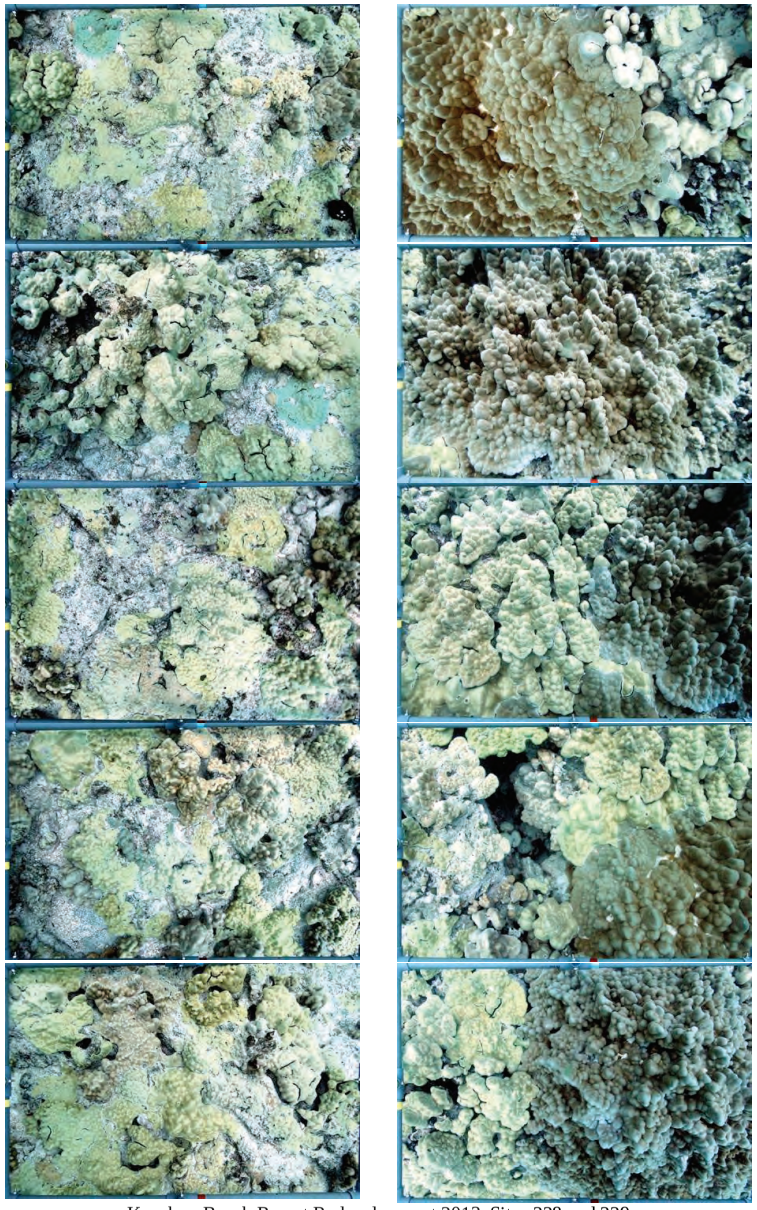
Keauhou Beach Resort Redevelopment 2013, Sites 221 and 222



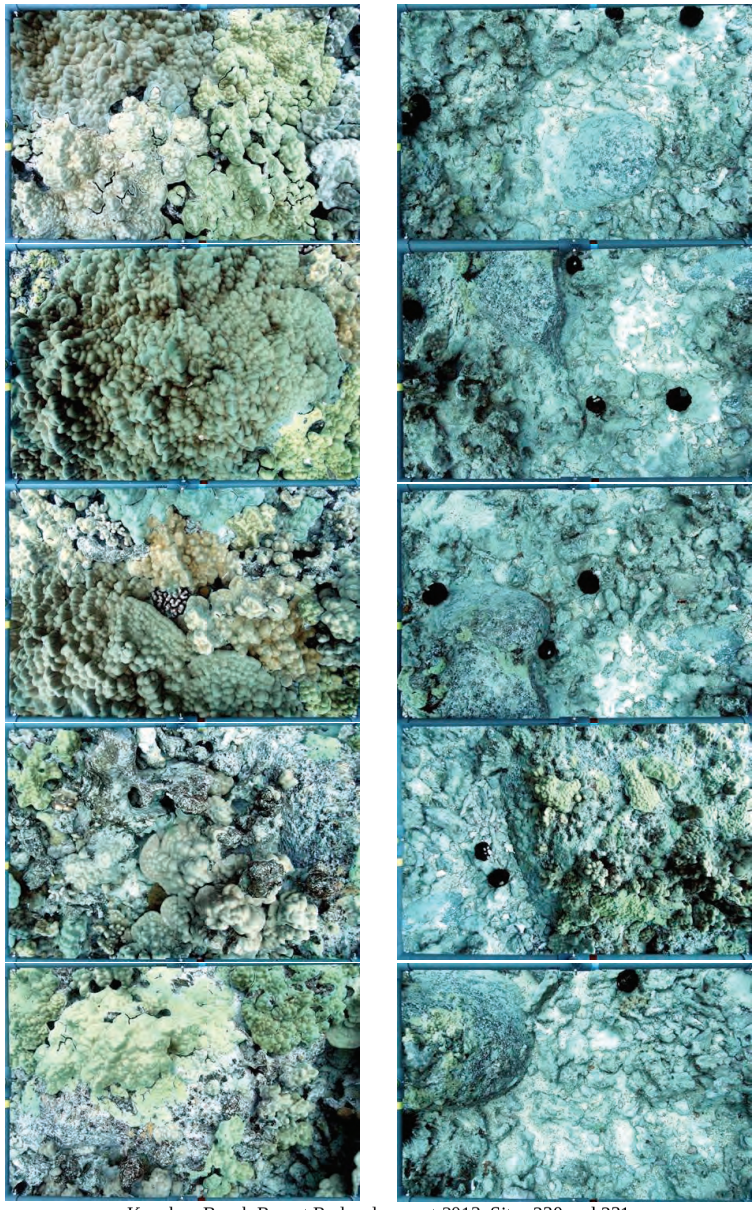
Keauhou Beach Resort Redevelopment 2013, Sites 223 and 224



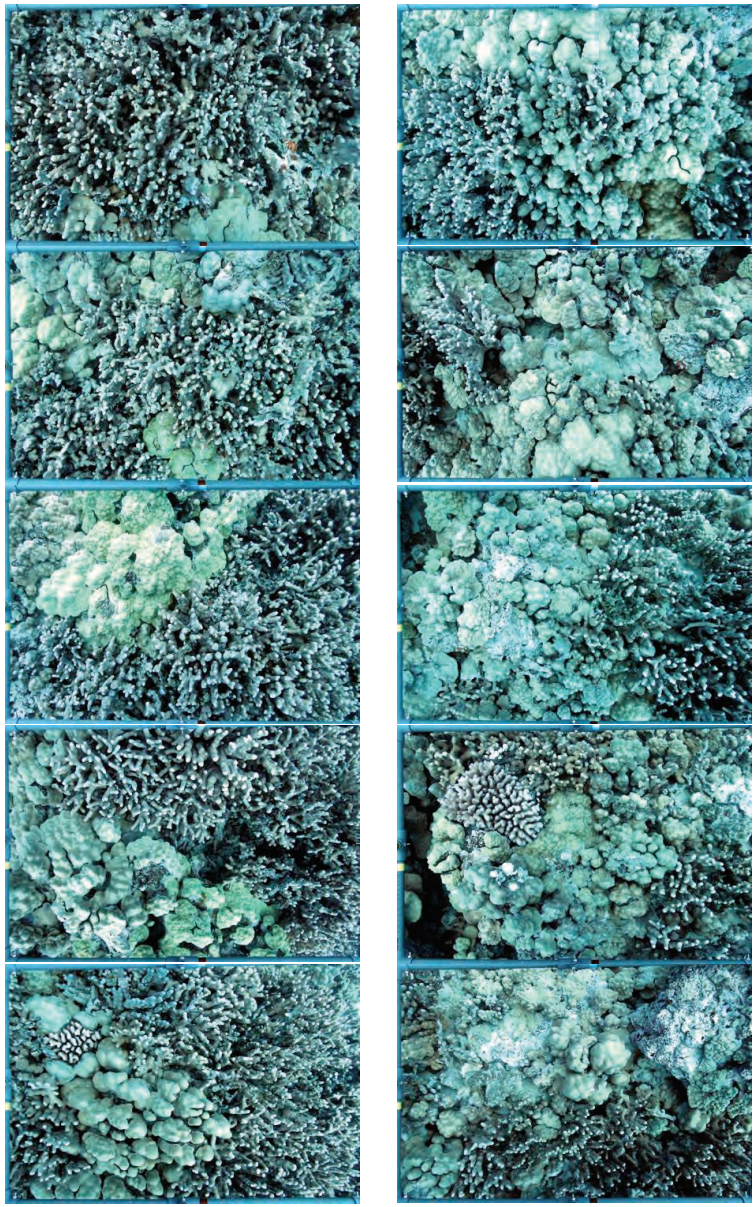
Keauhou Beach Resort Redevelopment 2013, Sites 225 and 227



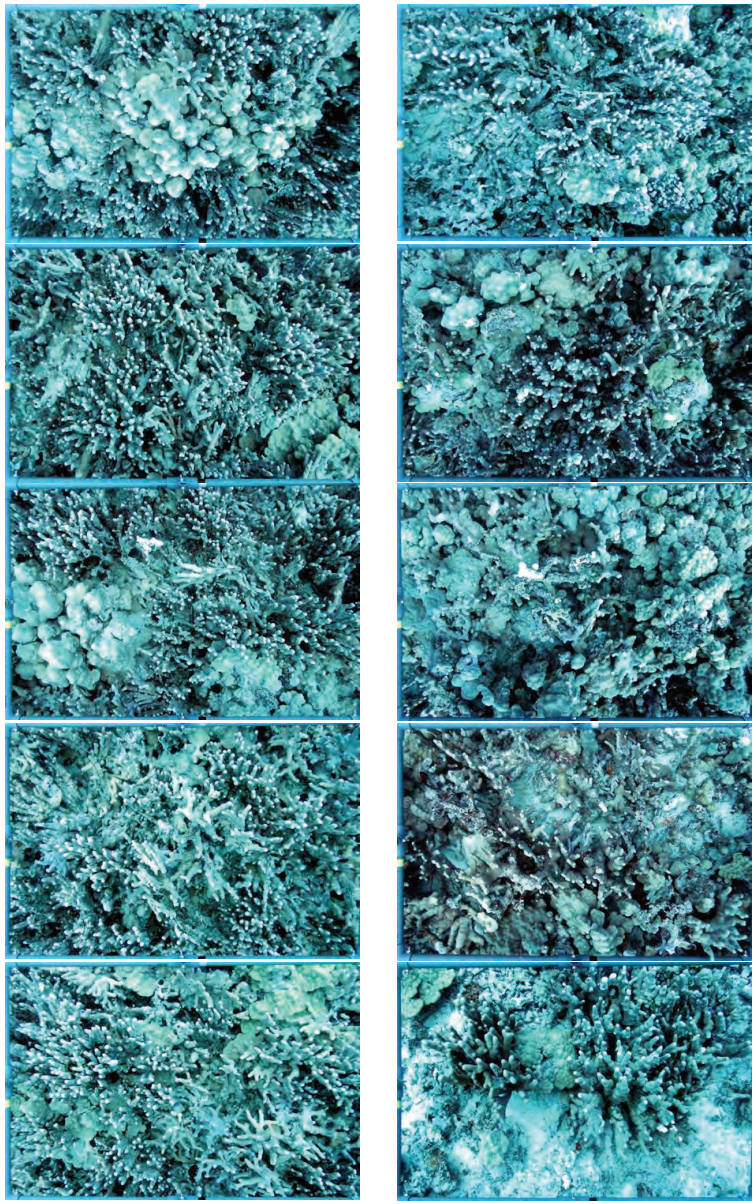
Keauhou Beach Resort Redevelopment 2013, Sites 228 and 229



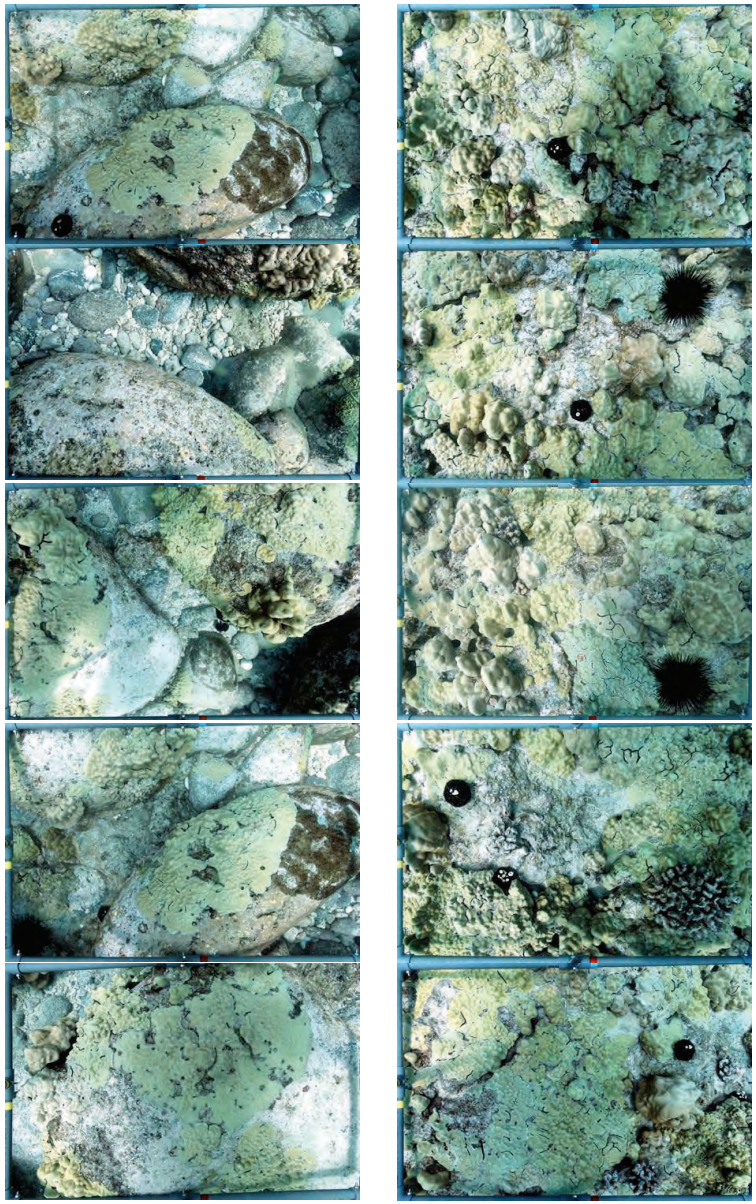
Keauhou Beach Resort Redevelopment 2013, Sites 230 and 231



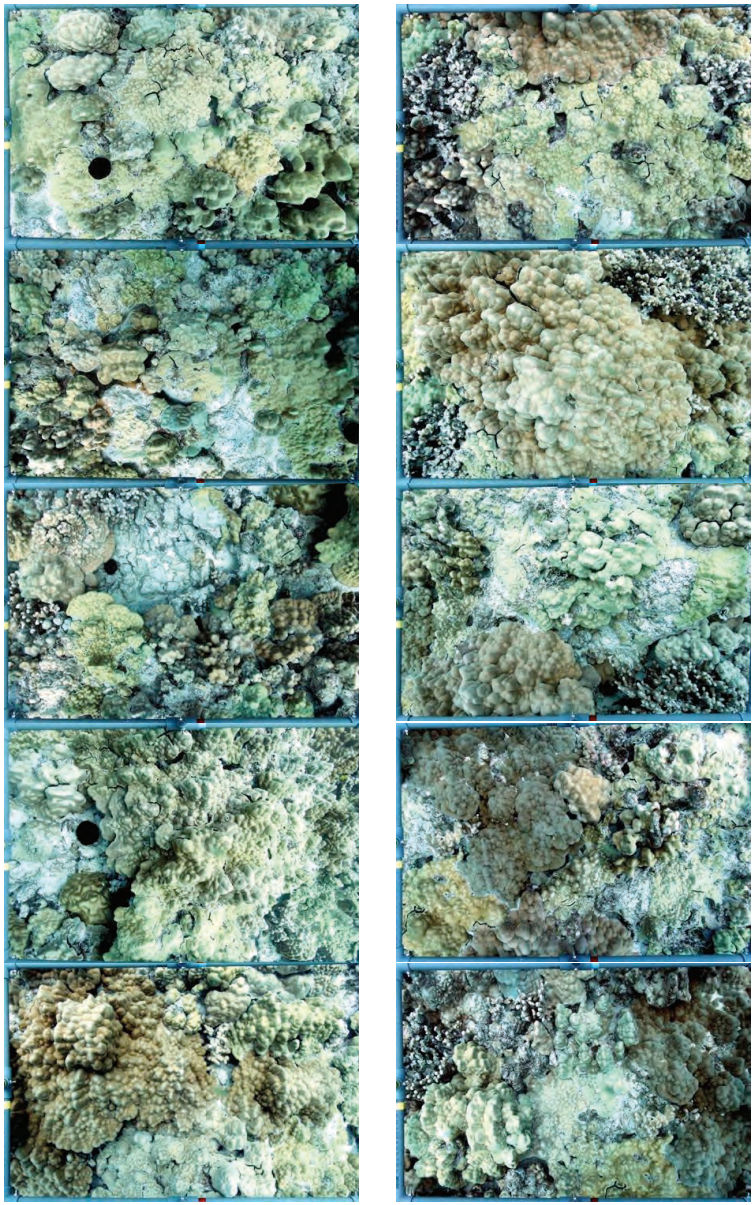
Keauhou Beach Resort Redevelopment 2013, Sites 232 and 233



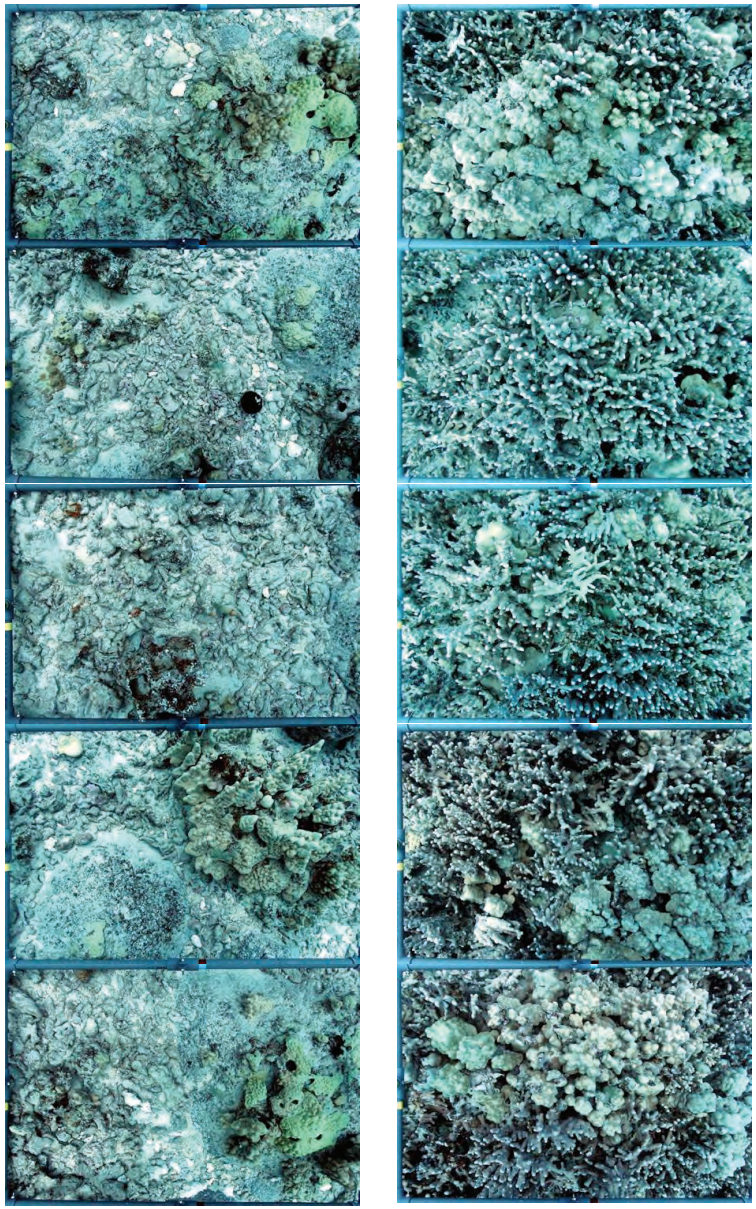
Keauhou Beach Resort Redevelopment 2013, Sites 234 and 235



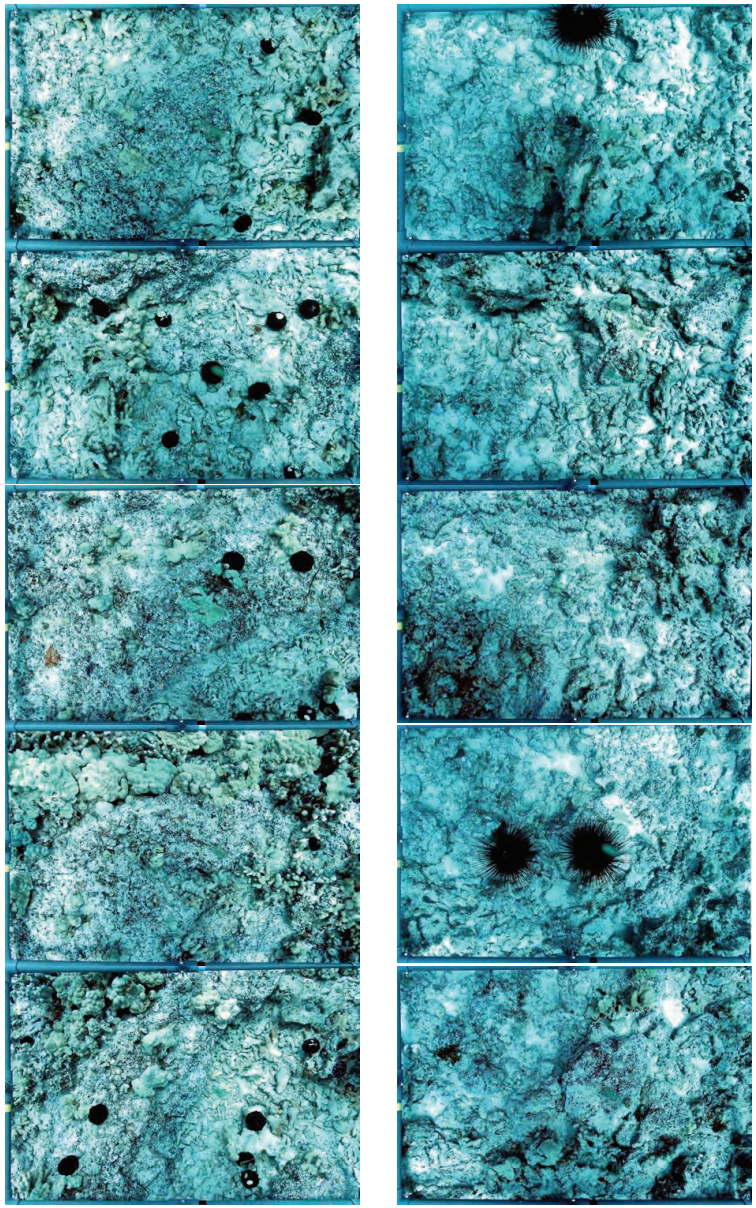
Keauhou Beach Resort Redevelopment 2013, Sites 237 and 238



Keauhou Beach Resort Redevelopment 2013, Sites 239 and 240



Keauhou Beach Resort Redevelopment 2013, Sites 241 and 242



Keauhou Beach Resort Redevelopment 2013, Sites 243 and 244

Appendix G

ARCHAEOLOGICAL INVENTORY SURVEY

Draft

Archaeological Inventory Survey for the Kahaluʻu Ma Kai Project, Kahaluʻu Ahupuaʻa, North Kona District, Island of Hawaiʻi, TMKs: [3] 7-8-013:002, 013, 042, and 043

Volume I

Prepared for
Helber Hastert & Fee, Planners, Inc.
and
Kamehameha Schools (KS)

Prepared by
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(Job Code: KAHALUU 13)

May 2014

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Management Summary

Reference	Archaeological Inventory Survey for the Kahaluʻu Ma Kai Project, Kahaluʻu Ahupuaʻa, North Kona District, Island of Hawaiʻi, TMKs [3] 7-8-013:002, 013, 042, and 043 (Wilkinson et al. 2014)* **This report is organized as two volumes: Volume 1 (current document) contains the overall AIS report, while Volume II consists of Appendices*
Date	May 2014
Project Number	Cultural Surveys Hawaiʻi, Inc. (CSH) Job Code: KAHALUU 13
Investigation Permit Number	The fieldwork for this project was carried out under archaeological permit numbers 13-06 and 14-04 issued by the State of Hawaiʻi Department of Land and Natural Resources/State Historic Preservation Division (SHPD) per Hawaiʻi Administrative Rules (HAR) § 13-282
Project Location	The project area is located on the *makai* (seaward) side of Aliʻi Drive in the *māno wai* (water source or headwaters) of the *ahupuaʻa* (traditional land division) of Kahaluʻu. It is situated within the Kahaluʻu Historic District (State Inventory of Historic Properties [SIHP] # 50-10-37-04150).
Land Jurisdiction	Private, Kamehameha Schools (KS)
Agencies	SHPD
Project Description	KS intends to demolish existing facilities (i.e., Keauhou Beach Resort [KBR] and remnant facilities of the former Kona Lagoon Hotel) and build certain new education facilities.
Project Acreage and Area of Potential Effect (APE)	For the purposes of the present project, the area of potential effect (APE) and project acreage are considered to be one and the same, totaling 22.73 acres.* **The staging, processing, and stockpiling of demolition material will be conducted on site and included as part of the APE. The project APE does not include any areas for the off-site storage, disposal, or use of demolition debris. This material will be handled by one of the following options: 1) demolition debris will be transported directly to the County landfill, either as fill or possibly as a cap material (suitably processed concrete rubble); 2) some material may be taken directly from the site to be used as base course in on-going roadway projects in progress on lands owned by KS; or 3) the material may be taken by the demolition contractor to a site already zoned and otherwise entitled to allow storage of demolition material, including appropriate reviews by the SHPD. Disposal of this material will be conducted in an appropriate manner by the demolition contractor, who will also be responsible for ensuring applicable historic preservation review as part of permits required for the materials use.*

Historic Preservation Regulatory Context	The proposed project requires compliance with and review under State of Hawai‘i historic preservation review legislation (Hawai‘i Revised Statutes [HRS] §6E-42 and Hawai‘i Administrative Rules [HAR] §13-284). In consultation with SHPD, the current archaeological inventory survey (AIS) investigation was designed to fulfill the State requirements for an archaeological inventory survey, per HAR §13-276. In addition, Section 106 compliance is required for this project related to a U.S. Army Corps Nationwide Permit for planned demolition activities. Consultations to fulfill Section 106 requirements have been initiated and are on-going among stakeholders. This study follows a project archaeological inventory survey plan (AISP) (Wheeler et al. 2014), which was accepted by SHPD in historic preservation review correspondence dated 22 April 2014 (LOG NO: 2014.0910, DOC NO: 1404MV22; Appendix B).
Consultation Effort	Consultation for the Kahalu‘u Ma Kai project is ongoing. A companion CIA will detail the full results of the consultation undertaken for this project. The AISP included the results of interviews with three individuals: KS educational specialists Mr. Māhealani Pai and Ms. Kalei Nu‘uhiwa and lineal descendant, Uncle Mitchell Fujisaka. Uncle Fujisaka attended a site visit with Auntie Kalani Hamm, CSH staff, and Michael Vitousek of the SHPD on 30 October 2013 to discuss the current project and its setting. Mr. Pai was further consulted during the AIS fieldwork to assist in cultural protocols and for assistance with historic property interpretation and documentation.
Fieldwork Effort	The fieldwork component of the archaeological inventory survey was accomplished on 22–24 October 2013, 8 and 25 November 2013, 6–31 January 2014, 11 February 2014 and 25 March 2014 by CSH archaeologists Trevor Yucha, B.S., Fred LaChance, B.A., Johnny Dudoit, B.A., and Olivier Bautista, B.A. under the general supervision of Hallett H. Hammatt, Ph.D. (principal investigator). The AIS fieldwork required approximately 42 person days to complete. In addition, CSH archaeologist Johnny Dudoit, B.A., was on site to observe a geotechnical survey on 18–27 March 2014, requiring an additional six person-days to complete.
Number of Historic Properties Identified	Eight previously identified historic properties were confirmed and documented during the current investigation. No new historic properties were identified. An additional previously identified historic property was not confirmed but is considered to still be present but buried within the project area (Probable Sand Dune Burial, SIHP # -12915); for this reason, the eligibility of this site for the Hawai‘i Register of Historic Places (HRHP) could not be evaluated.

Historic Properties Recommended Eligible to the Hawai‘i Register of Historic Places

Based on the current findings, eight historic properties are recommended eligible to the HRHP. These historic properties have all been previously recommended as eligible, but under obsolete significance criteria. For this reason, the significance of these historic properties has been reevaluated under the current investigation:

SIHP # (50-10-37)	Temporary Site #(s)	Function	Probable Age	Significance Criteria
-03817	50-Ha-D4-2, H-00165-25 (Hāpaiali‘i)	Ceremonial, religious	Pre-Contact; AD 1200s or 1300-1400s	b, c, d, e
-03818	50-HA-D4-3, H-00073-4, H-00165-24 (Ke‘ekū + Hale O Papa)	Ceremonial, religious	Pre-Contact; AD 1200-1300s	b, c, d, e
-03819	50-Ha-D4-5, H-00073-6, H-00165-22 (Mākole‘ā)	Ceremonial, religious	Pre-Contact	b, d, e
-10997	H-00073-2, H-00165-41 (Kapuanoni)	Ceremonial, religious	Pre-Contact	b, d, e
-12951	PHRI 439-51, PHRI 439-52, H-00769, H-01426	Habitation	Historic; nineteenth century	d
-12953	PHRI 439-53, H-00165-43, H-00748-11881,	Habitation	Unknown (over 50 years)	b, d
-12955	PHRI 439-55, PHRI 439-56, 50-Ha-D4-47, 50-Ha-D4-49,	Boundary, Habitation	Historic; early 1800s to mid-1900s	d
-12957	PHRI 439-57	Habitation	Historic (mid to late 1800s) and modern	d

Historic Properties Recommended Ineligible to the Hawai‘i Register of Historic Places	None of the previously identified historic properties in the project area are recommended as ineligible to the HRHP. While the present investigation has concluded that four previously identified historic properties are no longer present (SIHP #s -Ha-D4-52* [Keawehala Pond], -Ha-D4-53* [Petroglyphs on Pāhoehoe], -Ha-D4-34 / 01616* [Rectangular Structure], and -12950 [Low-Walled Enclosure]), these sites are still significant at a minimum for the information they once contained, which has been documented during previous archaeological studies. **The current understanding is that these atypical, alpha-numeric numbers are SIHP numbers that incorporate the prior Bishop Museum site numbers*
Effect Recommendation	CSH’s project specific effect recommendation is “effect, with proposed mitigation commitments.” The recommended mitigation measures will reduce the project’s effect on identified historic properties identified within the project area and be pro-active in addressing possible community concerns.

Mitigation Recommendation	No further work is recommended for SIHP # -12951. Sufficient information regarding the location, function, age, and construction methods of these features have been generated by the current AIS investigation to mitigate any adverse effect (though none is presently anticipated). CSH recommends development of a single, project area-wide preservation plan in accordance with HAR §13-277-3 to address future repair and restoration work at SIHP # -03818 Feature B and -12955 and to update existing preservation plans for SIHP # -03817, -03818 Feature A, -03819, -10997, and -12953, which were developed prior to restoration work which has already occurred. Aside from addressing buffer zones and protective measures for all historic properties recommended for preservation within the project area, this preservation plan would include detailed maps of the restored *heiau* sites. In consultation with KS it is proposed that this mapping would be completed as part of future *‘āina* (land)-based education activities at the site. Additonally, preservation by avoidance is recommended for two historic properties: SIHP # -12915 and SIHP # -12957. Project plans presently do not indicate ground disturbing activities at these sites. No ground disturbing activities should be undertaken at any time within the backshore sand dune area at SIHP # -12915. It is recommended that after storms or other events of high seas, the vicinity be inspected by KS staff for any exposed remains. If at any time human remains are exposed in this area, development of a Burial Treatment Plan will be required in accordance with Hawai‘i Revised Statutes (HRS) 6E-43 and HAR §13-300. Following the recommendations of Walker and Rosendahl (1989), if in the future any projects are proposed with the potential to impact SIHP # -12957, it is recommended that the site first be subjected to a program of data recovery. If required, this work should proceed in accordance with a data recovery plan pursuant to HAR §13-278. Due to the potential for additional surface and subsurface historic properties, including human burials, it is recommended that development (including the KBR demolition) within the project area be attended by an archaeological monitoring program. The monitoring program will begin with the production of an archaeological monitoring plan for the review and approval of SHPD prior to the beginning of construction. Field monitoring should be carried out in accordance with the plan. An archaeological monitoring report should be submitted for review and acceptance by SHPD following the completion of all monitoring activities related to project development.

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Section 1 Introduction

1.1 Project Background

At the request of Helber Hastert & Fee, Planners, Inc., and Kamehameha Schools (KS), Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this archaeological inventory survey (AIS) for the Kahalu‘u Ma Kai Project, Kahalu‘u Ahupua‘a, North Kona District, Island of Hawai‘i, TMKs: [3] 7-8-013:002, 013, 042, and 043. The project area is shown on a U.S. Geological Survey (USGS) 7.5-Minute Topographic Map (Figure 1), a Hawai‘i State tax map plat (Figure 2), and an aerial photograph (Figure 3). The 22.73-acre project area is located on the *makai* (seaward) side of Ali‘i Drive in the *māno wai* (water source or headwaters) of Kahalu‘u Ahupua‘a.

The proposed project includes the demolition of exisiting facilities (i.e., Keauhou Beach Resort and remnant facilities of the former Kona Lagoon Hotel) and the building of new education facilities.

Demolition of the Keauhou Beach Resort will require adherence to Best Management Practices which includes an erosion control plan, and will necessitate the creation of staging and stockpiling areas which will be placed entirely on the site’s existing ground surfaces (presently asphalted parking areas) (Figure 4 and Figure 5). The project area of potential effect (APE) does not include any area for the off-site disposal or use of demolition debris as this is not contemplated as part of the overall demolition plan. However, should the demolition contractor decide to transport materials to an off-site location for storage, this material will be processed and disposed of in an appropriate manner by the demolition contractor, who will also be responsible for ensuring applicable historic preservation review as part of permits required for the use of that site.

The redevelopment of the site as a natural, cultural and historical educational complex is illustrated in Figure 6 and is referred to as Kahalu‘u Ma Kai. It will include the following:

- Indoor/outdoor classrooms and interpretation areas
- Cultural *hālau*
- Canoe making and wood carving sheds
- Heritage center for visitors
- Multi-purpose building
- Improve open space and landscaping
- Overnight camping accommodations

The Kahalu‘u Ma Kai Project will support KS programs such as the Keauhou-Kahalu‘u Education Group (KKEG) along with other KS collaborators including government agencies, education institutions, and non-profit and community based organizations.

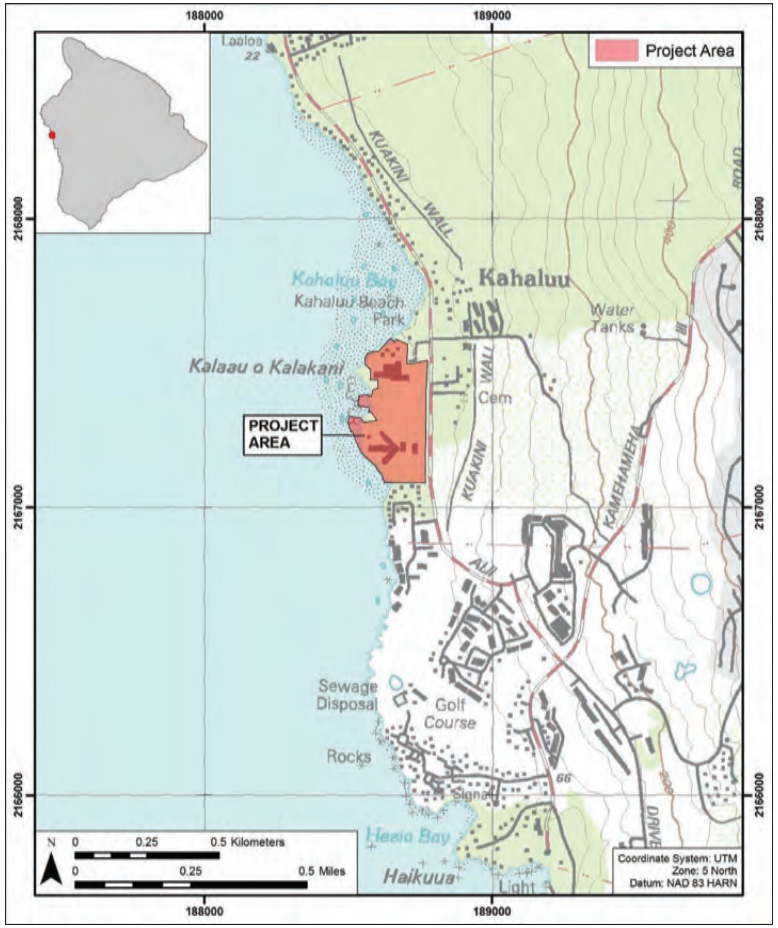


Figure 1. Portion of the 1996 Kealakekua USGS 7.5-Minute Topographic Quadrangle, showing the location of the proposed project area

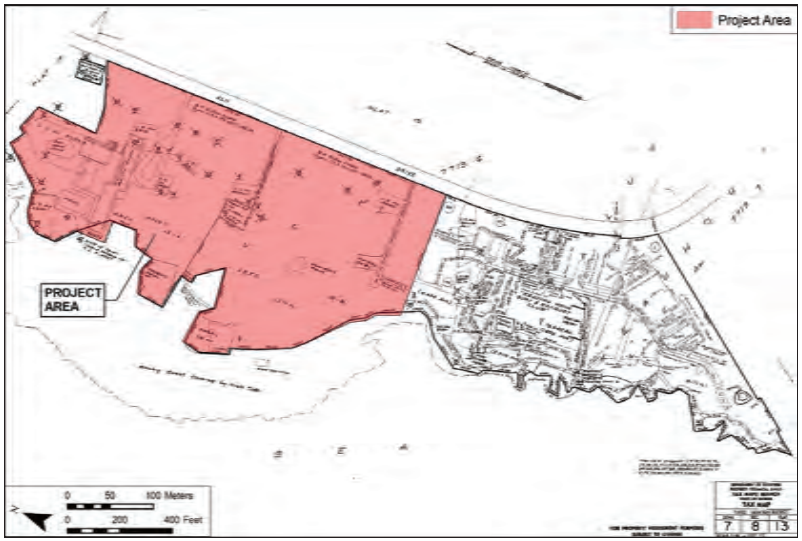


Figure 2. Tax Map Key (TMK) 7-8-013, showing the location of the proposed project area (Hawai‘i TMK Service 2009)

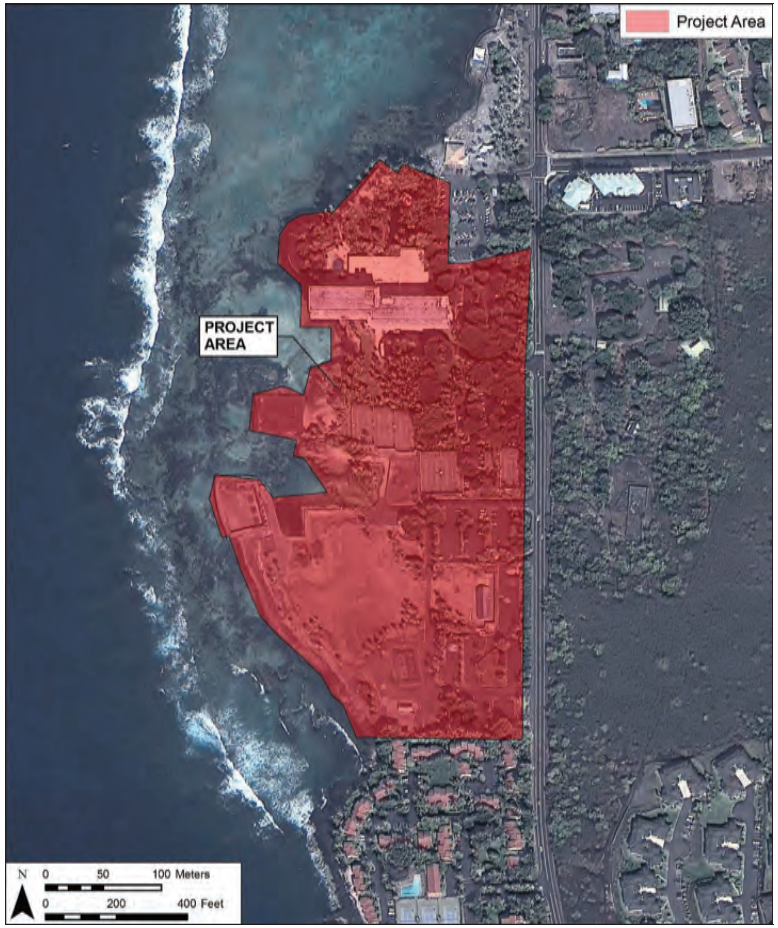


Figure 3. Aerial photograph showing the location of the proposed project area (Google Earth 2010)

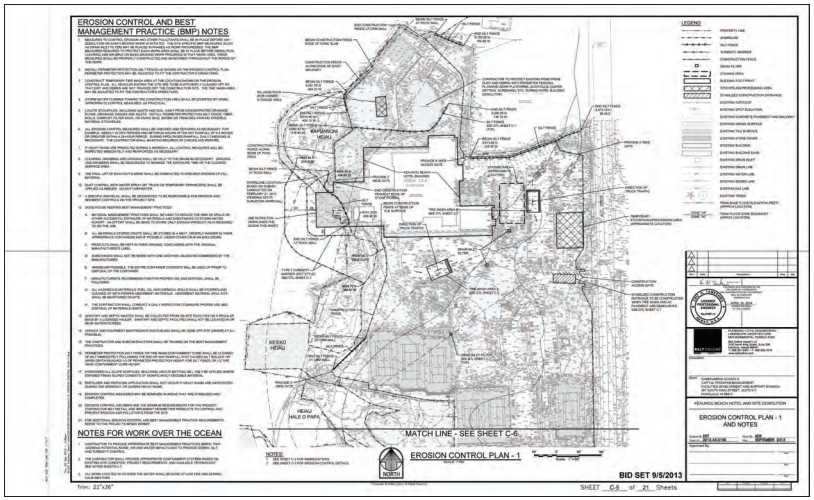


Figure 4. Erosion control plan (page 1) for the Keauhou Beach Resort demolition, showing the locations of proposed staging and stockpiling/processing areas (courtesy of Belt Collins)

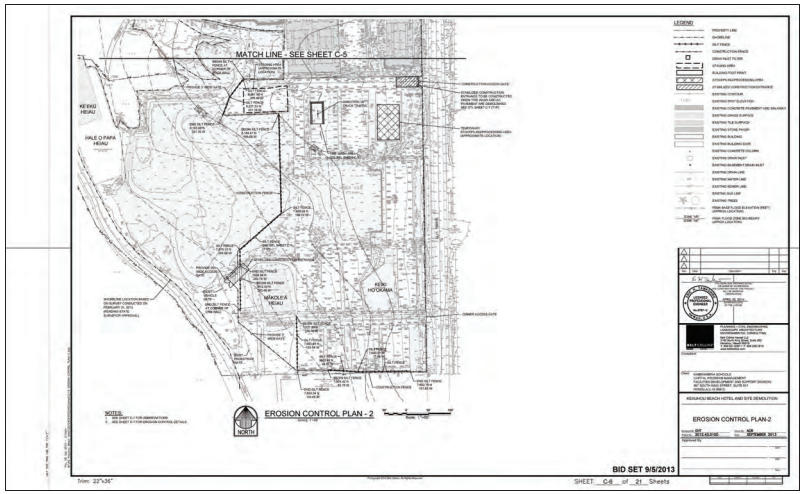


Figure 5. Erosion control plan (page 2) for the Keauhou Beach Resort demolition, showing the locations of proposed staging and stockpiling/processing areas (courtesy of Belt Collins)

Figure 6. Conceptual site plan (courtesy of KYA Design Group); note: the present project area does not extend to areas east of Ali'i Drive

Restoration of historic sites is ongoing within the project area. Restoration activies presently include the completion of Ke‘ekū Heiau, and restoration of Kapuanoni Heiau and Po‘o Hawai‘i. These restoration activities have approved entitlements and preservation plans in place, and are not considered part of the proposed Kahalu‘u Ma Kai project to which the present AIS is applicable.

This study follows a project archaeological inventory survey plan (AISP) (Wheeler et al. 2014), which was accepted by SHPD in historic preservation review correspondence dated 22 April 2014 (LOG NO: 2014.0910, DOC NO: 1404MV22; Appendix B).

This document was prepared to support the proposed project’s historic preservation review under Hawai‘i Revised Statutes (HRS) §6E-42 and Hawai‘i Administrative Rules (HAR) §13-284. In consultation with the State of Hawai‘i Department of Land and Natural Resources/State Historic Preservation Division (SHPD), the current AIS investigation was designed to fulfill the State requirements for an archaeological inventory survey per HAR §13-276.

Given its size, this AIS report is organized as two volumes. Volume 1 (current document) contains the overall AIS report. Volume II consists of Appendices including: applicable Land Commission Award (LCA) documents (Appendix A); DLNR/SHPD correspondence (Appendix B); existing preservation plans for sites within the project area (Appendix C); observations of a geotechnical survey within the project area by Hirata and Associates, Inc. (Appendix D); and a pollen and starch grain analysis report by PaleoResearch Institute for samples collected during the AIS (Appendix E).

1.2 Scope of Work

The following scope of work satisfies the State of Hawai‘i requirements for archaeological inventory surveys (HAR §13-276 and §13-284):

1. Historical and previous archaeological background research to include study of archival sources, historic maps, Land Commission Awards and previous archaeological investigations. This research will focus on the specific project area’s past land use, with general background on the pre-Contact and historic settlement patterns of the *ahupua‘a* (land division usually extending from the uplands to the sea) and district. This background information will be used to compile a predictive model for the types and locations of historic properties that could be expected within the project area.
2. A complete (100%) systematic pedestrian inspection of the project area to identify any potential surface historic properties. Surface historic properties will be recorded with an evaluation of age, function, interrelationships, and significance. Documentation will be recorded with an evaluation of age, function, and as warranted, limited controlled excavation of select sites and/or features.
3. Based on the project area’s environment and the results of background research, subsurface testing with a combination of hand and backhoe excavation may be used to identify and document subsurface historic properties that would not be located by surface pedestrian inspection. Appropriate samples from these excavations will be analyzed for cultural and chronological information. All subsurface historic properties

identified will be documented to the extent possible, including geographic extent, content, function/derivation, age, interrelationships, and significance.

4. As appropriate, consultation with knowledgeable individuals regarding the project area’s history, past and use and the function and age of the historic properties documented within the project area.
5. As appropriate, laboratory work to process and gather relevant environmental and/or archaeological information from collected samples.
6. Preparation of an inventory survey report, which will include the following:
   a) A project description;
   b) A section of a USGS topographic map showing the project area boundaries and the location of all recorded historic properties;
   c) Historical and archaeological background sections summarizing pre-historic and historic land use of the project area and its vicinity;
   d) Descriptions of all historic properties, including selected photographs, scale drawings and discussions of age, function, laboratory results, and significance, per the requirements of HAR §13-276. Each historic property will be assigned a Hawai‘i State Inventory of Historic Properties (SIHP) number;
   e) If appropriate, a section concerning cultural consultations (per the requirements of HAR §13-276-5[g] and HAR §13-275/284-8[a][2]);
   f) A summary of historic property categories, integrity and significance based upon the Hawai‘i Register of Historic Places criteria;
   g) A project effect recommendation(s);
   h) Treatment recommendations to mitigate the project’s adverse effect on any historic properties identified in the project area that are recommended eligible to the Hawai‘i Register of Historic Places.

In addition, Section 106 compliance is required for this project related to a U.S. Army Corps Nationwide Permit for planned demolition activities. Consultations to fulfill Section 106 requirements have been initiated and are on-going among stakeholders.

1.3 Environmental Setting

1.3.1 Natural Environment

The 22.73-acre project area is located at sea level on the *makai* side of Ali‘i Drive in the *māno wai* of Kahalu‘u Ahupua‘a in the North Kona District of Hawai‘i Island. The project area includes large areas extensively altered by the construction of the Keauhou Beach Resort (KBR) and the former Kona Lagoon Hotel, and a brackish water pond (Po‘o Hawai‘i) located just north of the main hotel building. The coastline consists mostly of a flat *pāhoehoe* (smooth, unbroken type of lava) bedrock shelf with very large boulders and numerous shallow tidal pools that extend into the surge zone. On the southern end of the project area is a small bay with a rocky

sand beach. Vegetation consists mainly of landscaping plants—exotic ornamentals with scattered native trees and shrubs—including manicured grass lawns.

The project area is almost entirely underlain by *pāhoehoe* lava flows (rLW), with a small portion to the north covered by soils of the Punalu‘u Series (rPYD, Punalu‘u extremely rocky peat, 6 to 20% slopes; Figure 7). The mean annual temperature within the project area is approximately 75 degrees Fahrenheit, and rainfall ranges between 30 to 40 inches per year (Juvik and Juvik 1998:57).

1.3.2 Built Environment

The project area is situated in the Kahalu‘u Historic District (SIHP # 50-10-37-04150, also on the National Register of Historic Places [NRHP]) (Figure 8).

The study area is bounded by Kahalu‘u Beach Park to the north, the Keauhou Kona Surf and Racquet Club to the south, Ali‘i Drive to the east and the Pacific Ocean to the west. Presently the northern portion of the project area includes the KBR, which ceased operation in October 2012, and related development (e.g. driveways, parking lots, tennis courts, swimming pool, comfort stations, pump station; see Figure 6). Additonally, the project area contains pre-Contact and historic structures that represent archaeological sites, or historic properties. Five *heiau* (pre-Contact places of high worship) are present. Three of the *heiau* have recently undergone restoration work: Hāpaiali‘i Heiau, located south of Kahalu‘u Beach Park; Ke‘ekū Heiau, situated 150 feet southwest of Hāpaiali‘i Heiau; and Mākole‘ā Heiau southeast of Ke‘ekū Heiau. Hāpaiali‘i Heiau is located on the same tidal flat as Ke‘ekū Heiau and is encircled by the breakwater at high tide. East of Ke‘ekū Heiau, rock walls have been constructed to prevent seawater from flooding into the vicinity of the former Keawehala Pond at high tide.

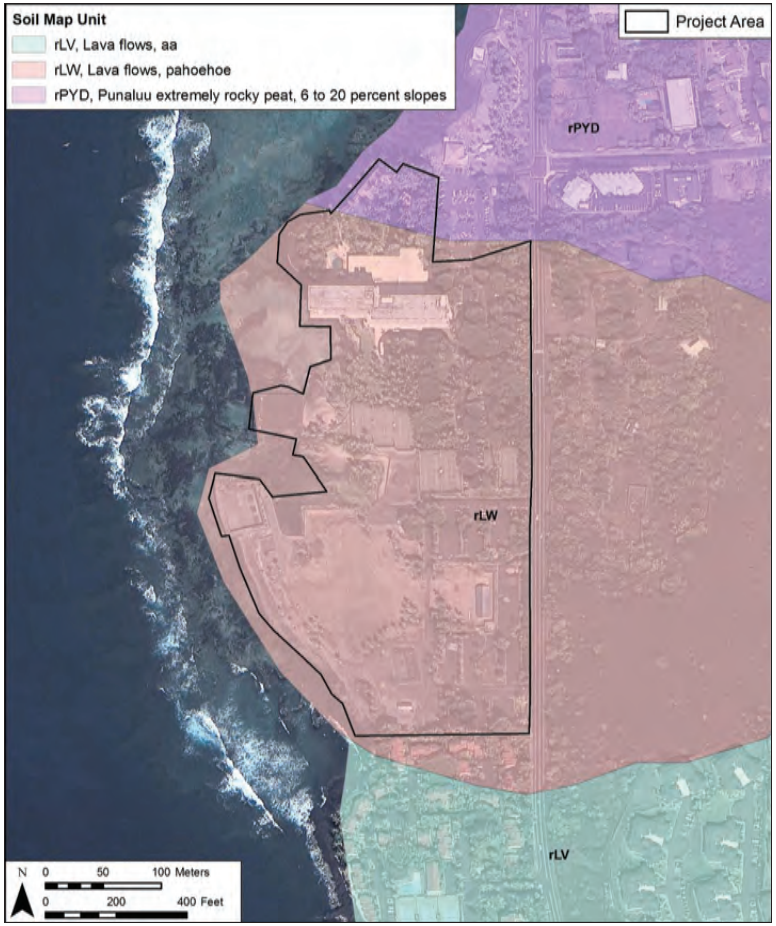


Figure 7. Aerial photograph (Google Earth 2010) overlain with *Soil Survey* data (Sato et al. 1973), showing the land and soil types within the project area

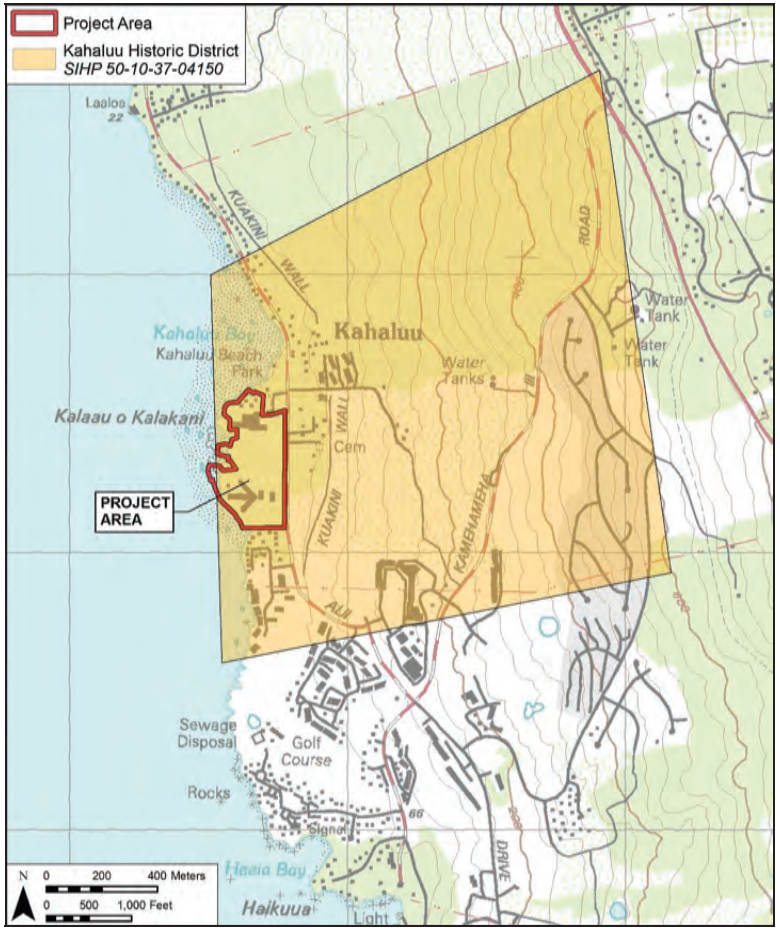


Figure 8. Portion of 1996 Kealakekua USGS 7.5-Minute Topographic Quadrangle, showing the project area within the Kahalu‘u Historic District (SIHP # 50-10-37-04150)

Section 2 Methods

2.1 Field Methods

The fieldwork component of the archaeological inventory survey investigation was carried out under archaeological permit numbers 13-06 and 14-04, issued SHPD, per HAR § 13-282. The fieldwork component of the archaeological inventory survey was accomplished on 22–24 October 2013, 8 and 25 November 2013, 6–31 January 2014, 11 February 2014 and 25 March 2014 by CSH archaeologists Trevor Yucha, B.S., Fred LaChance, B.A., Johnny Dudoit, B.A. and Olivier Bautista, B.A., under the general supervision of Hallett H. Hammatt, Ph.D. (principal investigator). The fieldwork required approximately 42 person-days to complete. In addition, CSH archaeologist Johnny Dudoit, B.A., was on site to observe a geotechnical survey on 18–27 March 2014, requiring an additional six person-days to complete.

2.1.1 Pedestrian Survey

A complete, 100% ground survey of the project area was undertaken for the purpose of historic property identification and documentation. The ground survey of the project area was accomplished through systematic sweeps. The interval between the archaeologists was generally between 5 to 10 m. All historic properties were documented through detailed written description, with evaluation of function, interrelationships, and significance; photographs; scale drawings using standard tape-and-compass mapping procedures as applicable; and located with a GARMIN GPSMAP60Cx unit (accuracy +/- 2-5 m).

Had new historic properties been encountered, the determination of site boundaries would have based on factors including apparent age, architectural style, and the spatial and functional interrelationships of both natural and man-made features.

2.1.2 Ground Penetrating Radar Survey

A GPR survey was completed after the pedestrian survey but before inception of the subsurface testing program, to inform project planning and the placement of particular subsurface test units. The GPR survey was performed using a Geophysical Survey Systems, Inc. (GSSI) SIR-3000 system equipped with 400 MHz antenna. The GPR survey was conducted using single-run transects to generate two-dimensional (2D) depth profiles and horizontal depth slices (i.e., plan view maps of subsurface anomalies at selected depths below the surface; see also Section 5.2).

All collected radar data were post-processed using *RADAN 7*, which is an industry standard for GPR data processing. Position correction was utilized to remove unwanted surface “noise” from GPR profiles. A Horizontal High Pass Finite Impulse Response “Boxcar” (Background Removal) filter was utilized in order to retain the image of recorded stratigraphic layers. Horizontal slicing of GPR data was conducted at uniform depth intervals, but were not generated for portions of GPR data that are distorted and/or attenuated due to environmental conditions and disturbances (see Section 5.2).

2.1.3 Testing

2.1.3.1 Subsurface Testing

A program of subsurface testing was undertaken to determine the extent and nature of subsurface deposits within the project area. Twenty-eight test trenches were proposed by the AISP; one additional test trench was completed in an area where the initial proposed test trench reached a very shallow depth. The selection of trench locations was made with the following three criteria in mind: testing for potential remnant buried historic properties as indicated in the background research (namely, based on the locations of features shown on the 1952 Henry Kekahuna sketch; see Section 3.1); testing based on anticipated disturbance as indicated by the proposed project site plan (see Figure 6) and the locations of planes seepage pits; and testing to provide general coverage of the project area. These units were marked out prior to the testing fieldwork based on the locations proposed in the AISP. The actual placement of the test trenches varied slightly from the marked unit locations to avoid roots, utilities, or other obstructions.

Subsurface testing was to be conducted primarily by hand to determine the extent and nature of associated subsurface deposits. Limited mechanical assistance was employed in areas where rock fill or other modern compacted deposits were encountered. Hand excavation was always attempted first, but where it was not feasible mechanical excavation was utilized in an effort to reach pre-development sediments. Mechanical excavation was undertaken at 16 of the 29 test trenches (55%) using a CAT 303 Mini Excavator. This included excavation at T-22 in the vicinity of Kapuanoni Heiau, where mechanical assistance was required for the removal of the hard pool deck surface and subsurface layers of concrete and other consolidated construction materials. The archaeologist carefully watched all machine excavations, which were conducted at a normal pace, inspecting the sediment as it was removed from a trench and dumped into an adjacent backfill pile. Excavation at T-22 was also monitored by Mr. Mahealani Pai.

The locations of all test trenches were recorded with a Garmin GPSMAP60Cx and on scaled plan view field maps where applicable. The hand-excavated test trenches measured 1.0 by 1.0 m (1.0 sq m). Soil-sedimentary deposits were removed either by trowel or by scooping by hand. Mechanically excavated test trenches also measured 1.0 by 1.0 m (1.0 sq m). As the exposed sediments throughout the project area overwhelmingly consisted of fill materials, both the hand- and mechanically-excavated test trenches were excavated and recorded one level (or stratum) at a time to the underlying bedrock. All excavated deposits were passed through standard 1/8-inch screen. All soil-sediment passed through the screen was captured on a plastic tarpaulin, returned to its original provenience and tamped down. The original surfaces were restored as best as possible using sod, gravel and/or asphalt. All cultural materials were appropriately documented and described, catalogued, labeled, and delivered to the CSH laboratory for analysis.

All trenches were photographed in digital format during the pre-excavation and post-excavation phases. Photo logs of all digital images were maintained to record the digital frame number, date, subject, approximate cardinal direction, and photographer’s initials. All photographs included a visible scale and north arrow. In addition, stratigraphic profiles were drawn and stratigraphic profile records were prepared for each trench. Standard USDA descriptions were recorded for each stratum including moisture content, depth, color, texture, structure, consistence, plasticity, sediment origin, stratum boundary characteristics, root content,

cultural material content, and sediment/soil type. The profiled sections of the trenches were also photographed.

In addition to the formal test trenches, a shovel test (STP-1) was conducted inside the circular constructed feature within the low walled enclosure at SIHP # -12957. This shovel test was undertaken to determine the likelihood of any buried cultural deposits within the feature. At the shovel test location, sediment was removed by shovel to bedrock, noting any changes in stratigraphy and cultural materials. When complete, the shovel test location was documented using the standard methodology described above.

2.1.3.2 Sediment Core Sampling

Coring was accomplished at SIHP # -12951 Features A and B by pounding a prepared section of open-ended PVC pipe (2-inch diameter) with a heavy-duty fence post pounder into the sedimentary deposits located within the former springs. These locations were recorded with a Garmin GPSMAP60Cx. (Coring at Po‘o Hawai‘i Pond [SIHP # -12953] had been recommended in the AISP, but CSH was advised against this activity in the field by Mr. Mahealani Pai due to the culturally sensitive nature of the pond.) When significant resistance was encountered, the PVC coring pipe was cut and capped above the ground surface. The depth of the PVC pipe from ground surface was then documented. Capping the above-ground portion of the PVC pipe created a vacuum within the below-ground portion of the pipe, assuring that the sediment core contained within remained intact. The CSH field crew then attached large pipe wrenches to the capped end of the PVC pipe and manually removed the pipe section from the feature floor. Upon extraction, the opposite or coring end of the PVC pipe was also capped, to seal in the sediment core sample from external contamination. The sediment core pipe was labeled with provenience information and core direction and returned to the CSH laboratory in Waimānalo for processing.

2.1.4 Geotechnical Survey Observation

CSH performed observation of all ground disturbance associated with the geotechnical survey undertaken for the project by Hirata and Associates, Inc. The CSH archaeologist’s role was similar to that of an archaeological monitor. The purpose of the observation work was to provide CSH and the client with valuable data regarding the project area sediments, which could provide context to the other findings of the AIS fieldwork. Furthermore, if any cultural deposits were located, CSH would document and provide analysis of these materials within the present report.

The fieldwork consisted of on-site observation of geotechnical boring (drilling) and subsequent core sample extraction or percolation tests. Each bore test location was recorded with a Garmin GPSMAP60Cx. The archaeologist watched the machinery as it worked at a normal pace. Once the desired depth of excavation was reached, the resulting 4.0-inch (0.10 m) diameter hole was visually inspected and photographed. The archaeologist then watched as an iron pipeline was inserted to either extract a sediment core or to preform a percolation test. Photos were taken of either the extracted core sample or the area surrounding the hole after a percolation test was performed. All GPS locations and photos were logged. Furthermore, a daily field form was completed describing the activities performed, the locations of these activities within the project area, and any applicable observations.

2.2 Laboratory Analysis

2.2.1 Analysis of Materials Collected during Subsurface Testing

A number of artifacts and other cultural materials were collected during the subsurface testing program. All collected materials were analyzed using current standard archaeological laboratory techniques. Historic artifacts were identified using standard reference materials and resources available on the internet.

All collected invertebrate remains were identified to genus and species, weighed, and analyzed. Data was tabulated by depth and stratigraphic unit. Common marine shells were identified and analyzed at the CSH laboratory in Pāhoa, Hawai‘i using an in-house comparative collection and reference texts (i.e. Abbott and Dance 1990; Eisenberg 1981; Kay 1979; Titcomb 1979). Were any rare and/or extinct marine or freshwater shells recovered, an outside expert was to be consulted for identification of the material. The total weight of any midden was tabulated by collection unit.

All collected non-human vertebrate faunal materials were identified to the lowest possible taxa at the CSH laboratory using an in-house comparative collection and reference texts (i.e. Olsen 1964; Schmid 1972; Sisson 1914). If a large number of bird or fish bones, or any unusual bones, were recovered they were to be submitted to an expert in faunal analysis for identification. The total weight of any midden was tabulated by collection unit.

2.2.2 Sediment Core Analysis

2.2.2.1 Core Extraction

Sediment core extraction and preparation were undertaken using the following methods. First a makeshift stand was prepared from two saw horses and a cut sheet of plywood to support the PVC pipe core during the cutting process. The PVC pipe was then rested on the surface of the stand and clamped in place using C-clamps and two 2 x 4 boards, which also acted as guides for the router. After the PVC pipe core was secured, a router with a V-shaped bit was used to create a wide groove along the length of the pipe. The router was adjusted in order to cut through the bulk of the PVC pipe exterior, leaving only a thin membrane of PVC plastic between the actual sediment core and the outside environment. Upon completion of one linear router cut, the PVC pipe core was slightly rotated within the makeshift stand and a second linear router cut was added. Following use of the router, a final cut through the thin PVC membrane of each router cut was performed using a rug knife with a clean blade. The final cut allowed for the removal of a linear section of PVC pipe, equal to approximately 1/4 of the PVC pipe’s circumference, which exposed the length of the sediment core for documentation and sampling.

The objective of obtaining sediment core samples was to generate data regarding the construction and use of the former water features and/or any climactic changes indicated within their sediments. Samples appropriate for radiocarbon and/or pollen analysis were analyzed (see Sections 2.2.2.2 and 2.2.2.3), and any marine invertebrates encountered were to be documented using standard laboratory techniques (see Section 2.2.1).

2.2.2.2 Radiocarbon Analysis

Sediment sub-samples were sent to Beta Analytic, Inc. of Miami, Florida for radiocarbon dating analysis using the Accelerator Mass Spectrometer (AMS) method. The conventional radiocarbon age determined by Beta Analytic, Inc. was calibrated to calendar ages using the OxCal calibration program, Version 4.1, developed by the University of Oxford Radiocarbon Accelerator Unit (ORAU).

2.2.2.3 Pollen Analysis

Sediment sub-samples were sent to PaleoResearch Institute of Golden, Colorado for pollen analysis. A chemical extraction technique based on flotation was used to remove pollen from the sediment matrix. After additional treatments, a light microscope was used to count and identify pollen grains within the sample.

2.3 Document Review

Background research included a review of previous archaeological studies on file at SHPD; review of documents at Hamilton Library of the University of Hawai‘i at Mānoa, the Hawai‘i State Archives, the Mission Houses Museum Library, the Hawai‘i Public Library, and the Bishop Museum Archives; study of historic photographs at the Hawai‘i State Archives and the Bishop Museum Archives; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Māhele (portion, division, section, land division of 1848) records were examined from the Waihona ‘Aina database (Waihona ‘Aina 2009).

2.4 Consultation

Consultation has been undertaken for the project to comply with HAR §13-276-5 of Hawai‘i state law. A cultural impact assessment is being prepared for the proposed project, which will involve a general consultation process. The project area contains numerous archaeological sites of high cultural importance (e.g., the various *heiau*, Po‘o Hawai‘i). For this reason and at the request of SHPD, project area/site-specific consultation was also completed as part of the AISP.

The AISP consultation efffort included two formal interviews with KS educational specialists Mr. Māhealani Pai and Ms. Kalei Nu‘uhiwa. These interviews were conducted by CSH cultural researcher Aulii Mitchell on 27 January 2013 and 13 February 2013.

Furthermore, a site visit for the purpose of consulting with key community members, Uncle Mitchell Fujisaka and Auntie Kalani Hamm, occurred on 30 October 2013 with KS in attendance as well as CSH staff and Michael Vitousek of the SHPD. A third community member, Auntie Velma Kauhi, was also contacted about participating in the site visit, but was not able to attend. During the site visit, participants Auntie Kalani Hamm and Uncle Mitchell Fujisaka were shown historic maps and aerial photographs to further the discussion. The identified historic properties were also summarized and discussed. In addition, Uncle Mitchell Fujisaka was interviewed and his interview is included below.

The results of the above consultation efforts were detailed in the project AISP. The results of the general consultation process will be given in the CIA.

Some additional on-site consultation occurred as Mr. Mahealani Pai was frequently on-site with the CSH archaeologists. For example, core smapling at Po‘o Hawai‘i Pond (SIHP # -12953) was abandoned when Mr. Pai advised that such sampling should not be undertaken due to the cultural sensitivity of the site. Furthermore, Mr. Pai offered his insights about the various historic properties within the project area during the surface documentation process.

Section 3 Traditional and Historical Background

This section summarizes aspects of the traditional and historical importance of the project area, which includes descriptions of place names or *wahi pana* (legendary places) and significant historical events and persons.

3.1 Place Names of Kahalu‘u

Wahi pana (“legendary place” Pukui and Elbert 1986:376) or “place names” are an integral part of Hawaiian culture. “In Hawaiian culture, if a particular spot is given a name, it is because an event occurred there which has meaning for the people of that time” (McGuire and Hammatt 2000:23). The *wahi pana* are then passed on through language and oral tradition, thus preserving the unique significance of the place. Hawaiians have named a wide variety of objects and places, including points of interest that may have gone unnoticed by persons of other cultural backgrounds. Hawaiians have named taro patches, rocks and trees that represented deities and ancestors, sites of houses and *heiau*, canoe landings, fishing stations in the sea, resting places in the forests, and the tiniest spots where miraculous or interesting events are believed to have taken place (Pukui et al. 1974:x).

The place names of Kahalu‘u Ahupua‘a are listed in Table 1; this table first presents general place names (primarily *‘ili ‘āina*, or land area), then the place names of coastal *heiau*, coastal places, inland *heiau* and, finally, inland places. The location of the project area within the overall *ahupua‘a* (traditional land division usually extending from the uplands to the sea) of Kahalu‘u is shown in Figure 9.

The primary compilation source for place names in this section is the online database of Lloyd Soehren’s (2011) *Hawaiian Place Names*. Soehren has compiled all names from mid-nineteenth century land documents such as Land Commission Awards (LCA) and Boundary Commission Testimony (BCT) reports. The BCT lists boundary points for many (but not all) of the *ahupua‘a*. The names of *‘ili ‘āina* are compiled from the testimony in Māhele Land Commission Awards, from both awards successfully claimed and those rejected.

The Soehren database includes place name meanings from the definitive book on Hawaiian place names, *Place Names of Hawai‘i* (Pukui et al. 1974). Where Pukui et al. (1974) do not provide a translation, Soehren often suggests a meaning for simple names from the *Hawaiian Dictionary* (Pukui and Elbert 1986). Thomas Thrum (1922) also compiled a list of place names in the 1922 edition of Lorrin Andrews’s *A Dictionary of the Hawaiian Language*, although these meanings are considered to be less reliable than those in *Place Names of Hawai‘i*. Many of these place names are shown on historic maps; in the mid-twentieth century Henry Kekahuna produced maps referencing numerous coastal places within Kahalu‘u (Figure 10 through Figure 12). However, oftentimes the exact locations of place names are not known, but only their general location between two other points along an *ahupua‘a* boundary. These cannot be placed accurately on any maps, so their position is only noted in the following place name table.

Table 1. Place Names of Kahalu‘u Ahupua‘a

Place Name	Type	Meaning (Source)	Description (Source)
Kahalu‘u	*Ahupua‘a*, bay	Diving place (Pukui et al. 1974:62); dripping trough (Thrum 1922:637)	Retained by V. Kamāmalu, LCA 7713:6; a land favored by chiefs where many *heiau* survive. The land was named for a high ranking chiefess called Kahalu‘u who was the wife of Keolonāhihi. In some accounts, Kahalu‘u is said to have been the wife of Keauhou, the ruling chief of Kona district, and they were parents of Mākole‘ā, famed for her beauty, who was engaged to the King of Maui, Kaka‘alaneo (Fornander 1916–1919:384, 385).
Hali‘ipālala 1–5	*‘Ili ‘āina*	Spread wide (Pukui et al. 1974:39)	LCA 5671B, 5695, 5642; bounded by LCA 5673:1-3 and 5677:1, 2
Hāpaiali‘i	*‘Ili ‘āina*	Elevating chief (Pukui et al. 1974:42)	LCA 5915 (house site of award near Hāpaiali‘i Heiau)
Helekamahina	*‘Ili ‘āina*		Bounded by LCA 5690:1 and 5964:6
Hiloa 1–2	*‘Ili ‘āina*	Long *‘ili* land division (Soehren 2011)	LCA 5687-A
Hōkio 1–4	*‘Ili ‘āina*	Small gourd whistle (Soehren 2011)	LCA 5673, 5694
Kahuamoa	*‘Ili ‘āina*	The chicken egg (Soehren 2011)	LCA 5813-B, 3449-B
Kaloaulu	*‘Ili ‘āina*		LCA 6091
Kamuku 1–4	*‘Ili ‘āina*	Cut short (Thrum 1922:643)	LCA 5673, 5677, 6094
Ka‘ōpapa	*‘Ili ‘āina*		Bounded by LCA 6139
Kapio	*‘Ili ‘āina*		Bounded by LCA 6029
Kealaehu	*‘ili ‘āina*	The dusty road (Soehren 2011)	Bounded by LCA 5676, 5689
Kepani	*‘Ili ‘āina*		Bounded by LCA 5676, 5686
Kihikihi 1, 2	*‘Ili ‘āina*		LCA 5690, 3445-B

Place Name	Type	Meaning (Source)	Description (Source)
Koai‘e 1–3	*‘Ili ‘āina*	A native tree, *Acacia koa* (Soehren 2011)	LCA 3443-B, 10766
Kukuiha‘a	*‘Ili ‘āina*	Low candlenut tree (Soehren 2011)	LCA 6128, 5831, 5689, 3455-B, 3447-B
Kukui o ka hinu	*‘Ili ‘āina*		LCA 5966-B
Kumuhāwane	*‘Ili ‘āina*	Trunk of the *loulu* palm tree (Soehren 2011)	Bounded by LCA 5673-C
Lehuakona	*‘Ili ‘āina*	Milky Way star, perhaps Antares (Soehren 2011)	LCA 5688, 5632, 3440-B; bounded by LCA 5691
Makakiloi‘a	*‘Ili ‘āina*	Fish-observing point (Pukui et al. 1974:40)	LCA 5688, 5688-B, 6032
Mauiloa	*‘Ili ‘āina*	Distant Maui, perhaps (Soehren 2011)	Bounded by LCA 5686
Pahauopu	*‘Ili ‘āina*		LCA 5672
Pāhoa	*‘Ili ‘āina*	Dagger (Pukui et al. 1974:174)	LCA 6032, 5690, 3442-B; bounded by LCA 6091
Pāki‘i 1–6	*‘Ili ‘āina*	Flat, spread out (Soehren 2011)	LCA 5691, 5632, 6032, 5690, 3440-B
Pamaki	*‘Ili ‘āina*	Fatal illness, perhaps (Soehren 2011)	LCA 5678
Pāpua‘a 1–3	*‘Ili ‘āina*	Pig fence, or enclosure (Soehren 2011)	LCA 6139, 6029, 6080
Paulu	*‘Ili ‘āina*		LCA 6029
Po‘ohawai‘i	*‘Ili ‘āina*		LCA 6026; contains Po‘o Hawai‘i Pond
Puekahi	*‘Ili ‘āina*		LCA 5673, 6094

Place Name	Type	Meaning (Source)	Description (Source)
Pu‘u Hinahina	*‘Ili ‘āina*	Perhaps named for one of the several *hinahina* plants (Pukui et al. 1974:196)	LCA 5676
‘Ulumoe	*‘Ili ‘āina*	Reclining breadfruit tree (Soehren 2011)	LCA 5688-B, 5632, 6023, 3440-B; bounded by LCA 5691
Coastal *Heiau*			***Makai* of Ali‘i Drive near Kahalu‘u Bay**
Hanakalau‘ai	*Heiau*	Name of a star associated with Hana-kau-luna (a star), and the name of a legendary place (Soehren 2011)	Thrum only lists site (Stokes and Dye 1991:71; Thrum 1907a:44).
Hāpaiali‘i	*Heiau*	Elevating chief (Pukui et al. 1974:42)	“A large *heiau* said to have been built by Kamehameha about 1782 after the battle of Mokuohai” (Thrum); “. . . in which human sacrifices were offered and it also served as a *pu‘uhonua* [place of refuge]” (Stokes and Dye 1991:71-74; Thrum 1907a:44)
Kapuanoni	*Heiau*	The Indian Mulberry flower (Soehren 2011)	A place for prayers in general, built by Kalani‘ōpu‘u at the shore; little remains; one-time residence of Alapa‘inui (Stokes and Dye 1991:71, 80; Thrum 1907a:44, 1907b:72; Kekahuna and Kelsey 1954: Article 18).
Kapukini (Paniau)	*Heiau*	Many taboos (Pukui et al. 1974:90); Kapukini was also the name of a wife and a daughter of ‘Umi (Tuggle 1989:16)	“Called Heiau Paniau on Bishop Estate map [and TMK: [3] 7-8-013:03], but Paniau is the name of the point above which it stands . . . This *heiau* and those hereabouts . . . were built by Kings Kuakini and Iwikaumaiikaua” (Reinecke 1930:3:2, 3); misnamed Paniau Heiau on TMK: [3] 7-8-013:003

Place Name	Type	Meaning (Source)	Description (Source)
Ke‘ekū (Kamaike‘ekū; Kamai‘ike‘ekū)	*Heiau*	Abrupt turn (Pukui et al. 1974:105)	Also called Kamaikeeku (Kamakau 1992:180; Stokes and Dye 1991:79; Thrum 1907a:45, 1907b:72); built by Lonoikamakahiki who offered Kamalalawalu as a sacrifice; restored by Kamehameha (Stokes and Dye 1991:74-79; Kamakau 1992:180); also called Kamai‘ike‘ekū (Forbes 1800s)
Ke‘ekuapua‘a (Mākole‘ā; Haleokapuni)	*Heiau*	Rooting of [the] pig (Soehren 2011)	Also known as Mākole‘ā (Reinecke 1930:3:4); possibly same as Haleokapuni (Forbes 1800s in Tuggle 1989:15)
Ku‘emanu (Ku‘e Manu)	*Heiau*	To attract and net petrel birds, perhaps (Clark 2002:199-200)	A small *heiau* and one of the few ceremonial sites devoted to the sport of surfing; chiefs of old would pray for good surfing conditions and ride the surf breaks called Kaleikini and Kapu‘ā (Kona Historical Society n.d.); presently owned and maintained by the County of Hawai‘i (TMK: [3] 7-8-014:004, 005); named in LCA 6071 by Ho‘opale who had two houses on the fenced lot which had been given to his father by Governor Kuakini (Stokes and Dye 1991:67–70; Thrum 1907a:44; Reinecke 1930:3:9)
Kū‘ula	*Heiau*	Red Kū, the god of fishermen; fishing *heiau*; stone god used to attract fish (Soehren 2011)	Site 11: “a small enclosure containing two *kuula* stones, a *kane* and a *wahine*, to whom fish is offered” (Reinecke 1930:3:2)
Lahai or Lahae	*Heiau*		On boundary of Kahalu‘u and Kapala‘alaea at a place called Keawemua (Stokes and Dye 1991:65; Thrum 1907a:44; Reinecke 1930:2:1)
Maka‘uhane	*Heiau*		“Site 46 . . . Now in ruins . . . Said to be a *heiau* for making the king’s canoes” (Reinecke 1930:3:8)

Place Name	Type	Meaning (Source)	Description (Source)
Mākole‘ā (same as Ke‘ekuapua‘a)	*Heiau*	Name of a legendary princess; means “glowing red eye” (Pukui et al. 1974:1420	“Set back approximately 600 feet from shore, on the same tidal flat as Kapuanoni Heiau, Hāpaiali‘i Heiau and Ke‘ekū Heiau. This is a walled *heiau*, apparently facing to the west. Built or consecrated by Lonoikamakahiki and was used for prayers in general” (Stokes and Dye 1991:80).
‘Ōhi‘amuku-muku	*Heiau*		A *luakini* (human sacrificial) *heiau* traditionally said to have been built by the gods or possibly built by Lonoikamakahiki or Alapa‘i, repaired by Kalani‘ōpu‘u and Kamehameha I. It was repaired by Kalani‘ōpu‘u at which time Holoa‘e was its priest. It was lastly repaired by Kamehameha I. Nothing remains as its stones were removed to build the adjoining Helani Church (Stokes and Dye 1991:70; Thrum 1907a:45; 1907b:71; Kamakau 1992:85, 180, 200).
Papakoholuia	*Heiau*		A minor *heiau*, much disturbed (Reinecke Ms. 3:7, site 37).
Coastal Places			***Makai* of Ali‘i Drive near Kahalu‘u Bay**
Ahuahinaloa	*Kuleana*		“Site 58 . . . Ahuahinaloa [LCA 5684 to Kanahuimoana], where there was formerly a spring, Waiakane, and a small *heiau* for resting” (Reinecke 1930:3:9)
Helani Church	Church	A sky or a royal chief (Pukui et al. 1974:44)	Now a roofless ruin; remains of the first, smaller church lie a few yards south; it was built of stones taken from ‘Ōhi‘amukumuku *heiau*, adjoining on the south (Stokes and Dye 1991:70)
‘Inikiwai	Coastal point	Piercing water (Clark 2002:122)	Site 4. At the south end of the “*menehune* breakwater,” this once extended about 3,900 ft to Kaumaha‘ole Point on the north side of Kahalu‘u Bay. There is an undersea spring of brackish water at ‘Inikiwai. Cf. Kauakoekoe (Reinecke 1930:3:1, 4)
Kaho‘ali‘i	Spring		A sacred spring of drinking water for royalty only (Kekahuna 1952)

Place Name	Type	Meaning (Source)	Description (Source)
Kahope	Place in sea		“Site 59 . . . at Kahope . . . where kings used to swim through holes in the rocks under the water” (Reinecke 1930:3:9)
Kahuwaiwai	Spring		“Site 59 . . . at Kahope . . . [h]ere there is a fine fresh water spring under the surface four fathoms, where the natives used to dive and fill their calabashes” (Reinecke 1930:3:9)
Ka‘ihimoku	Coastal point		“Site 59 . . . Kawai and Kaihimoku, points on which, if one makes nets, he will be successful in fishing” (Reinecke 1930:3:9)
Kaimuahoa	Place in sea		“Site 59 . . . two shallow places where manini fish are born and can be taken at new moon” (Reinecke 1930:3:9)
Ka Lā‘au o Kaleikini	*Pōhaku* (stone)	The club or stick of Kaleikini (Soehren 2011)	“. . . the huge rock laid in the sea as the very last stone of the [*Menehune* seawall]” (Kekahuna map 1952); Kaleikini was a legendary strong man who left his mark, and name, in several places (Reinecke 1930:3:map)
Ka Lae o Līloa	Coastal point	The point of Līloa, named for father of ‘Umi-a-Līloa (Soehren 2011)	A surf called “Ka Nalu o Kapu‘a [was] off shore from the little point known as Ka Lae o Liloa” very near Ku‘emanu *heiau* (Reinecke 1930:3:9; Kekahuna and Kelsey 1954: Article 20)
Kaleikini	Surf	The many leis; Kaleikini was a legendary strong man (Pukui et al. 1974:76)	Kahalu‘u “bay’s splendid surf, known today as Ka Nalu o Kaleikini” was threatened by construction of the “Menehune sea wall,” but was saved by the intervention of Hinamoa, priest of the surfing *heiau* Ku‘emanu. Cf. Ka Lā‘au o Kaleikini (Kekahuna and Kelsey 1954: Article 20).
Kalopoipu	Cave		“Site 50, a tiny cave near the road” (Reinecke 1930:3:8)
Kaluokele (Kalua o keli‘i)	Sea cave	Cavern of the chief (Pukui et al. 1974:79)	“Site 27 . . . a hole about 5 fathoms deep, outside Keeku, where the Hawaiians used to offer *awa* root, food, etc. to the king shark Moanaliha” (Reinecke 1930:3:11)

Place Name	Type	Meaning (Source)	Description (Source)
Kamalalawalu	Petroglyphs		“Outside the entrance to the *heiau* (Ke‘ekū) and towards the southwest area number of petroglyphs on the *pāhoehoe*. One is said to represent Kamalalawalu” (Sterling 1960:4)
Ka-naia	Stone		A *kū‘ula* stone (Kekahuna 1952)
Kanaluokapu‘ā	Surf	The surf of Kapu‘ā (Soehren 2011)	Surf called “Ka Nalu o Kapu‘a [was] right offshore from the little point known as Ka Lae o Liloa . . . ” very near Ku‘emanu *heiau*” (Kekahuna and Kelsey 1954: Article 20)
Kanupa	Cave	The deep cave (Soehren 2011)	“Site e . . . A burial cave with its entrance in a deep circular pit” (Reinecke 1930:3:11)
Kapapa	*Ko‘a* (fishing shrine)	The flat surface (Pukui et al. 1974:87)	Site 56 . . . The deep water for fishing just outside [Kuemanu *heiau*] is called Kapapa” (Reinecke 1930:3:9)
Ka-papa-ko	Dog		A legendary black dog (Kekahuna 1952)
Kapu‘ā	Surf		“. . . waves of Kapu‘ā, right offshore from the little point known as Ka Lae o Li-loa, named for King ‘Umi's famous sire . . . near Ku‘emanu *heiau* “ (Kekahuna and Kelsey 1954: Article 20)
Kapua‘iwai	Spring		A spring of brackish drinking water only for the use of tenants (*ohua*) of a chief (Kekahuna 1952)
Kaua-kahi-okaoka	Dog		A legendary white dog (Kekahuna 1952)
Kauko‘eko‘e	Place		“ . . . the great Menehune [fishpond] wall . . . extends in a line of large scattered stones in the sea from the lava flat of Ka-ua-ko‘eko‘e, near the south end of Makole-‘a beach . . . Also called Inikiwai” (Kekahuna and Kelsey 1954: Article 19)
Ka‘ulili	Spring		A commoners bathing spring (Kekahuna 1952)
Kaumaha‘ole	Coastal point	Not heavy (Soehren 2011); weightless (Clark 2002:169)	“Site 59 . . . the north end of the breakwater” (Reinecke 1930:3:9)

Place Name	Type	Meaning (Source)	Description (Source)
Kawai	Coastal point	The water (Soehren 2011)	“Site 59 . . . Kawai and Kaihimoku, points on which, if one makes nets, he will be successful in fishing” (Reinecke 1930:3:9)
Kawaikohali‘i	Coastal point		“Site 17. Dry well . . . about 8 feet deep and surrounded by concentric tiers of walls” (Reinecke 1930:3:4)
Kawaiokapo	Pool	The water of Kapo (Soehren 2011)	“. . . out on a small flat of *pahoehoe* lies the once chiefly bathing pool of Ka Wai o Kapo, commemorative of Kapo, a sister of . . . Pele . . . ” *makai* of Po‘o Hawai‘i (Kekahuna and Kelsey 1954: Article 18)
Kawai‘ōpae	Pool		Pool in which red shrimps of royalty (*‘ōpae‘ula‘ula*) were raised (Kekahuna 1952)
Ke‘alialia	Lagoon		Kekahuna 1952
Keawaiki	Canoe landing	The small passage (Pukui et al. 1974:104)	South of St. Peter’s church (Reinecke 1930:3: map 1)
Keawehala (also seen as Keawahala)	Pond		“A pond *kapu* to women during menstruation. Two *mo‘o* . . . one good natured and the other ill tempered, were custodians of the pond” (Reinecke 1930:3:4)
Kēwā	Coastal boundary point	Anticipation (Pukui et al. 1974:109)	“The boundary at sea shore [between Kahaluu and Keauhou 1] is a *pali* called Paaniau [sic; pā-nī‘au] and a long wall from Kewa to [*makai* govt.] road” (Boundary Commission 1864–1935:1:318)
Kīlauea	Fire place		Ceremonial fire place (*kapuahi kuni*) (Kekahuna 1952)
Kilohana	Pond	Lookout point, or outer tapa, or best superior (Pukui et al. 1974:111–112)	Between Mākole‘ā *heiau* and Keawehala pond; Kekahuna uses descriptive term “Ka-wai-‘ōpae [shrimp pond];” pond was destroyed by a hotel (Kekahuna 1952)
Kuluaokeli‘i	Sea cave	The cavern of the chief (Pukui et al. 1974:79)	Located “below the *heiau* of Keeku and Hapaialii;” it was believed that a shark chief lived here but did not disturb divers for sea urchins (*wana*) (Pukui et al. 1974:79).

Place Name	Type	Meaning (Source)	Description (Source)
Lapauila	*Pōhaku*	Lightning flash (Soehren 2011)	Site 47. “Formerly along the roadside below ‘Ōhi‘amukumuku *heiau* (q.v.), the ‘stone called Lapauila,’ described as a ‘strangling stone’ . . . is now (1989) at Hulihe‘e Palace in Kailua. Only the perforated top portion remains, identified as a ‘canoe anchor’ by palace staff” (Reinecke 1930:3:8; Stokes and Dye 1991:70).
Lono-i-ka-makahiki	Residence		“Thought to be the residence of Lonoikamakahiki with complex walls, platforms and enclosures. Also is called Kapukini Heiau and Paniau Heiau for the point where it is located. 1812, this may also be the site of Kamehameha’s residence with the adjoining *heiau*’s” (Sterling 1960:6).
Mahina o Kiwala‘ō	Boundary point		“a place where Kiiwalao [sic; read Kiwalao] was raised, an *alii kapu*” [son of Kalani‘ōpu‘u]; on south boundary Kahalu‘u between Kuohae and Māmalahoa Highway (Boundary Commission 1864–1935:1:321)
Moku‘aweoweo	Fireplace		Ceremonial fireplace (*kapuahi kuni*) (Kekahuna 1952)
Malolo Kai O Paniau	Spring		Now almost completely covered by the present road (Kekahuna 1952)
Menehune Breakwater	Fishpond wall		See Pāokamenehune
Mokuahi‘ole (Kamoku-uwahi‘ole)	Residence, possible *heiau*	Firebrand, charred wood (Soehren 2011)	At Po‘o Hawai‘i; said to have been residence of Ke‘eaumoku and perhaps formerly a *heiau*; also may have been birthplace of Kaluaikonahale, John Adams Kuakini; Kalākaua later built a frame house on the site (Kekakuna 1952, Reinecke 1930:3: site 45; Stokes and Dye 1991:70-71.); also called Kamoku-uwahi‘ole (Forbes 1800s)
‘Ōhiki	Coastal boundary point, cove	To shell out (Thrum 1922:662)	“A point on the south side of Paniau, and near to it” is the sea shore boundary between Kahaluu and Keauhou 1 (Boundary Commission 1864–1935:1:321, 322); now located in Keauhou 1 (Kekakuna 1952)

Place Name	Type	Meaning (Source)	Description (Source)
Pahuwai	Spring		A commoners’ spring of brackish drinking water (Kekahuna 1952)
Paniau	Coastal boundary point	Paniau: unknown; Pānī‘au: touch midrib (Pukui et al 1974:178)	“Now the boundary between Kahaluu and Keauhou. Was formerly for diving” (Reinecke 1930); “Paniau, the name of a *kupua* . . . turned into stone in the sea below, where it divides . . . Kahaluu from . . . Keauhou”; see Kapukini Heiau, misnamed Paniau Heiau on TMK: [3] 7-8-013:003 (Reinecke 1929:3:2, 3; Kekahuna and Kelsey 1954: Article 20; Boundary Commission 1864–1935:1:318, 319, 320; Kekahuna 1952)
Pāokamenehune	Fishpond wall	Wall of the *menehune* (Clark 2002:282)	The Menehune breakwater, built by the *menehune* in one night (Clark 2002:282)
Pāpā	Well, spring	Perhaps, forbidden (Soehren 2011)	“Site 56 . . . The brackish well in the heaps of rocks south of the [Ku‘emanu] *heiau*, used for laundry, is called Papa” (Reinecke 1930:3:9)
Pohaku-li-kanaka	Stone		Location of execution stone now at Hulihe‘e Palace (Kekahuna 1952)
Pōhakuloa	*Pōhaku*	Long rock (Pukui et al. 1974:186)	“Site 26. A large boulder lying on the lava flat covered at high tide . . . a shark of supernatural powers, changed to a stone because he refused to give fish to Pele” (Reinecke 1930:3:7)
Pōhaku o Kanaio	*Kū‘ula* (standing stone)	Stone of Kanaio (Soehren 2011)	“A companion *ku‘ula* stone [to Pohaku o Ulupalakua] was similarly imported from Kanaio, Maui, and now stands facing the sea in a stone wall just back of the beach” (Kekahuna and Kelsey 1954: Article 18).
Pōhaku o Ulupalakua	*Kū‘ula*	Stone of Ulupalakua (Soehren 2011)	“In the sea near Kapuanoni [*heiau*] . . . a fair sized flat stone named Pohaku o Ulupalakua after its former home on Maui”; companion to Pōhaku o Kanaio (Kekahuna and Kelsey 1954:18)
Poho o Kapo	Pool		A sacred bathing pool for royalty (Kekahuna 1952)

Place Name	Type	Meaning (Source)	Description (Source)
Po‘o Hawai‘i (same as Pōhaku o Kanaio)	*Kū‘ula*, pond		“A fish god, called Poo Hawaii . . . Originally it lay on the beach toward Kapuanoni . . . moved to its present position by Mr. Nahale . . . Near it was a pool . . . used by Kamehameha” (Reinecke 1930:3:8); a stone house was built here by Kuakini; Kalākaua replaced it (Kekahuna and Kelsey 1954: Article 31)
Ulu-pala-kua	Stone		A *kū‘ula* stone (Kekahuna 1952)
‘Umihale	Residence	House of ‘Umi (Soehren 2011)	Former name of the residence of Lonoikamakahiki, “said . . . to have been originally built by King ‘Umi” (Kekahuna and Kelsey 1954: Article 20; LCA 5682 mentions ‘Umihale)
Waiakāne	Spring	Water [made] by Kāne (Soehren 2011)	“Site 58 . . . Ahuahinaloa [LCAw 5684 to Kanahuimoana], where there was formerly a spring, Waiakane, and a small *heiau* for resting. The spring was sacred to Kane” (Reinecke 1930:3:9); destroyed by construction of Ali‘i Drive
Waikua‘a‘ala	Pond	Lichen water (Soehren 2011)	“. . . used for swimming by the king” (Reinecke 1930:3:8)
Waiku‘i	Pond, house		The name of the brackish water pond adjoining Ku‘emanu Heiau where chiefs of old washed the salt from their bodies after surfing (Kona Historical Society n.d.); also, a house site mentioned in LCA 5674
Inland *Heiau*			***Mauka* of Ali‘i Drive**
Ālainamona	*Heiau*		“Site h. Not visited [by Reinecke]; described by Kahulumu as a platform about 40 feet by 25 feet by 5 feet. Doubtless for agriculture” (Reinecke 1930:3:11)
Halelā‘au	*Heiau*	House of wood (Soehren 2011)	An agricultural *heiau* at 140 ft elevation near Halelā‘au cave (Stokes and Dye 1991:67, 68; Reinecke 1930:3:11; Thrum 1907a:44)

Place Name	Type	Meaning (Source)	Description (Source)
Haleokāne (Halekumukalani)	*Heiau*	House of Kāne (Pukui et al. 1974:38); house of the foundations of heaven (Stokes n.d.)	“Located 750 feet above sea level, 5000 feet from the sea . . . an unusual structure . . . ” (Stokes and Dye 1991:66-67); “. . . supposed to be the Halekumukalani of ancient time” (Thrum 1907a:44 in Kamakau 1976:145)
Ka‘io‘ena (Keahiolo)	*Heiau*		Also called Keahiolo; on boundary of Kahalu‘u and Keauhou, elevation 340 ft founded by Lono-i-ka-makahiki; named for a *kahuna* and strong man, Ka‘io‘ena (Reinecke 1930:3:10); “a large *heiau*” (Boundary Commission 1864–1935:1:321); “a large pile of stones like a *heiau*” (Boundary Commission 1864–1935:1: 322); Site a. On Keauhou boundary, 3,000 ft inland at 400 ft elevation; agricultural *heiau* founded by Lono-i-ka-makahiki; also called Ka-‘io-‘ena (Stokes and Dye 1991:83; Reinecke 1930:3:10; Thrum 1907a:45)
Keanalele	*Heiau*	The flying cave (Soehren 2011)	“Site c . . . said to be a *heiau* about 20 x 20 feet built in the bottom of a deep cave *mauka* of and between Ohia Cave and Keahiolo Heiau” (Reinecke 1930:3:11)
Ke‘ekū (*mauka*)	*Heiau*	Abrupt turn (Pukui et al. 1974:105)	A small *heiau*, 40 ft sq, built by Alapa‘i for agriculture; 250 ft *mauka* of upper government road; not seen by Stokes (Stokes and Dye 1991:87)
Kēhau	*Heiau*	Dew; a gentle land breeze of Kona (Soehren 2011)	Shown on Bishop Estate map, but called a goat pen (Site 6) by Reinecke’s (1930:3:3) informant, Kahulumu
Nohoanapalena	*Heiau*		Site k. A *heiau* named by Thomas Kahulumu; not visited; also, a cave (Reinecke 1930:3:12)
Pāo‘umi (Poumi)	*Heiau*		Possibly an agricultural *heiau* built by ‘Umi; also called Poumi (Thrum 1907a:45; Stokes and Dye 1991:80; Reinecke 1930:3:11)
Pu‘u o Kikone	*Heiau*	Hill of Kikone (Soehren 2011)	“There is also a *heiau* far *mauka* of the road, named Puuokikone . . . ” (Reinecke 1930:3:12)

Place Name	Type	Meaning (Source)	Description (Source)
Inland Places			***Mauka* of Ali‘i Drive**
Halelā‘au	Cave	House of wood (Soehren 2011)	“Site j . . . About 125 feet due north of [Hale laau *heiau*] is a cave . . . used in time of war and also as a burial cave . . . The entrance was used by the women for pounding *kapa*. There is a beach boulder here, the *ku‘ula* of the cave” (Reinecke 1930:3:12).
Kahinihini‘ula	Boundary point; *pōhaku* (stone)	The red moss (Soehren 2011)	“At the *mauk*a Government road where there are two *ahua pohaku*” (Boundary Commission 1864-1935:1:318); “Large *ahu* 15 feet high and 12 feet in diameter” (Bishop Estate n.d.); elevation about 1,270 ft on south boundary Kahalu‘u, 900 ft above Māmalahoa Hwy
Kalalahua	Boundary point		“Kalalahua, an *‘ōhi‘a akua* (an *‘ōhi‘a* deity) in the woods” on south boundary Kahalu‘u between Māmalahoa Hwy and Kalaeohi (Boundary Commission 1864–1935:1:322)
Kuakini Wall			Wall inland of Ali‘i Drive, named between 1850-1892 for Kuakini, governor of Hawai‘i, who probably ordered its construction (Kelly and Barrere 1980:20)
Kumumāmaki	Water hole	Trunk of the *māmaki* tree (Soehren 2011)	Bishop Estate Map No. 554, at an elevation of 1775 ft
Kuohae	Boundary point		“Near *kukui* trees (a grove called Kuohae)” on south boundary Kahalu‘u between Kaioena and Mahina-o-Kiwalao (Boundary Commission 1864–1935:1:321)
Lauhue	Water hole	A variety of poisonous gourd (Soehren 2011)	On Bishop Estate map No. 554, elevation 1,740 ft
Nohoanapalena	Cave		“Site k . . . The cave’s mouth is now walled up. It was visited, but not the *heiau*” (Reinecke 1930:3:12).

Place Name	Type	Meaning (Source)	Description (Source)
‘Ōhi‘a	Cave	*‘Ōhi‘a* tree (Pukui et al. 1974:140)	“Site c . . . has many ramifications, some of them unexplored; was used as a refuge and place of ambush in times of war, and of burial in times of peace; is said to connect with the cave near Ohiamukumuku *heiau* on the one hand, and with the cave *mauka* in which Keanalele *heiau* is built, on the other” (Reinecke 1930:3:11).
Pa‘ahao	Water hole	Prisoner (Soehren 2011; Thrum 1922:663)	“A waterhole in the woods” on south boundary Kahalu‘u between Kaleohi and Ka‘e‘amai‘a (Boundary Commission 1864–1935:1:322, 323)
Pa‘apa‘alani	Boundary point		*Ka ‘e‘a mai‘a* [mountain banana patch] “called Paapaalani where banana trees used to grow in great numbers, aa on South side of this place is on Keauhou”; on south boundary Kahalu‘u between Pa‘ahao and Pu‘u Kanoa (Boundary Commission 1864–1935:1:322)
Pulepule	Water cave		On Bishop Estate Map No. 554, elevation 1,900 ft
Pupuawai	Water hole		Location uncertain; mentioned in Boundary Commission 1864–1935:1:322
Pu‘u Kanoa	Boundary point	Bowl hill (Soehren 2011)	“In the *koa* woods . . . At Puu Kanoa the boundary runs out of the woods. Wall’s house is on Kaumalumalu”; perhaps same as Kanoa on south boundary Kahalu‘u above Pa‘apa‘alani (Boundary Commission 1864–1935:1:322)
Pu‘u o Kukae	Hill	Hill of excrement (Soehren 2011)	“Site 154 . . . a slight elevation known as Puu o Kukae, near which there is an entrance to a cave used recently as a burial cave by Kahaluu residents and therefore not shown me” (Reinecke 1930:4:14)
Waiapaoa	Water hole		On Bishop Estate Map No. 554, elevation 1,710 ft
Waohale	Water hole		On Bishop Estate Map No. 554, elevation 1,650 ft

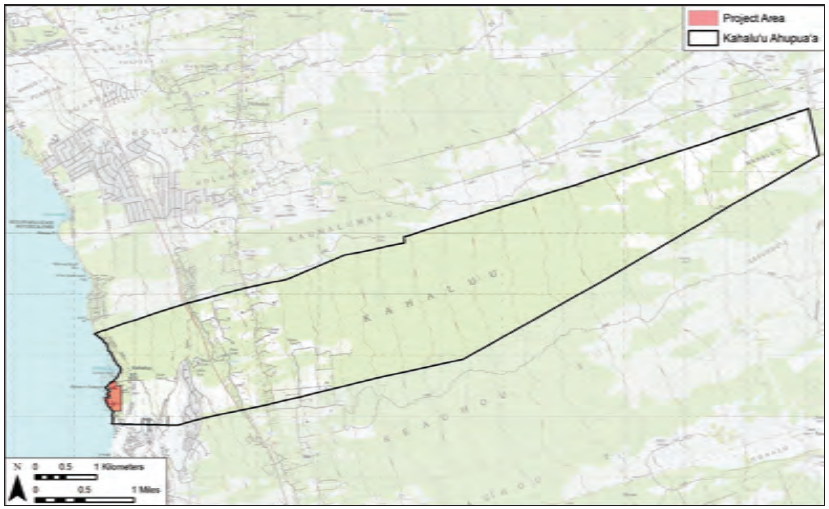


Figure 9. Portion of 1996 Kealakekua and Puu Lehua UUSGS 7.5-Minute Topographic Quadrangles, showing the location of the project area along the coast of Kahalu‘u Ahupua‘a

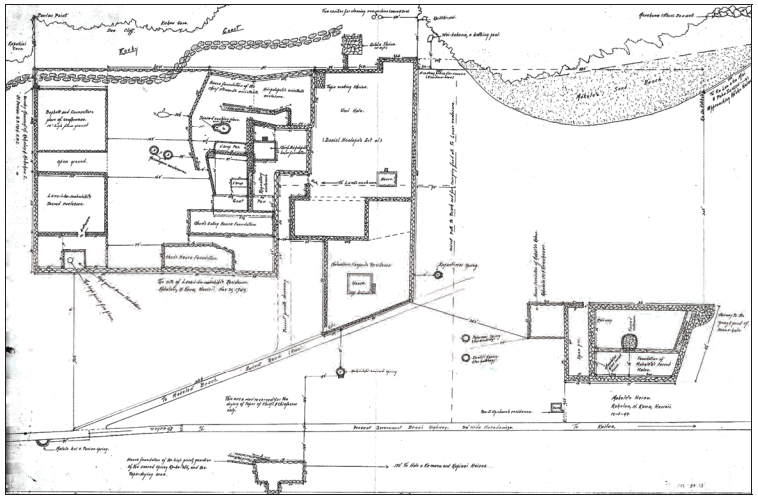


Figure 10. 1949 sketch of Kahalu‘u by Henry Kekahuna of the area from Kapukini Cove to Mākole‘ā Sand Beach, depicting the residence of Lono-i-ka-makahiki and Mākole‘ā Heiau

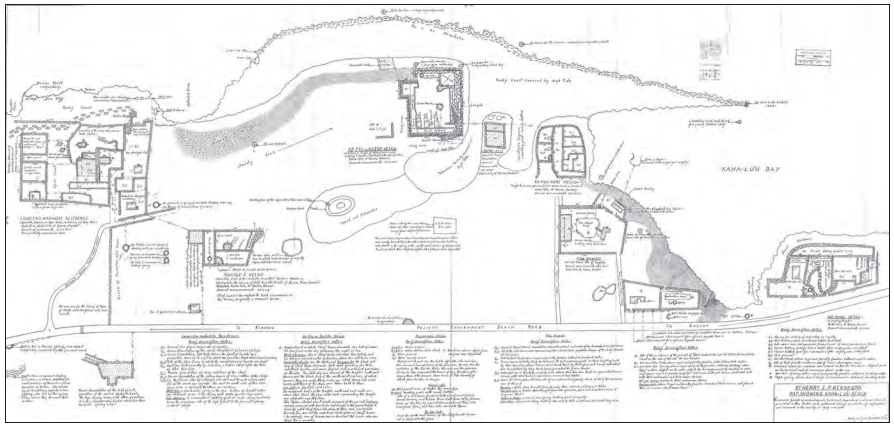


Figure 11. 1952 sketch by Henry Kekahuna of Kahalu'u Beach, showing some of the place names within the project area (portions of this sketch detailed in following sections)

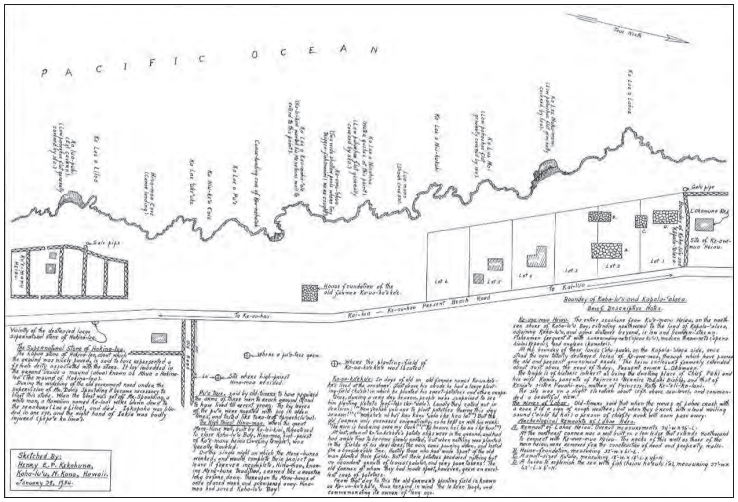


Figure 12. 1954 sketch by Henry Kekahuna of Ku'e Manu, Keowemua and Lahae Heiau in Kahalu'u, located near the Kahalu'u and Kapala'alaea boundary, showing other place names of Kahalu'u

3.2 Mo‘olelo

3.2.1 Pāokamenehune

The Menehune breakwall, or Pāokamenehune, is a topic of the traditional *mo‘olelo* (stories, tales, legends) of Kahalu‘u. It is said that this wall, which was constructed in the surf to create a fishpond, was built by the *menehune* (a legendary race of small people who worked at night) in the course of one night (Clark 2002:282). However, during the construction a rooster crowed before dawn, causing the *menehune* to abandon the site.

According to notes written by Henry Kekahuna on a 1954 sketch of Kahalu‘u (see Figure 12), the crowing rooster was actually the high priest Hino-Moo of the surfing temple Ku‘emanu (also written Ku‘e Manu), who was troubled at the prospect of the wall completely enclosing Kahalu‘u Bay. In these notes, Kekahuna attributes the construction of the wall to Kaleikini. The Pāokamenehune is depicted on Figure 11 and Figure 13.

3.2.2 Famous Sharks of Kahalu‘u

Reinecke (1930:2) wrote of the *mo‘olelo* of the famous sharks of Kahalu‘u. The people of Kahalu‘u would make offerings to the king sharks Kehau and Laenui, who controlled the lesser sharks to ensure no men were attacked. This *kapu* (taboo) did not extend to the waters of neighboring *ahupua‘a*.

A 1952 sketch by Henry Kekahuna of Kahalu‘u Beach (see Figure 11) depicts the “Ka-lua-o-ke-lii cavern—named for a legendary skark,” located just off Pāokamenehune north of Hāpaiali‘i Heiau. Reinecke (1930:2) identified this legendary shark as “the king shark Moanaliha,” noting that the feature was an offering place.

3.2.3 Twin Mo‘o Sisters of Keawehala Pond

Kekahuna’s 1952 sketch (see Figure 11) also identifies Keawehala Pond (SIHP # -Ha-D4-52) as the home of the “supernatural twin *mo‘o* [reptile] sisters”. His sketch (which labels the pond as “Keawahala”) indicates the sisters lived alongside an island situated near the center of the pond, and that the pond was fed with seawater at high tide. Kekahuna (1952) gives the following description of the *mo‘o*:

> The mo‘o twins, supernatural born (hanau ‘e‘epa‘ai) were sisters, one sandy-haired (‘ehu), the other dark-haired (lauoha ‘ele ‘ele), who dwelt in the spring in the south-west corner of Keawe-hala Pond, in which their deified reptile-like fetuses were deposited. [Kekahuna 1952]

Kehahuna also notes a homesite “of the care-takers (kahu)” of the sisters, corresponding to LCA 5966, located north of the pond (see Figure 11 and Figure 13).

3.2.4 “Kaao Hooniua Puuwai no Ka-Miki”

Throughout various piblications, cultural historian Kepā Maly has translated portions of the “Kaao Hooniua Puuwai no Ka-Miki” (“The Heart stirring Story of Ka-Miki”) that appeared in

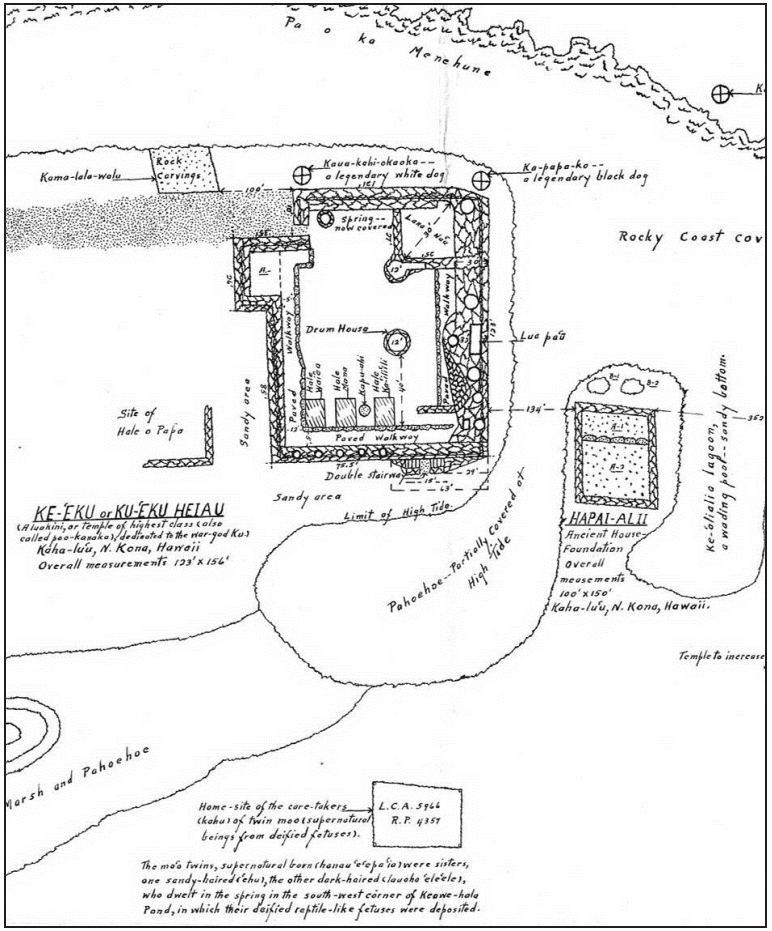


Figure 13. Portion of 1952 sketch by Henry Kekahuna of Kahalu‘u Beach, showing Hāpaiali‘i Heiau, Ke‘ekū Heiau, Pāokamenehune, Ke‘alialia Lagoon, a portion of Keawehala Pond, and other significant cultural sites

the newspaper *Ka Hoku o Hawai‘i* between 1914 and 1917. Along with his wife Onaona Maly, Maly (2012:31) writes, “While ‘Ka-Miki’ is not an ancient account, the authors used a mixture of local traditions, tales, and family histories in association with place names to tie together fragments of site specific histories that had been handed down over the generations.” The legend provides details about life and the environment of Kona as well as for the entire island of Hawai‘i.

Ka-Miki, the quick or adept one, and his brother Maka‘iole (“rat or squinting eyes”), traveled around the island to participate in competitions ca. the thirteenth century when Pili-a-Ka‘aiea was the chief of Kona. The boys’ parents were Pōhaku-o-Kāne (male) and Kapa‘ihilani (female), the *ali‘i* of Kaloko and Kohanaiki. The legend relates that the supernatural brothers “were empowered by their ancestress Ka-uluhe-nui-hihi-kolo-i-uka (the great entangled growth of *uluhe* fern which spreads across the uplands) who was one of the myriad of body forms of the goddess Haumea, the earth-mother, creative force of nature who was also called Papa or Hina” (Maly and Maly 2012:32). The twins were raised by Ka-uluhe, who taught them how to use their supernatural powers. Portions of the legend contain place names relevant to Kahalu’u and the project area:

> The village with the walled pond and grove of hau and coconut trees was **Kahalu‘u**, and Kahalu‘u-kai-ākea was the chief who controlled the ahupua‘a which bears his name.
>
> He was the father of the beautiful, glowing-skinned chiefess, **Mākole‘ā**. The beauty of Kahalu‘u is described with the saying ‘Kahalu‘u ua ‘āina ala i ka wai puka iki o Helani’ (Kahalu‘u is the land [known for] the small rising waters of **Helani**.)
>
> At Kahalu‘u, **Hale‘ōpele** was the *āhua* (hillock-agricultural feature) covered with coconut trees. . . [translation in Maly and Maly 2012:32]

According to Maly and Maly (2012):

> Departing from Kalama‘ula, Ka-Miki and Maka-‘iole set out on their quest around the island of Hawai‘i, to challenge disreputable *‘ōlohe* [experts skilled in fighting or in other competitions, such as running, fishing, debating, or solving riddles practiced by the ancient Hawaiians] and priests whose dishonorable conduct offended the gods of ancient Hawai‘i. The journey took the brothers first through the lands of Kona—*O Kona i ka pohu nā‘ū ke keiki e kāohi ala i ke kūkuna o ka lā, O Kona ia!* (Kona in the calm where children take in their breath and then chant, claiming the rays of the sun as their own. Indeed it is Kona!). Their path took them to the *kahua* (contest arena) at Kāulaokalani (Hōlualoa), where they met with the representatives of the chief Kahalu‘u-kaiākea; and then traveled on to meet the priest Keahiolo, for whom the heiau near the Kahalu‘u-Keauhou 1st boundary, is named. [Maly and Maly 2012:33]

The Ka-Miki narrative names Halekumukalani as the *ilāmuku* (contest official) of the competitions at Kāulaokalani and “the general-counselor for the chief Kahalu‘u-kai-ākea and his daughter Mākole‘ā—the heiau Halekumukalani in Kahalu‘u was named for this ilāmuku of

Kahalu‘u” (translation in Maly and Maly 2012:33). Upon Ka-Miki’s defeat of the warrior Pālau‘eka at Kāulaokalani, the brothers traveled south:

> . . . and arrived next at the compound of Keahiolo, situated near the boundary of **Kahalu‘u** and **Keauhou**. Keahiolo was a ‘*kahuna nui kēia a he kaulana pa‘a ‘āina*’ (high priest and one who secured, or maintained peace upon the land) who served under the chief Pōhaku-nui-o-Kāne, who governed the lands between Keauhou and Mā‘ihi.
>
> This powerful priest was jealous of the abilities of Ka-Miki and Maka-‘iole, and he sought to kill them. Keahiolo called the brothers to share *‘awa* (kava, *Piper methysticum*) with him, at the same time he picked up his *pīkoi* (tripping club) which he had hidden in a mat, and prepared to attack them (June 25, 1914).
>
> Ka-Miki knew the nature of **Keahiolo**, and Ka-Miki used the *‘olohū* (an *‘ulu maika* tripping stone) called Ka‘akuamā‘ihi to strike at the feet of Keahiolo, and thus defeated the *‘ōlohe* priest. Keahiolo apologized for his deception, but Ka-Miki told him there was no value in his repentance, as it was made in fear of his death. . .
>
> Maka-‘iole took compassion and chanted to Ka-Miki asking him to spare the priest. Ka-Miki agreed, Keahiolo repented and prepared *‘awa* and a feast for Ka-Miki *mā*. The heiau near the Keauhou-Kahalu‘u boundary was named for the priest Keahiolo.
>
> Keahiolo then took Ka-Miki (Nana-i-ke-kihi-o-Kamalama) and Maka-‘iole (Kahuelo-kui-ke-kihi-o-Kā‘elo) to the *kahua* of **Kahō‘e‘e** (at Keauhou 2nd) where contests were to occur [translation in Maly and Maly 2012:34].

Here Ka-Miki undertook several rounds of fighting with Haumanomano and ‘Ōhi‘amukumuku. According to the tale, “‘Ōhi‘amukumuku was a ‘ōlohe pūkani pa‘a ‘āina for the chief Pōhakunuiokāne, the heiau by the name of ‘Ōhi‘amukumuku [in Kahalu‘u] was named for this famous warrior” (translation in Maly and Maly 2012:35). During these contests, the brothers called upon their supernatural skills and emerged victorious once more, resuming their travels.

3.3 Early Pre-Contact History

Kahalu‘u is known to have been a royal center and numerous *heiau* have been documented in the coastal portions of this *ahupua‘a*. It is generally agreed that the Kona region was initially settled sometime after AD 900 with habitation around Kahulu‘u Bay; by AD 1300 some of the upland areas had been cultivated, representing the beginnings of the Kona Field System. During the fourteenth through sixteenth centuries, settlements and the Kona Field System expanded inland. Between the sixteenth and eighteenth centuries, the Kona area became an important political center.

3.3.1 The Beginning of Settlement: Pre-AD 1000 to the 1300s

Based on radiocarbon data, Burtchard et al. (1996:54) suggest the earliest settlement in Kona began around AD 900. Early settlement is suggested to be marine resource-oriented, with habitation in Kahalu’u probably focused around Kahalu‘u Bay. Kin-based social and economic ties linked coastal areas in the vicinities of the bay. By AD 1300, upland areas at least 4,000 ft. inland were cultivated; Burtchard et al. (1996:83) cites a calibrated date of AD 1350 from a midden next to a habitation platform in nearby Keauhou *mauka* (inland, upland). This pattern is suggested to be the origin of the Kona Field System, which developed from lower elevations farther inland after this time (Tuggle 1989:18).

The general settlement pattern associated with the Kona Field System, based on ethnographic, ethno-historic, and archaeological sources, includes three main zones: coastal, intermediate, and upland. The Kona Field System has been further broken down into four sub-zones based on agricultural production. The four sub-zones and their correlations to the coastal, intermediate, and upland zones (Kelly 1983) are as follows:

Sub-Zone	AMSL	Zone
Kula	0–500 ft (0–152.4 m)	Coastal and portion of Intermediate
Kalu‘ulu	500–1,000 ft (152.4–304.8 m)	Intermediate
‘Āpa‘a	1,000–2,500 ft (304.8–762 m)	Upland
‘Ama‘u	2,500–4,000 ft (762–1,219.2 m)	Portion of Upland

The Coastal Zone can be characterized as a relatively narrow strip of land along the coast that had the highest concentrations of habitation and religious sites. The Intermediate Zone had agricultural features, temporary habitation sites, and some dispersed permanent habitation sites. The Upland Zone, like the Intermediate Zone, contained widespread evidence of agriculture and temporary and permanent habitations, but at the upper end there existed the *wao* or upland forest. Beyond the upland forest was the Saddle Region where habitation, mostly temporary, was focused in lava tubes, with the main human activity being bird hunting. The current project area is within the lower portion (sea level) of the *Kula* (coastal) Zone, the prime coastal habitation and religious zone.

3.3.2 Settlement Expansion: the Fourtheenth to Sixteenth Centuries

Initial development of the complex chiefdoms and social organization recorded at Western Contact began in this period. Genealogical traditions for the Kona coast are firm from the time of Līloa, the senior dynastic ruler of Hawai‘i Island, who, by genealogical count of 25 years to a generation, lived in the latter part of the fifteenth century (Emory et al. 1971:1). During his reign, the chiefs of the apparently already established district chiefdoms of Hilo, Puna, Kona, Ka‘ū and Kohala acknowledged Līloa as their superior chief. Each, including ‘Ehukaimalino (‘Ehu-kai-malino) ruling chief of Kona, sent a son to Līloa’s court at Waipi‘o, Hāmākua, his patrimonial chiefdom (Kamakau 1992:1-2). At this point in Hawai‘i Island’s history, ‘Ehukaimalino (or ‘Ehu) was second only to Līloa in seniority of descent from their common ancestor Pili, the chief brought from Tahiti in the thirteenth century to restore chiefly blood strains on Hawai‘i (Malo 1951:6).

Settlements and the Kona Field System expanded inland. Due to increased population and developing chiefdoms, intensification of zonal utilization occurred (Tomonari-Tuggle 1985:15-19). Expansion and intensification of agriculture into higher elevations and more formal fields was also taking place in response to population growth and a shift of political power to the Kona Region (Tomonari-Tuggle 1985:15-19). Additionally, evidence of the intensification includes the construction of large *heiau* complexes along the coast. Although it was built within the saddle region, one example of such a complex is Ahu-a-‘Umi, constructed around AD 1550.

According to information given to John F.G. Stokes in 1906 by a local informant named Malanui, the *heiau* of Hāpaiali‘i (SIHP # -3817; see Section 4.3 and Appendix B), located within the project area, was built by a *kahuna* (priest) named Ma‘a during this period (later than the time of Pa‘ao [thirteenth century] but earlier than that of Lono [sixteenth century]; Stokes and Dye 1991:73). Kekahuna delineated this *heiau* on his 1952 map (see Figure 11 and Figure 13) and noted that it was the “. . . site of a residence, formerly with an adjacent family shrine.” He repeated Stokes’ attribution of its building to Ma‘a. According to Ross Cordy (1986b:5), T.G. Thrum’s contention that this *heiau* was used for human sacrifices contradicts other oral information gathered on *heiau* of Kahalu‘u. Cordy (1986b), in assessing the role of Hāpaiali‘i Heiau as related in early histories and by native informants, indicates this *heiau* was probably used not as a *luakini* (human sacrificial *heiau*) or *pu‘uhonua* (place of refuge) but for “other important [unidentified] functions,” and that it was built sometime between AD 1200-1400.

Mākole‘ā Heiau was also probably constructed during this period, though most historical references mention it in relation to Lono-i-ka-makahiki (see Section 3.3.3). According to Kekahuna and Kelsey (14 March 1954), Mākole‘ā Heiau (SIHP # -3819; see Section 4.3 and Appendix B) “was once the dwelling place of Makole-‘a, a most beautiful chiefess of great fame” (see Section 3.2.4). Reinecke (1930:6) identified this *heiau* as “Keekuapuaa . . . known as . . . Makolea, a beautiful chiefess, daughter of Keolonahihi and Kahaluu.” Kekahuna (1952) noted this chiefess as the “. . . radiantly beautiful Makole-‘a . . . spouse of Chief Ke-paka-‘ili-‘ula” whose dwelling place was this *heiau* (see Figure 11 and Figure 14). A chiefess by the name Mākole‘ā appears in the “Legend of Kepakailiula” (Ke-paka-‘ili-‘ula) as the daughter of “Kahalu‘u” and “Keauhou” (Fornander 1917:IV:2:500), but there was no connection between her and any *heiau* in that legend. She was represented in the story as a wife of both Kepaka‘ili‘ula of Puna and of Kaka‘alaneo, “king of Maui” (Fornander 1919:IV:500). The latter name appears in genealogies as a contemporary of the fifteenth century Kona chief ‘Ehu (Fornander 1880:82).

3.3.3 The Time of ‘Umi-A-Līloa and Lono-i-ka-makahiki or the Late Traditional Period: Late Sixteenth to Eighteenth Centuries

This period marks the time of the first specific legendary information concerning Kahalu‘u, which saw a series of successive wars directed toward the expansion of political boundaries through force that extends into the time of initial European Contact (Tomonari-Tuggle 1990:7).

After Līloa’s death, his oldest son Hākau was acknowledged as the superior chief over all Hawai‘i. When he was slain and his rule was usurped by his half-brother ‘Umi-a-Līloa, Līloa’s

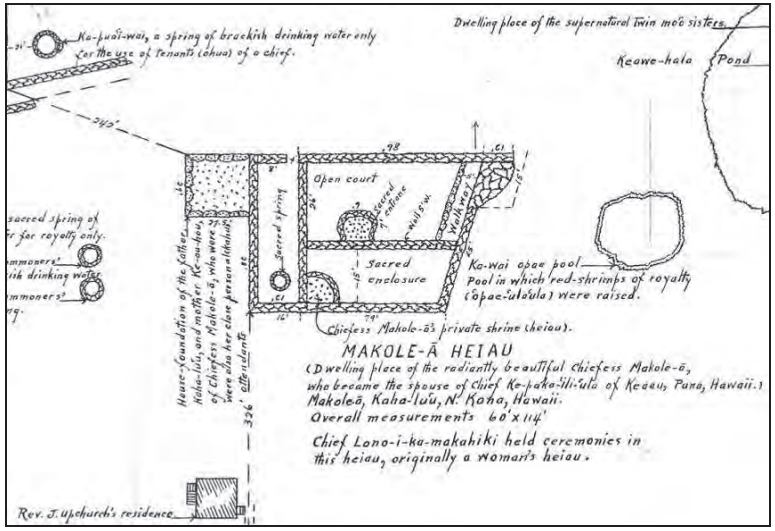


Figure 14. Portion of 1952 sketch by Henry Kekahuna of Kahaluʻu Beach, showing Mākoleʻā Heiau and other significant cultural features

second son, the district chiefs recalled their sons from the court at Waipiʻo and declared themselves independent (Kamakau 1992:14). ʻUmi-a-Līloa then proceeded to war against each of these chiefdoms, succeeded in subjugating each and united the island once more into one kingdom (Kamakau 1992:16-19). Tradition holds that ʻUmi-a-Līloa moved his court to Kona, stopping for a time at the Ahu-a-ʻUmi in the uplands of Keauhou 2 (Baker 1917:63; see also Fornander 1917:IV:2: 232). While ʻUmi-a-Līloa's place of residence in Kona is usually tied to the Kailua area, Pā-o-ʻUmi (SIHP # -3823), reportedly a *heiau hoʻouluulu ʻai* (a temple dedicated to the abundance of agricultural crops), was built by ʻUmi-a-Līloa above Kahaluʻu Village (Maly and Maly 2004:8; Stokes and Dye 1991:80-81).

Tomonari-Tuggle (1985) suggests the creation of refuge-type openings at major lava tubes, like ʻŌhiʻa Cave in Kahaluʻu, was undertaken for purposes of concealment during the wars and political instability of this period. Habitation, particularly high-status habitation, appears to have focused on the lands back of Kahaluʻu Bay, where they could take advantage of the amenities of extensive inshore reefs and the proximity of brackish or freshwater ponds. Other habitation areas extended to the south, to Heʻeia and Keauhou Bays, and were scattered among the agricultural fields.

The ruling chief Lono-i-ka-makahiki (or Lono), a grandson of ʻUmi-a-Līloa, is said to have resided in coastal Kahaluʻu Ahupuaʻa at an impressive high-walled complex (the Lono-i-ka-makahiki Residence; Fornander 1917:IV:2: 356). There is a brief mention of Kahaluʻu in the stories concerning Lono. During his reign, Kamalalawalu, the chief of Maui, decided to make war on the chiefs of Hawaiʻi. Kamalalawalu sent out spies to count the number of people in the coastal villages of the district of Kona. One of these spies was a man named Kauhiokalani, a swift runner, who ran from Kawaihae in South Kohala all the way to Kaʻawaloa, an *ahupuaʻa* in South Kona. He described the areas that he traveled through, including the coconut groves of Hōlualoa and Kahaluʻu (Kamakau 1992:56). The historian John Papa ʻĪʻī describes how some of these groves were reserved for the *aliʻi* of Oʻahu:

> Before the king and chiefs went to Kahaluʻu for the Makahiki, were seen some strange coconut trees in the midst of a coconut grove. The leaves of some of them had been bent over the dried nuts and plaited from the base of the leaf to the trunk, thereby holding up the nuts. This was truly an uncommon procedure and one not seen by Iʻi anywhere else. We were told that no one was allowed to take the dried coconuts. All the chiefs who own groves were on Oʻahu, and perhaps that was why the caretakers of the land protected each chief's grove. Not long afterwards, when the people who were to consume the nuts returned, such bound-up trees were seen no more. [ʻĪʻī 1959:113]

When Kamalalawalu heard the report from his spies that "there were many houses, but few men," he was eager to stir his chiefs, his sons, and warriors to make war on Hawaiʻi (Kamakau 1992:56-57). Kamalalawalu and his army landed in Kohala and moved south to Kawaihae, but found no one there as the people were gathered in Waimea for "services at the heiau of Mailekini" (Kamakau 1992:58). Two old men of Kawaihae falsely advised Kamalalawalu to dismantle his canoes and take his army to the Puʻoaʻoaka battlefield in Waimea, knowing that the advantage would lie with the warriors of Hawaiʻi Island. Indeed, Kamalalawalu was killed and his army defeated on the grassy plain of Puakō (Kamakau 1992:60).

The details regarding the death of Kamalalawalu as recounted in the earliest recorded traditions (e.g., Kamakau and/or Fornander) are contradicted by later accounts asserting that upon his defeat, Kamalalawalu was brought to Kahaluʻu and sacrificed at either the *luakini* of ʻŌhiʻamukumuku or Keʻekū. While Kamakau and Fornander do not specifically mention this sacrifice, they do they generally recognize these *heiau* as *luakini*.

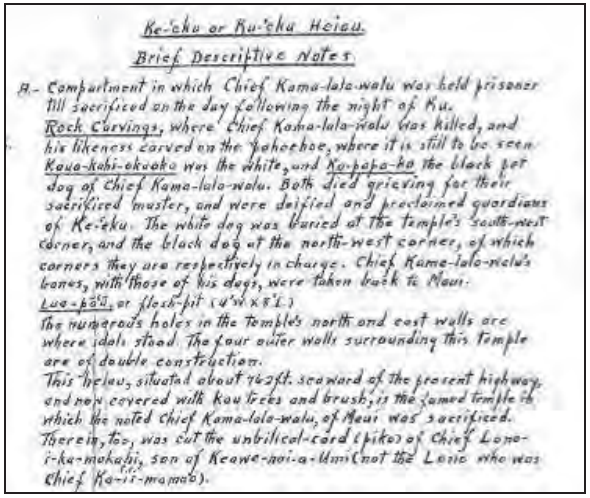
Thrum was given information that the Maui king was sacrificed at ʻŌhiʻamukumuku Heiau, "one of the early heiau's of the district (traditionally said to have been built by the gods not by the people) . . . " (Emory et al. 1971:4; Thrum 1907b:71). Stokes' informant Malanui, a grandson of the last priest of nearby Kapuanoni Heiau, placed the sacrifice of Kamalalawalu at Keʻekū Heiau (SIHP # -3818; see Section 4.3), which is located in the project area (Stokes and Dye 1991:77). Kekahuna and Kelsey (17 March 1954) combined these traditions, writing that on ʻŌhiʻamukumuku Heiau ". . . the body of King Kama-lala-walu, of Maui, was ceremoniously displayed, following his sacrifice by King Lono-ika-makahiki in the noted Keʻeku Heiau down on the shore." Reinecke's (1930:6) informant Kahulamu told him that "Kamalalawalu was impaled for ten or eleven days on the beach by Keeku, and then, as he still lingered, slain, and his body towed out for the Niuhi sharks." The 1952 Kekahuna map bears a notation indicating

the “Compartment in which Chief Kama-lala-walu was held prisoner till sacrificed on the day following the night of Kū (see Figure 11 and Figure 15). Thrum (1907b:71) mentions that Kamalalawalu’s two dogs, Kapapako (black dog) and Kauakahiokaoka (white dog), supposedly died beside the walls of Ke‘ekū and were buried there. Kekahuna’s 1952 map (see Figure 11 and Figure 15) includes the names of these dogs, indicating that “they were deified and proclaimed guardians of Ke-‘eku; the white dog was buried at the temple’s south-west corner, and the black dog at the north-west corner, of which corners they are respectively in charge.” This map also indicates that at some point the bones of Kamalalawalu and his dogs were taken back to Maui (Kekahuna 1952; see Table 1, Figure 11, and Figure 15). Southwest of Ke‘ekū on a *pāhoehoe* flat in the tidal zone is a field of petroglyphs (“Ke‘ekū Petroglyphs,” SIHP # -12954). On his 1952 map (see Figure 11 and Figure 15), Kekahuna indicates these petroglyphs marked the location where Kamalalawalu was killed, and one of the glyphs is believed to represent Kamalalawalu himself (see also Stokes and Dye 1991:77, 79; Section 4.2.1). Stokes was also given the information that Ke‘ekū served as a *pu‘uhonua*, presumably some time after Kamalalawalu’s invasion and defeat (Stokes and Dye 1991:77).

Thrum (1908a, b; 1938) described Kapuanoni Heiau (SIHP # -10997; see Section 4.3), also located in the present project area, as an “ancient *luakini* and *puuhonua*” built during the reign of Lono. This assessment was disputed by Stokes’ informant Malanui, who attested that Ke‘ekū and ‘Ōhi‘amukumuku were the only *luakini* in the area, and that Kapuanoni was used generally for prayer (Stokes and Dye 1991:70, 71, 77). Furthemore, Stokes attributed the construction of Kapuanoni to Kalani‘ōpu‘u (Stokes and Dye 1991:71). Reineke was informed that this *heiau* was once the residence of Alapa‘inui, a ruler in the mid-1700’s (Reinecke in Walker and Rosendahl 1989:10). Around 1950, Kekahuna was informed by Naluahine Kaopua that this *heiau* was used “to increase food and fish” (see Figure 11 and Figure 16). Based on the various historical references to this *heiau* and its relationship to others nearby, Cordy (1986a) concluded that it is likely that Kapuanoni was used for worship in relation to farming and fishing (see Walker and Rosendahl 1989:10).

According to Fornander (1880:122), Lono went around the island “. . . consecrating [existing] heiaus as acknowledgment to the gods for his victories.” One of these *heiau* was Mākole‘ā (Fornander 1917:IV:2:330). Thrum (1907b:71) and Stokes (Stoke and Dye 1991:80) mention Mākole‘ā Heiau only in connection with Lono. Kekahuna’s 1952 sketch (see Figure 14) notes that “Chief Lonoikamakahiki held ceremonies in the [Mākole‘ā] heiau, formerly a women’s heiau” (see Section 3.3.2). Lono is also said to have built Keahiolo Heiau (also called Ka‘io‘ena, SIHP # -4621), situated on the boundary of Kahalu‘u and Keauhou 1st (cf. Fornander 1969, Stokes and Dye 1991, and Reinecke 1930). More information about the *heiau* within in the project area is given in Section 4.3.

In the “The Story of Lonoikamakahiki,” (Fornander 1917:IV:2:356), Lono was said to have lived at Kahalu‘u after his travels and wars were through. The connection of Lono with the *heiau* of Ke‘ekū may have led to the designation of a nearby dwelling site as the “Lonoikamakahiki Residence” (SIHP # -1576, also referred to as Kapukini or Paniau Heiau). Henry Kekahuna labeled this feature as such on his 1949 and 1952 sketches (see Figure 10, Figure 11, and Figure 17), although he later placed its construction with ‘Umi-a-Līloa (Kekahuna and Kelsey 1954).


Ke-'eku or Ku-'eku Heiau.

Brief Descriptive Notes.

A.- Compartment in which Chief Kama-lala-walu was held prisoner till sacrificed on the day following the night of Ku.
Rock Carvings, where Chief Kama-lala-walu was killed, and his likeness carved on the pahoehoe, where it is still to be seen.
Kaua-kahi-ekaoka was the white, and Ka-papa-ko the black pet dog of Chief Kama-lala-walu. Both died grieving for their sacrificed master, and were deified and proclaimed guardians of Ke-'eku. The white dog was buried at the temple's south-west corner, and the black dog at the north-west corner, of which corners they are respectively in charge. Chief Kama-lala-walu's bones, with those of his dogs, were taken back to Maui.
Lua-pōū, or flesh-pit (4'W x 8'L)
The numerous holes in the Temple's north and east walls are where idols stood. The four outer walls surrounding this Temple are of double construction.
This heiau, situated about 762 ft. seaward of the present highway, and now covered with kau trees and brush, is the famed temple in which the noted Chief Kama-lala-walu, of Maui was sacrificed.
Therein, too, was cut the unbilical-cord (piko) of Chief Lono-i-ka-mokahi, son of Keawe-noi-a-Umi (not the Lono who was Chief Ka-ii-mamao).

Figure 15. Portion of the 1952 sketch by Henry Kekahuna of Kahalu‘u Beach, showing the handwritten notations about Ke‘ekū Heiau and the nearby petroglyphs

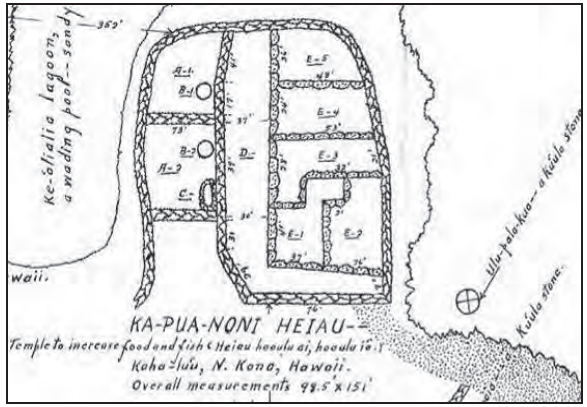


Figure 16. Portion of 1952 sketch by Henry Kekahuna of Kahalu‘u Beach, showing Kapuanoni Heiau and other significant cultural sites

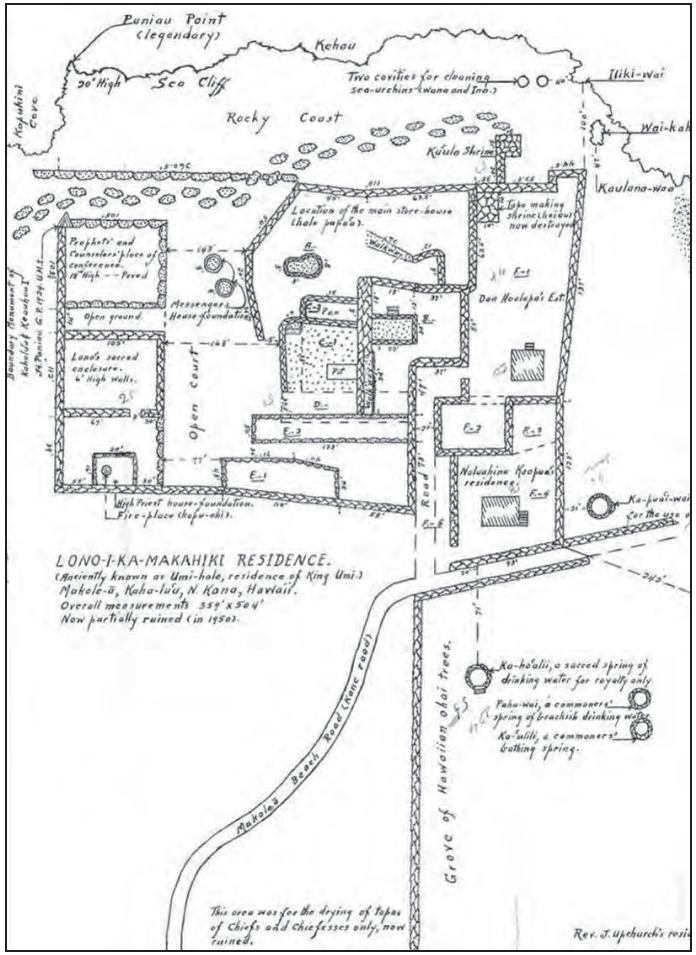


Figure 17. Portion of 1952 sketch by Henry Kekahuna of Kahalu‘u Beach, showing the Lono-i-ka-makahiki Residence, the Kahoali‘i, Kapua‘iwai, Ka‘ulili and Pahuwai springs, and other cultural features

3.4 The Late Pre-Contact and Early Contact Period

3.4.1 The Time of Kalani‘ōpu‘u and Kamehameha I: Eighteenth Century to the Early 1800s

When Captain Cook died in 1779, it is said that the ruling chief Kalani‘ōpu‘u resided for some time around Kahalu‘u and Keauhou, occupying his time with *hula* (dance) and surfing (Kamakau 1992:105).

After a defeat on Maui, Kalani‘ōpu‘u spent a year preparing another army and building “houses for his war god Ka‘ili, ‘Ohi‘amukumuku at Kahaluu, and Keiki-pu‘i-pu‘i at Kailua as heiaus against sedition and for vengeance upon the chief of Maui” (Kamakau 1992:85). Fornander (1880:151-152) said that Kalani‘ōpu‘u “. . . repaired and put in good order” these two *heiau*, implying that they were already in existence. This may have also been the reason Kapuanoni was attributed to Kalani‘ōpu‘u by Stokes’ informant (see Section 3.3.3). According to Kekahuna and Kelsey (1954), in modern times the stones of ‘Ōhi‘amukumuku Heiau were used in building the first Helani Church; nothing remains of this structure today.

At the death of a high chief, it was the tradition to redistribute lands to the supporters of the new high chief. It was Kalani‘ōpu‘u’s wish that his son Kīwala‘ō, whose advisers were the chiefs of the Ka‘ū and Hilo Districts, would control his land, while his cousin, Kamehameha, who was allied with the Kohala and Kona District chiefs, had the care of his war god, Kūka‘ilimoku. In the redistribution, presided over by his uncle Keawema‘uhili, many of the chiefs received only the lands they had previously controlled, including Kamehameha I, who received only his original lands in Kohala. His supporters believed the six districts should have been divided equally, three districts to each Kamehameha and Kīwala‘ō. Keoua, the twin brother of Kīwala‘ō, was dismayed that neither he nor his brother received any new lands from the division by Keawema‘uhili. He questioned his brother about the lands:

> ‘Are Ola‘a and Kea‘au ours?’ The chief answered, ‘They have been given away; they are not ours.’ ‘How about Waiakea and Ponahawai?’ ‘They have been given away; they are not ours.’ . . . ‘Kahalu‘u then, and the two Keauhou?’ ‘They have been given away; they are not ours.’ ‘Then I am to have nothing in this division?’ ‘You are I are left without land in this division. Our uncle has taken it. Our old lands you will have.’ [Kamakau 1992:120]

Keoua was angry and gathered his fighting men. The next day they went to Ke‘ei and got into a quarrel with some of the men of Kamehameha’s party. They killed some of the men and took them to Kīwala‘ō who sacrificed them at his *heiau*. This action convinced Kamehameha and some of his allies to rebel. At the battle of Moku‘ohai, Kīwala‘ō was slain by Ke‘eaumoku, and Kamehameha became the ruler of Kona, Kohala, and western Hāmākua. Over the next few years, Kamehameha conquered the entire island of Hawai‘i and then united all of the Hawaiian Islands under his rule (Kamakau 1992:118-124; Cordy 2000:323-326).

Both Kalani‘ōpu‘u and Kamehameha attempted to gain the support of the deities by constructing or rededicating the many *heiau* of Kahalu‘u. It is said that after his defeat by the Maui chief Kahekili ca. 1775, Kalani‘ōpu‘u built (or rededicated) the *heiau* of ‘Ōhi‘amukumuku at Kahalu‘u and Keikipu‘ipu‘i at Kailua as *heiau* against sedition and for vengeance (Kamakau 1992:85). Kamehameha is also said to have built (or rededicated) Kamaike‘ekū and

‘Ōhi‘amukumuku Heiau (Kamakau 1992:180). ‘Ōhi‘amukumuku in particular appears to have been regarded as particularly auspicious, for upon Kamehameha’s return to Kona in 1813, “his first object was to pray to the gods and for this purpose he made *kapu* the *heiau* of Hikiau and then that of ‘Ōhi‘amukumuku at Kahalu‘u” (Kamakau 1992:200). Kamehameha and his court are said to have resided at Kahalu‘u for about a year following his return (‘Ī‘ī 1959:113).

3.4.2 *Ali‘i Nui* (High-Ranking Chiefs) at Kahalu‘u

As noted above, Lono-i-ka-makahiki, Alapa‘inui, Kalani‘ōpu’u, and Kamehameha lived in Kahalu‘u (Tuggle 1989:10). Several other high-ranking chiefs were born at Kahalu‘u. Tomonari-Tuggle (1985) suggests that the association of these *ali‘i* births with Kahalu‘u was not one of any particular auspiciousness (as in an *ali‘i* birthing place such as at Kūkaniloko, O‘ahu and Pōhaku Ho‘ohānau, Kaua‘i), but rather was the association of these lands with the ruling chief Ke‘eaumoku who was kin to these chiefs. Ke‘eaumoku played a major role in Kamehameha’s political ascent by personally killing his rivals Kīwala‘ō and Keoua (Tomonari-Tuggle 1985:23). This ruthless and independent “Kona Uncle” of Kamehameha the Great appears to have been awarded the *ahupua‘a* of Kahalu‘u and Keauhou for his services. Kalākaua (1972) writes the following:

> With the death of Kiwalao [in 1782] . . . the victory made Kamehameha master of the districts of Kona, Kohala, and Hamakua . . . Keeaumoku’s brilliant part in this first of the battles of the period for the sovereignty of Hawaii established him at once in the favor of Kamehameha, and raised him high in the esteem of the distinguished chiefs whose valor ennobled the closing years of barbaric supremacy in the group. [Kalākaua 1972:363]

The traditional site of Ke‘eaumoku’s residence, Moku-ahi-‘ole at Po‘o Hawai‘i (SIHP # -12953; see Section 4.3), is located within the project area. This site is identified as the “Ancient Home Site of Royalty” on Kekahuna’s 1952 sketch of Kahalu‘u Bay (see Figure 11 and Figure 18). It was perhaps here that Ka-lua-i-konahale Kuakini (also know as John Adams Kuakini), the long-time governor of the Island of Hawai‘i, was born. At his birth in 1791 there was a great *hula* at Kahalu‘u, attended by a female cousin of Ke‘eaumoku, to whom the child was given to suckle, and “. . . with him the land of Keauhou,” where she raised the chief (Kamakau 1992:388). Keopuolani, the sacred chiefess of Maui who became the state wife of Kamehameha, may have been living in Keauhou by then (Kamakau 1992:260). Kuakini played an important role in shaping the future of Kona, and upon his death in 1844, his body was prepared for burial on the shore of Kahalu‘u (Kekahuna and Kelsey 1954:7-8). Kamakau (1992:389, 391, 394) also wrote of the high chiefess, Kekāuluohi, who was brought up in Kahalu‘u and Keauhou by her grandparents Ke‘eaumoku and Namahana (ca. 1794-1803).

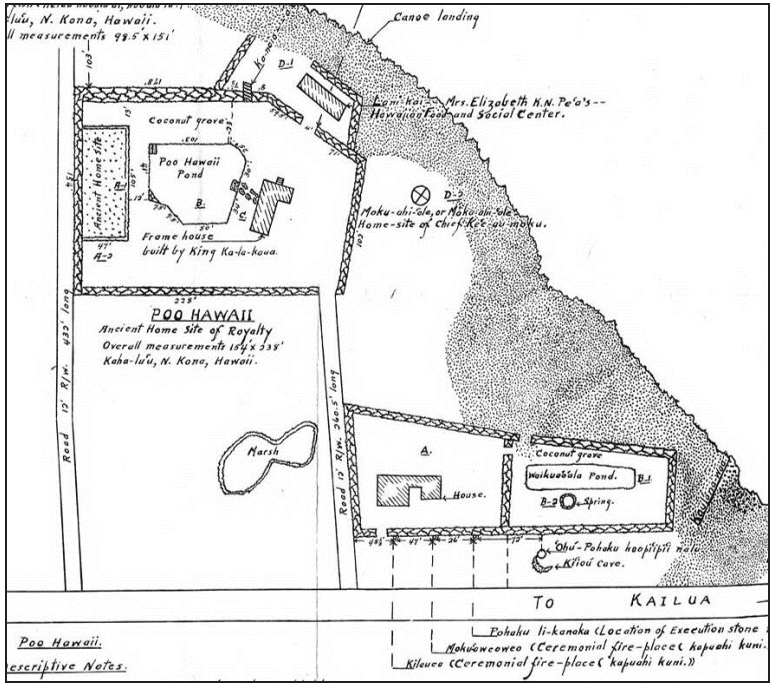


Figure 18. Portion of 1952 sketch by Henry Kekahuna of Kahalu‘u Beach, showing the site of Po‘o Hawai‘i and other associated cultural features

3.4.3 Western Contact at Kahalu‘u: 1794 to 1819

By 1794, there was a foreigner in residence at Keauhou engaged in the manufacture of charcoal to supply visiting western ships (Menzies 1920:149). While this operation played a part in keeping the port there viable, it seems probable that the population of Kahalu‘u overall declined rapidly in the early historic period. This would have been due not only to introduced diseases but also to demographic shifts to Kailua and Ka‘awaloa. With its many *heiau* suddenly abandoned, people no longer visited Kahalu‘u with their hogs and other offerings (Mann et al. 2003:9).

3.5 Western Contact: 1820s to Present

3.5.1 Merchants and Missionaries: 1820 to 1850

The departure of the center of the Hawaiian Kingdom’s government from Kona, Hawai‘i to Lahaina, Maui and Honolulu, O‘ahu in 1820 was a demographic catastrophe to places like Kahalu‘u, which must have relied at least in part on royal patronage. This loss would have been partially off-set by the continuing victualing trade with visiting foreign ships and the trade in sandalwood. Mackintosh (1838:2) wrote that the anchorage at Keauhou Bay “is resorted to by vessels for cargoes of firewood, sandalwood and other commodities of produce.” Keauhou was well-suited to funnel the bounty of the Kona Field System, which quickly included new cultigens such as coffee, melons, maize, Irish potatoes, beans and citrus, to supply shipping. Keauhou may have always been particularly well-suited geographically for the transportation of forest resources to the coast and the sandalwood of a vast interior could have been transported down through Keauhou to the waiting ship holds at Keauhou Bay.

Our first detailed glimpse of Kahalu‘u is with the missionary William Ellis of the London Missionary Society in 1823. Probably walking an alignment much like modern Ali‘i Drive, Ellis (1969:121) reported 19 *heiau* and 610 houses between Kailua and Keauhou, and eight *heiau* and 443 houses between Keauhou and Ka‘awaloa. Ellis remarked on the stepping stone trail across a mile-wide stretch of *‘a‘ā* between the Kahalu‘u and Keauhou villages. Ellis (1969:121) noted the houses of “those who live among the plantations on the sides of the hills.” Keauhou was an outlier for the Kailua Mission Station. Missionaries from the American Board of Commissioners for Foreign Missions (ABCFM) would periodically take sermonizing trips down the coast, often on their way to the Ka‘awaloa Mission. Artemis Bishop (1892:18) noted (ca. 1825) that the Hawaiian communities at Hōlualoa, Kahalu‘u, Keauhou, and Kainaliu routinely marshaled 500 or more people to meet him.

3.5.2 The Māhele ‘Āina (Land Division)

In 1845, the Board of Commissioners to Quiet Land Titles, also called the Land Commission, was established “for the investigation and final ascertainment or rejection of all claims of private individuals, whether natives or foreigners, to any landed property” (Chinen 1958:8). This led to the Māhele ‘Āina of 1848, the division of lands between the King of Hawai‘i, the *ali‘i*, and the *maka‘āinana* (common people), which introduced the concept of private property into the Hawaiian society. Previous to the Māhele, all land belonged to the *akua* (gods), held in trust for them by the paramount chief, and managed by subordinate chiefs.

Under the Māhele, Kamehameha III divided the land into four divisions: certain lands to be reserved for himself and the royal house were known as Crown Lands; lands set aside to generate revenue for the government were known as Government Lands; lands claimed by *ali‘i* and their *konohiki* were called Konohiki Lands; and habitation and agricultural plots claimed by the common people were called *kuleana* (Chinen 1958:8-15). Land Commission Awards (LCAs) for *kuleana* parcels were awarded to commoners and others who could prove residency on and use of the parcels they claimed. In theory, this “setting aside” of hundreds of thousands of acres as potential *kuleana* parcels ultimately led to about 10,000 claimants obtaining approximately

30,000 acres, while 252 chiefs, for example, divided up about a million acres. Many or most Hawaiians were simply disenfranchised by these acts.

In the division of lands, or Māhele ‘Āina, of 1848, Victoria Kamāmalu was awarded the 5,443 acres of Kahalu‘u (LCA 7713:6; Royal Patent 6856). That these lands were retained by the Kamehameha dynasty reflects their apparent value. However, the documentation of large royal land awards provides little specific land use data. It was subsequent *kuleana* award documents that offer the most detailed land use data.

There were a total of 89 *kuleana* claims by commoners in Kahalu‘u, of which 59 were awarded (Table 2). As is typically the case, the sizes of the *kuleana* LCA parcels were relatively small, ranging from 0.07 to 4.40 acres in size. Of the 56 LCA awarded in Kahalu‘u, 46 included at least one house lot near the shore; 28 of these house lots were clustered around the north end of Kahalu‘u Bay and 18 were scattered south of the bay; suggesting only ten claims in upland Kahalu‘u. Seven LCA parcels were awarded within the current project area (Table 3; Figure 19); documentation of these claims, including native testimony before the commissioners, is included in Appendix A of this report. These *kuleana* included up to 11 discrete parcels (*‘āpana*). The *kuleana* awards within the project area indicate that, at the time of the *Māhele*, habitation was the primary activity; the claims mention houses, roads and/or paths, and walls and/or fences (presumably including house site enclosures). More than one testimony mentions that the land was “idle,” and while there are claims of *kīhapai* (cultivated patches, gardens), no specific crops are named.

The locations of these LCA parcels are also shown on a map from Tuggle (1990:22), which has been overlain with the location of nineteenth century walls, as recorded by the surveyor E.D. Baldwin in 1909 (Figure 20). This graphic is useful for understanding how LCAs affected the traditional landscape of the project area, through contributing to the construction of a network of intersecting wall features, some of which remain today (see Section 4.3).

An interesting feature of the land claims is that many of the awardees did not claim possession of the land over a long period of time, and (as noted above) were up-front about the occupying families having moved onto vacant or idle land (Tomonari-Tuggle 1985:30). Archaeological evidence clearly indicates a wide belt of permanent habitation had contracted to a narrow coastal strip in the early historic period. By 1850, many of the families that once resided in Kahalu‘u had either died out or moved away. Depopulation, the collapse of the religious center, the focus of trade on Kailua and Ka‘awaloa, and the depredations of cattle, horses, and goats inland of the Kuakini wall would all have been factors underlying this demographic change (Tomonari-Tuggle 1985:30).

Table 2. LCAs in Kahalu‘u Ahupua‘a (Waihona ‘Aina 2000); Bold Entries Fall within the Project Area

LCA Number	Awardee	*‘Ili*
3440-B	Kaluahinui	Pakii 2
3441-B; 5635-H	Naaho	Makoha
3443-B; 128-C	Kuia	Koaie 3
3444-B; 130-B	Kapihe	Koaie 3
3445	Kahananui	Kihikihi
3446-B	Kahue	Kukuihae
3447-B	Palaukae	Kukuihaa 5
3455-B	Maikeiki, *wahine*	Kukuihaa 3
5632	**Keikihookama**	**Makolea, Lehuakona, Pakii 1, Ulumoe**
5635-B	Imakakoloa	
5635-E	Keomano	Kumuhawane
5635-P	Maiikeiki	Kukuihaa 3
5635-Q	Kauiaa	Pahoa 2
5642	Kokuahine	Haliipalala
5671-B	Kanehewahewa	Haliipalapala 3
5672	Kahalelahaole	Pahauopu
5673	Kamalo	Hokio 2
5673-B	Naahau	Kamuku
5673-C	Naahau	Puekahi
5676	Keliaihue, W.H.	Puuhinahina
5677	Kauwa	Kamuku
5678	Kauwale	Pamaki
5682	Keaupuni, *wahine*	Umihale
5683	Kualu	
5683-B	Kamauhili	
5683-BB; 5681	Keliihelelau	Hokio
5684	Kauahulimoana	
5685	Keakahaapoli	
5686	Keau	
5687	Kuaana ma	
5687-A	Papa	Ililoa

LCA Number	Awardee	*‘Ili*
5687-B	Kaukihelani	
5687-E	Moeloa	
5688	Leleola	Lehuakona, Makakiloia
5688-B	Kameeui	Makakiloia
5689	Nahoounauna	Kukuihaa, Koaie, Lehuakona
5690	Kanakole	Kihikihi 2, Pakii, Pahoa
5691	Kamaui	Makolea, Pakii 1
5693	**Koolau**	
5694	**Kawakoekoe**	**Hokio**
5695	Kaulike	Haliipalala 5
5831	Kaeha	Kukuihaa 4
5831-B	Kanalu	Kukuihaa 1, Kaunamoa
5895	Peekoa	
5915	**Pawai**	**Hapaialii**
5966	**Maheu**	
5966-B	Imakakoloa	Kukuiokahinu
6026	**Lanai, Ikaaka**	**Poohawaii, Hanapouli, Waioha**
6027	**Kapiimi, *wahine***	
6029	Nakea	Paulu?
6030	Noholowaa	Paulu?
6032	Napio	Makailoia, Makolea, Ulumoe, Pakii 6, Pahoa
6071	Hoopale	
6091	Malaihi	Kaloaulu
6094	Umiumi	Kamuku 1
6128	Napipi	Kukuiohaa
6129	Nawaimaka	
6139	Nakowana	
6143	Naauhau	Kealaehu
*7713*H*	*Kamamalu, Victoria*	*Ahupua‘a Award*
10258	Maikai	Kaohia, Haleape, Waipio, Haliipalala
10766	Pio	Kamuki, Ioaie

Table 3. Land Use in the LCAs Located within the Project Area

LCA Number	Awardee	Land Use
5632	Keikihookama	Eleven *‘āpana*; one house lot; 20 *Kihapai*/*Pakanu*; one Royal Patent
5693	Koolau	One *‘āpana*; one house lot; two houses
5694	Kawakoekoe	Seven *‘āpana*; 19 *Kihapai*/*Pakanu*; one Royal Patent; awarded two *‘āpana*, Kawakoekoe and Koolau
5915	Pawai	One *‘āpana*; one house lot; one Royal Patent; two houses
5966	Maheu	One *‘āpana*; one house lot; one Royal Patent; Claim 1 is awarded two *‘āpana*, two houses
6026	Lanai, Ikaaka	Two *‘āpana*; two house lot; one Royal Patent
6027	Kapiimi, *wahine*	*One ‘āpana*; one house lot; one house

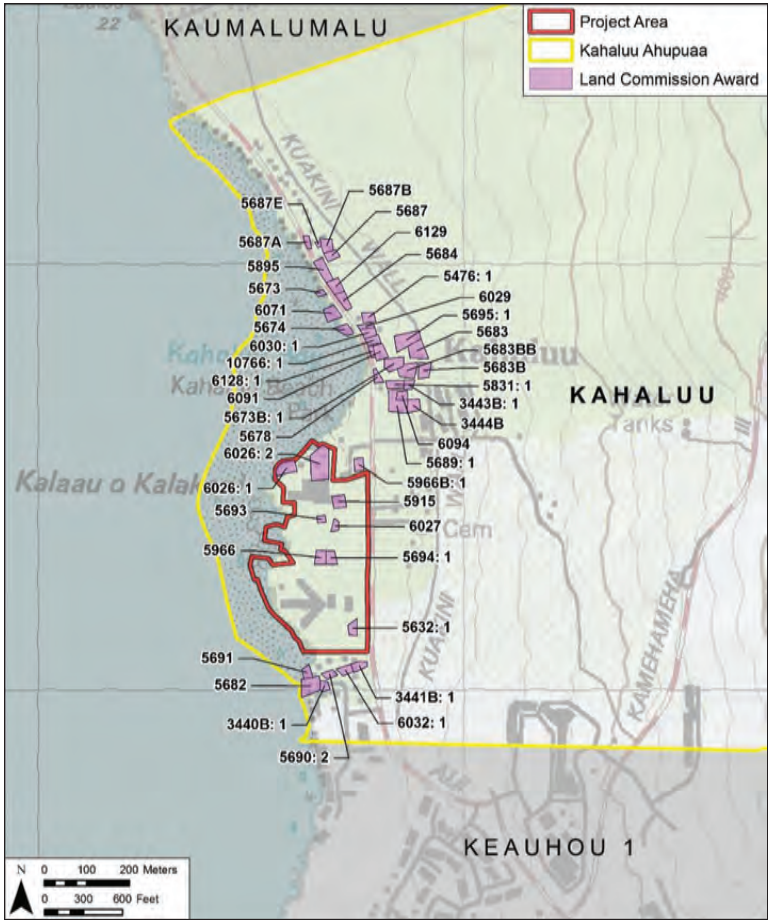


Figure 19. Portion of 1996 Kealakekua USGS 7.5-Minute topographic quadrangle showing locations of LCAs within and in the vicinity of the project area

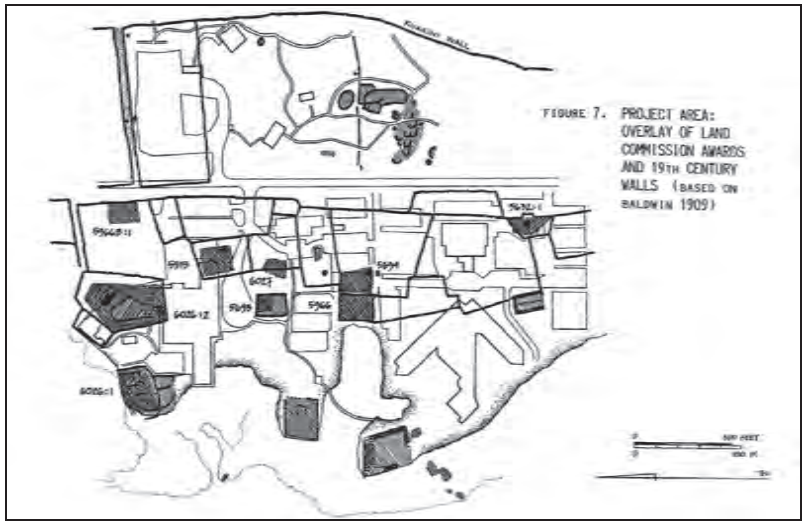


Figure 20. Map from Tuggle (1990:22) showing the locations of LCAs in the vicinity of the present project area in relation to nineteenth century walls, as recorded by E.D. Baldwin in 1909

3.5.3 Early Land Tenure

Maly and Maly (2012:444) report that the earliest record of land title with the Bureau of Conveyances for the Kahalu‘u-Keauhou area dates to 1856; it was in the decade following that “numbers of records began to be registered in the collection of public conveyances.” Land conveyances within the Kahalu‘u Ahupua‘a were mainly *mauka* of Government Road (currently known as Ali‘i Drive), and were either deeded or five- to 20-year leaseholds transferred to native heirs or foreigners to plant coffee, ranch, gather timber for firewood, or build houses and/or fences (Maly and Maly 2012:444–522). Land conveyances *makai* of Government Road were either deeded or one- to seven-year leaseholds transferred to native heirs or foreigners to gather coconuts for food purposes or graze livestock (Maly and Maly 2012:444–522).

A 23 May 1905 lease application for a rougly 2,800-acre portion of *makai* lands at Kahalu‘u and Keauhou 1 and 2 indicate activities such as fishing, grazing, and cultivation of coffee and fruit. The proposed lease was to except and reserve “. . . all *kuleana*s not owned by the lessors, also reserving such rights of way that may be necessary from the *mauka* Government road to the sea” (Maly and Maly 2012:410).

3.5.4 *Ala Loa* and *Ala Pi‘i*

Concurrent with the Māhele ‘Āina, business interests in the region were expanding, necessitating improved road systems to facilitate the use of horses and wagons (Maly and Maly 2004:67). Oftentimes traditional trail routes were improved for this purpose, as these trails usually followed ideal routes across the landscape. At that time, one *ala loa* (lateral trail crossing through the district) encircled the island near the shore, following the the current Ali‘i Drive alignment through the lands of Kahalu‘u and Keauhou. A second *ala loa*, known as “Kealaehu” crosses through the uplands in the vicinity of the current Māmalahoa Highway (Maly and Maly 2004:67).

Within an *ahupua‘a*, *ala pi‘i*, or *mauka-makai* trails, served to provide native tenants with access to their *kuleana*, which were usually situated at several elevational zones from the shore to the upland forests (Maly and Maly 2004:67). Three trails valued as traditional *ala pi‘i* by elder *kama‘āina* of the Kahalu‘u-Keauhou area include the Keauhou Trail, extending from Ha‘ikaua on Keauhou Bay; the Kahalu‘u or Mākole‘ā Trail, extending from near the Po‘o Hawai‘i on the shore to the forest and in use up the late 1940s (Figure 21); and the historic Keauhou-Kāināliu Trail (St. Paul’s Trail) extending from Keauhou Bay to the *mauka* village of Kāināliu (Maly and Maly 2004:135). Reineke (1930:1) also indicated “a network of lesser paths” through the area.

3.5.5 Boundary Commission and Land Survey Documents

The apportionment of land under the Māhele ‘Āina and subsequent sale of Government Lands required the establishment of a Boundary Commission (1864–1935), tasked with determining the boundaries of each of the island *ahupua‘a*. This involved conducting field surveys as well as hearing testimonies of native residents who were familiar with traditional boundaries and landmarks. These testimonies, though at times contradictory, often provide a wealth of information including traditional place names and land uses.

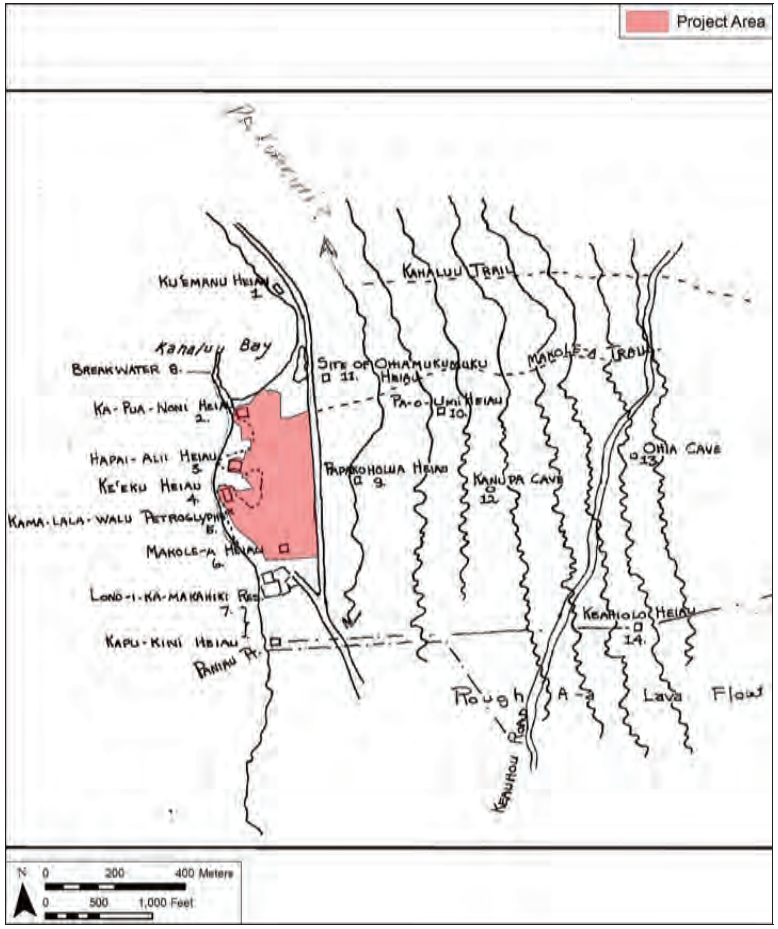


Figure 21. Map from Sterling (1960) showing important cultural features in Kahalu‘u

Surprisingly, the LCA and the Boundary Commission testimonies reveal striking changes in the vegetation in the nineteenth century. Informants stated that the forest zone was expanding. References include, “When I was young there were no trees there. But now the trees have grown up” (Boundary Commission testimony of Waiau, 1875); “At that time [i.e., going with his father] this place was above the woods and you could see from Kiha to Waio, now the trees are all grown up” (Boundary Commission testimony of Kahulialo, 1873); and “The woods extend there now. In olden times there were hardly any trees there” (Boundary Commission testimony of Keakaukawai, 1873).

Chronological references in the Boundary Commission testimonies are in terms of major events, not to specific dates. For example, informants related their births to “the death of Kamehameha I” (Keakaukawai), “The time of Kuewai o la lae” (Palea). Chronologically, this represents informants testifying in 1873, who were born in the early 1800s.

The narratives below were recorded as testimonies, surveys and Certificates of Boundaries for Kahalu‘u Ahupua‘a and have been documented in the works of Maly and Maly (2004:74-78; 2012:351-358):

> **Kahaluu Ahupuaa**
> **District of North Kona, Island of Hawaii**
> **Boundary Commission Volume A No. 1 pages 245-246**
>
> Honorable R.A. Lyman,
> Boundary Commission
> for Island of Hawaii
>
> The undersigned would herewith make application for the settlement of the Boundaries of the following named Ahupuaas or lands belonging to the Estate of Kekuanaoa & V. Kamamalu, viz.;
>
> . . . Keauhou, District of Kona, Hawaii, adjoining lands Kahaluu & Keauhou 2, Est.
> Kamehameha V.
> Haluu [Kahaluu], District of Kona, Hawaii, adjoining lands Kapalaea [Kapalaalaea] & Keauhou . . .
>
> Your Honor therefore will please appoint a
> day for the hearing of said application,
> and grant a certificate in accordance therewith.
> (sig) J.O. Dominis, Admstr.
> J.H. Harris, Attry. at Law
> Hilo, August 16th A.D. 1873

Kahaluu–Boundary Commission Volume A No. 1:321-323
The Ahupuaa of Kahaluu District of North Kona
Island of Hawaii, 3rd J.C.

On this 9th day of August A.D. 1873 the Commission of Boundaries met at the house of J.G. Hoapili, North Kona, Hawaii, 3rd J.C. for the hearing of the application of J.O. Dominis, Administrator of the Estate of M. Kekuanaoa for the settlement of the boundaries of Kahaluu situated in the District of North Kona, Hawaii.

Notice to all persons interested in the settlement of boundaries of lands in North and South Kona, Hawaii, that the Commissioner of Boundaries for the 3rd J.C. would be prepared to receive application for the settlement of boundaries of lands in said Districts, at the Court House in Kona on August 2nd, A.D. 1873; served by publication in the Hawaiian Gazette of July 16th and Kuokoa of July 19th 1873; and due notice personally owners or agents of adjoining lands, as far as known.

Present–J.G. Hoapili for applicant, Estate of Kamehameha V and Her Excellency, R. Keelikolani; Palapala, Konohiki.
For Petition see Folio 246

Testimony
Papa K. Sworn (Very old man)
I was born at Kahaluu, Kona, Hawaii at the time of Holuanui [ca. 1814, construction of the Holua at birth of Kauikeaouli], and have always lived there.
Know the land and its boundaries.

The sea bounds it makai, and it has ancient fishing rights extending out to sea.
Keauhou bounds Kahaluu on the Southern Side; at the sea shore the boundary between these two places is at Ohiki, a point on the south side of Paaniau, and near to it.
Thence mauka along Keauhou to Kaioena a large heiau [also called Keahiolo] way above the makai road.
Thence to aa near kukui trees (a grove called

Kuohai). The lapa [ridge] is on Keauhou, the dirt is on Kahaluu. Thence to Mahina o Kiiwalao [Kiwalao], a place where Kiwalao was raised [in ca. 1760s], an alii kapu [sacred chief]; thence to Kanihinihiula two ahu pohaku at the Government road; thence to Kalalahua, an ohia akua [an ohia deity] in the woods; thence mauka to Kalaeahi a kahua kauhale mahiai [a farmer’s house complex]. Thence to Paahao a water hole, thence and where there is a water hole; thence to Kaaeamaia called Paapaalani where banana trees used to grow in great numbers; aa on the south side of this place is on Keauhou; thence to Pukakanoa in the koa woods, thence to an awaawa [gulch] lumalu and Kahaluu; the boundary is at a mawae [fissure], cut off by Keauhou.
This place is out in pukeawe [pukiawe] and mamani [mamane] above the woods. I have always heard that Kahuku cuts off all South Kona lands and takes in the kuahiwi [mountainous zone] and runs to an ahu Kokolau [cairn at Ko‘oko‘olau], where Hilo, Hamakua, and Kona lands join. I used to go after sandal wood and have been to the water hole called Pupuawai.

Keauhou 2nd cuts Kahaluu off a the mawae; thence the boundary follows along Keauhou. At Puukanoa the boundary runs out of the woods; Walls house is on Kaumalumalu. Kaapaalaea [Kapalaalaea] 2nd ends on the mauka side of Hahanapuueo; thence Kaumalumalu bounds it in the ohia woods. Kahula’s land on Laaloa ends at Waialiipoa, all lands are cut off by these lands there; thence to Waiakalipuni [Kalaepuni], a water hole on Kahaluu near boundary; thence to Kanoaa cave; thence up pali and to the hill called Hiinau, and the mawae.
CX’d.

Kaihumua K. Sworn
I was born at Kahaluu, North Kona, Hawaii, at the time of building Kiholo [ca. 1811], and have always lived there, and know a part of the boundaries.
Keauhou bounds Kahaluu on the South side; sea makai; and the land has fishing rights.
The boundary at shore is Ohiki, a pile of stones on the South side of Paaniau; thence it runs way above the makai Government road to a large

pile of stones, like a heiau, called Kaioena; thence mauka
to Government road, the aa on Keauhou,
a small portion only being on Kahaluu;
thence follow up to Kanihinihiula, at the
mauka Government road; thence to Paahao,
a water hole in the woods; which is as far as I
know the boundaries in the woods. Kahaluu
ends at Mawae, Kaumalumalu also, and is cut
off by Keauhou 2nd. I used to go there after sandal
wood. I have heard Keauhou joins
Hamakua, Humuula, and Kahuku
but I do not know where; the mountain, Mauna Loa,
is on Kau. Kaumalumalu joins Kahaluu
on North side in woods at Waialiipoa.
I do not know the boundaries through the woods.
Kapalaaea [Kapalaalaea] bounds Kahaluu
on the North side from near Wailipoa to
sea shore.

CX’d.

Kapalaaea has been sold and patented.

Case continued until further notice to all
interested parties.

R.A. Lyman
Commissioner of Boundaries, 3rd J.C.

Hilo, June 14, 1876

D.H. Hitchcock K. Sworn says,
The map and notes of survey I file today were made
from filed notes taken by me when I surveyed the land.
I surveyed Kahaluu as Kakio pointed out to me.
He took me to old ahu above the thick woods.
Keakaikhawai said that the North corner of Kahaluu
was correct as pointed out by Kakio.
CX’d.

Decision
The boundaries of Kahaluu are decided to be as set forth in
notes of survey. Certificate of Boundaries will issue as of today,
#100, See Folio 228, Liber 1 or No. 3.

R.A. Lyman
Commissioner of Boundaries, 3rd J.C.

Kahaluu–Boundary Commission Volume C No. 3:228-230
For Decision of Kahaluu, see Folio 323 Book A or No. 1 [Figure 14]

No. 100

Land Boundary Commission, Hawaii, 3d Judicial Circuit,

Certificate of the boundaries of Kahaluu, District
of South [North] Kona, Island of Hawaii Third Judicial
Circuit.

Upon the application of J.O. Dominis, Administrator
of the Estate of H.R.H.M. Kekuanaoa and
H.R.H.V. Kamamalu by F.H. Harris, attny. at
Law, and by virtue of the authority vested in me
by law, as sole Commissioner of Land Boundaries
for the Island of Hawaii, 3d J.C.

I hereby decide and certify
the boundaries of the Ahupuaa of Kahaluu, Situated
in the District of South [North] Kona, Island of Hawaii,
to be as hereinafter set forth.

Given under my hand at Hilo, Hawaii,

this Fourteenth day of June, A.D. 1876.
R.A. Lyman
Commissioner of Boundaries, Third Judicial Circuit.

Boundaries of Kahaluu

Commencing on S.W. corner on boundary line of
Keauhou 1st at large ahu at place called Paniau
and running along boundary of Keauhou 1st
as follows:

1. North 80º 30’ East 50.50 chains to W. side of old heiau called Kaioena;
2. North 65º 30’ East 28.00 chains to scrub ohia;
3. North 71º 00’ East 58.00 chains to Government road; large ahu called Kahinihiniula;
4. North 66º 00’ East 916.00 chains;
5. North 50º 00’ East 62.00 chains along line of old aa; thence along line of Keauhou 2;
6. North 55º 00’ West 39.00 chains to ahu in kipuka makai of Charles Wall’s houses and line of Kaumalumalu & down said line;
7. South 68º 00’ West 155.00 chains;
8. South 62º 30’ West 244.00 chains to mauka corner of Kapalaaea 2nd; thence along land of Palauolelo;
9. South 6º 00’ West 44.00 chains:

10. South 40º 00’ West 19.00 chains;
11. South 45º 00’ West 31.70 chains;
12. South 57º 00’ West 24.50 chains to corner of Keoki’s land;
13. South 67º 30’ West 6.54 chains;
14. South 74º 00’ West 5.00 chains;
15. South 67º 00’ West 7.90 chains;
16. South 55º 00’ West 2.04 chains;
17. South 60º 45’ West 5.34 chains to Gov’t. Road; thence along Kaaipuhi’s land;
18. South 66º 45’ West 18.50 chains;
19. South 58º 00’ West 6.00 chains;
20. South 65º 00’ West 3.84 chains;
21. South 63º 00’ West 48.30 chains;
22. South 65º 00 West 30.20 chains;
23. Gov’t road on coast & rock marked X at place called Kapuhi

Thence along coast to commencement
and containing an area of 5443 acres
More or Less

R.A. Lyman

Commissioner of Boundaries, Third Judicial Circuit

3.5.6 Late Nineteenth Century

Lacking sufficient water and easily convertible land, the Kona Coast of Hawai‘i was largely spared the changes associated with plantation agriculture that affected so much of Hawai‘i. Economic opportunities created by this commercial agriculture elsewhere was another pull for relocation away from Kahalu‘u. Tomonari-Tuggle (1985) notes that according to Kingdom of Hawai‘i tax ledgers, the population of this area dropped from 72 in 1857 to 24 in 1881. While the overall importance of the Kona Coast diminished, the relative importance of Keauhou on that coast may have increased, as Kealakekua Bay (Ka‘awaloa and Napō‘opo‘o) became less important as an entry point.

The impetus of getting market-oriented produce to port centers like Keauhou, Kailua, and Kealakekua shifted the remaining population. This is made evident by the relatively large number of LCA parcels, 19 in Keauhou 2nd and 50 in Keauhou 1st. Additionally, at Keauhou Bay there were a few stores, a church, and a schoolhouse. Based on the government license ledger for retail outlets between 1855 and 1870, “Keauhou may have been one of the more active areas along the coast” (Tomonari-Tuggle 1985:31-32). In her survey of Government license ledgers between 1855 and 1870, Tomonari-Tuggle (1985:32) notes 11 applications (by five individuals) for enterprises at Keauhou in comparison with 25 applications at Kailua, ten for Kealakekua, seven for Napō‘opo‘o, four for Ka‘awaloa, and three each for Hōlualoa and Hōnaunau. Curiously, fishing appears to have been a minor enterprise during this period.

The uplands of Kahalu‘u/Keauhou became more important as the century drew to a close with the growth of the ranching operations and small plantations used to grow coffee. The uplands from approximately 457.2 to 1,371.6 m (1,500 to 4,500 ft) in elevation were at first used for grazing cattle, goats, and other livestock. Uplands from approximately 182.9 to 457.2 m (600 to

1,500 ft) in elevation were used for the cultivation of small plantations growing oranges and coffee. The trustees of Victoria Kamāmalu leased large portions of her award in Kahalu‘u for grazing land and for coffee cultivation (Maly and Maly 2004:98-100). A 1908 map of the “Kahalu‘u Lots” shows the parcels that the Bishop Estate owned or had an interest in (Figure 22).

Coffee in Kahalu‘u, as evidenced by the LCA information, was grown as an early commercial enterprise in small individual plots. The coffee industry went through a number of booms and depressions through the late 1800s, due to introduced diseases and price fluctuations.

Chinese and Japanese immigrants who had fulfilled their labor contracts to sugar plantations eventually became the dominant coffee growers. The coffee farmers for the most part lived on the farms in the upland agricultural zone, with no corresponding coastal habitation. Keauhou Bay still contained a church, a school house, post office, and by 1920, a single store. The focus of settlement was the *mauka* government road (i.e., Māmalahoa or Belt Highway).

3.5.7 Kahalu‘u in the Twentieth Century

The early 1900s continued the pattern of population movement from the coastal areas to the uplands. During this period, Keauhou was known as the “end of the road” in the Kona region (Walker and Rosendahl 1989:11). Albert S. Baker, a clergyman of Kona and Ka‘ū, described the seacoast in the area of Kahalu‘u-Keauhou as it appeared about 1915 (Emory et al. 1971:9):

> A half-mile north of Keauhou is still found a short branch trail to the shore, of ancient stepping-stones brought from the beach at Keauhou. Another half-mile brings us to Kahalu‘u, an ancient sacred locality of many heiaus . . . by the upper side of the trail just before the stone church, is a part of the old execution stone used in Kuakini’s time . . . Just a little above, and continuing all the way to Kailua, is a huge stone wiall built in Kuakini’s time to keep pigs from the cultivated lands above . . .

It appears there were a few somewhat unsuccessful attempts at growing sugar in Kahalu‘u during the late nineteenth century. The Kona Sugar Company had a short life, operating from 1898 to 1903. In 1906, the property was bought and redeveloped by James B. Castle, who founded the Kona Development Company, which harvested sugar on the lands for the next 20 years. During this time 11 miles of railroad were installed, with a station at the Kona mill. The West Hawaii Railway Company developed with the intent of further connecting the railway to North and South Kona (30 miles of track) with access to bays along the coast. This idea lost steam and the original 11 miles remained the extent of the railroad though North Kona.

The early twentieth century saw a boom in the coffee industry in the Kona uplands. Habitation along the coast was generally abandoned, as coffee growers moved to one of the many small towns that sprang up along the upland Māmalahoa Highway to be near their coffee farms and a convenient transportation route to the boat landing at Kailua-Kona. A 1927 USGS map (Figure 23) indicates only scattered houses along the upper highway, with a cluster of houses near Helani Church at the coast.

Tourism grew almost exponentially in the decades after World War II, and the boom starting just a couple of decades later radically changed the face of Kahalu‘u. Figure 24 and Figure 25 show the Kahualu‘u coastline in 1962; these photographs document the relatively undeveloped

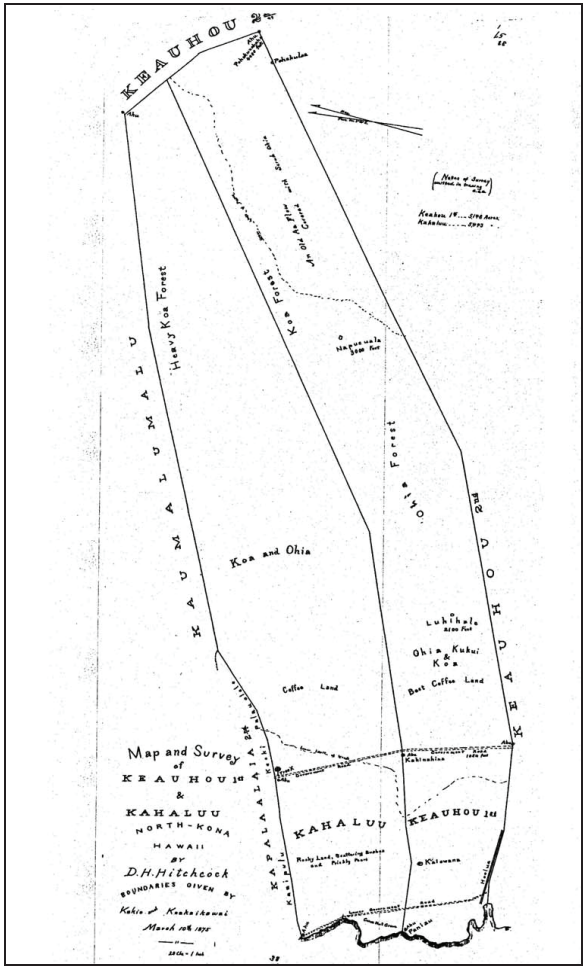


Figure 22. Kahalu‘u Boundary Commission Volume C No. 3:228-230; BE Map No. 38 (source: Maly and Maly 2012:356)

Figure 23. 1927 U.S. Geological Survey 7.5 Minute Topographic Map of Hawai‘i, Kainaliu Quadrangle, depicting little residential development near the present project area

Figure 24. 1962 aerial photograph (courtesy of KS) showing the relatively undeveloped coastline of Kahalu‘u and Keauhou

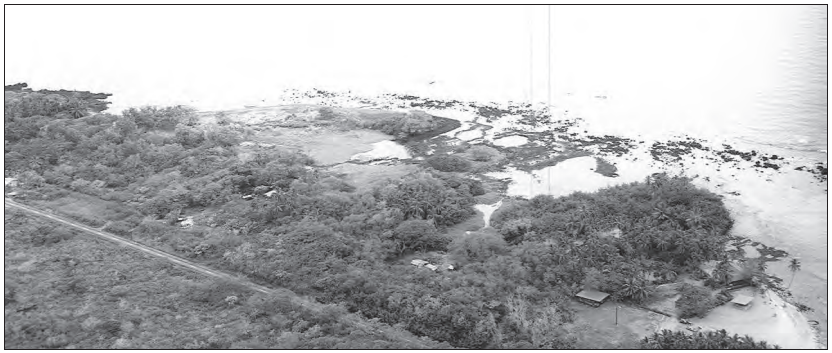


Figure 25. 1962 aerial photograph (courtesy of KS) showing the relatively undeveloped coastline of Kahalu‘u the Ke‘ekū and Hāpaiali‘i Heiau within the present project area

nature of the area at that time. Later that decade, a golf course was built in Kahalu‘u-Keauhou (Keauhou Resort). After the completion of the golf course, hotel condos and single family residences sprang along its edges, thus returning residential occupation of significant numbers to the coastal zone. The construction of the Outrigger Keauhou Beach Resort (KBR) in 1968 and the former Kona Lagoon Hotel in 1975 (both within the project area) capitalized on this increased tourism. Since the early 1980s the Keauhou-Kahalu‘u area of North Kona has become a major resort center with coastal hotels, new shopping centers, golf courses, and residential developments (see Figure 3).

The Kona Lagoon Hotel, the arrow-shaped structure appearing on the modern USGS map (see Figure 1), was situated over the site of Keawehala Pond (Site # Ha-D4-52). Many locals believed the hotel was cursed because of its location on and amongst many significant archaeological sites. It ceased operation in 1988; subsequent proposals to redevelop the property fell through.

3.5.8 Kahalu‘u in the Twenty-First Century

Presently, some of the prime agricultural lands of Kahalu‘u remain under coffee cultivation and the Belt Highway is still a focus of the local community.

The Kona Lagoon Hotel was demolished in 2004; this activity was monitored under an archaeological monitoring plan prepared by Haun et al. (2004a and b).

In 2007 and 2008, T.S. Dye & Colleagues, Archaeologists, Inc. prepared preservation plans for Hāpaiali‘i, Kapuanoni, Ke‘ekū, and Mākole‘ā Heiau and Po‘o Hawai‘i, to be carried out by Kamehameha Investment Corp. Inc. (KIC), a for-profit arm of Kamehameha Schools (Stanton 2008). Restoration work was made in consultation with several Hawaiian organizations and local individuals and was based on historical sources (e.g., the works of John F.G. Stokes and HenryKekahuna) and modern archaeological investigation. The main goal of restoring these features is to return them to their appropriate cultural use and support educational programs; the stabilization of Po‘o Hawai‘i is designed to restore it as habitat for native animals (Dye and Ayau 2007:1, 2008:1). The 2007 and 2008 Preservation Plans are included herein as Appendix C.

In 2007, restoration began on Hāpaiali‘i Heiau. Over the course of four months, Master Mason Billy Fields of Fields Masonry, with the assistance of a four-man crew and modern machinery, recreated the *heiau* (Stanton 2008) (Figure 26). That same year the restoration project was recognized with a Historic Hawai‘i Foundation Historic Preservation Honor Award. The following year, restoration was completed for the Mākole‘ā Heiau, and restoration of Ke‘ekū Heiau was finished in 2009. Restoration work at Mākole‘ā and Ke‘ekū Heiau was preceded by archaeological investigation work (Kalawe and Dye 2010, Dye 2012; see Sections 4.2.10 and 4.2.11). Restoration per the approved Preservation Plan developed by Dye and Ayau (2008) has not yet been undertaken at Kapuanoni Heiau or Po‘o Hawai‘i.

As of October 31, 2012 the hotel at KBR has been closed.

Figure 26. 2013 CSH photograph showing the 90% restored Ke‘ekū (upper) and fully restored Hāpaiali‘i (lower) Heiau, both located within the present project area; view to south

Section 4 Previous Archaeological Research

4.1 Archaeology of Kahalu‘u Ahupua‘a

Keauhou/Kahalu‘u is one of the most studied areas in Polynesia. A large majority of the studies, especially archaeological surveys of the large habitation/*heiau* complexes, are near the coast, *makai* of Ali‘i Highway. Many of these sites are part of the Kahalu‘u Historic District (SIHP # -04150), which was placed on the National Register of Historic Places (NRHP) in 1974 and encompasses the project area (see Figure 8). Virtually all of the archaeological studies documented not only provide evidence of human occupation, but also evidence of permanent habitation and agricultural development in areas that have not been previously disturbed. The extensive agricultural complexes in the inland portion of Kahalu‘u are part of the Kona Field System (SIHP # -6601), which was nominated to the NRHP in 1977.

The first archaeological study in the area was the survey of prominent structures, mainly *heiau*, by Bishop Museum archaeologist John F.G. Stokes in the early 1900s. This was followed by a similar study by Bishop Museum archaeologist J.E. Reineke from 1929–1930. In the 1930s, the first study of the large underground refuge cave, ‘Ōhi‘a Cave (SIHP # -7962), was made by K.P. Emory of the Bishop Museum. Numerous additional studies have been conducted at ‘Ōhi‘a Cave and the surface sites in ‘Ohi‘a Reserve, including extensive mapping and excavations (e.g., Tomonari-Tuggle and Allen 1983).

Since the 1970s, a large number of studies in Kahalu‘u were conducted for the Kamehameha Investment Corporation (KIC), in an area originally called the Keauhou-Kona Resort, but now referred to as the KIC Development Parcels. This development area extends from the coast to Kuakini Highway and from Kahalu‘u through Keauhou 1 and 2. The report titles for these archaeological studies often do not list the exact *ahupua‘a* in which the work took place, but instead refer to the KIC Parcel number. A map of the KIC parcel designations is shown in Figure 27. Table 4 indicates the locations of archaeological projects in the KIC area by the Development Parcel, and also summarizes several studies that have been conducted during the planning phases for the construction of roads and highways, such as for the Kamehameha III road (e.g., Crozier 1971a and b). These previous archaeological studies within Kahalu‘u Ahupua‘a are indicated on a USGS topographic map (Figure 28).

By 1983 (summary in Tomonari-Tuggle and Allen 1983:6), 217 sites had been recorded in the KIC development area; these consisted of an almost continuous spread of agricultural sites along the slopes of Hualālai Volcano, with concentrations of features within and adjacent to swales. A wide belt of permanent habitation began at the coast, with scattered permanent habitations extending up the slopes to at least the elevation of the modern Kuakini Highway. While it has generally been understood that the optimal area for agriculture lies above 1,000 ft elevation, there are widespread indications of fairly intensive agriculture at lower elevations as well. This record of pre-Contact/early post-Contact habitation and agriculture was disturbed in several areas by mid-nineteenth century habitation sites associated with Māhele LCA homesteads, the destruction and/or modification of old agricultural features for the new cultivation of coffee in the nineteenth and twentieth centuries, and later residential and commercial land development.

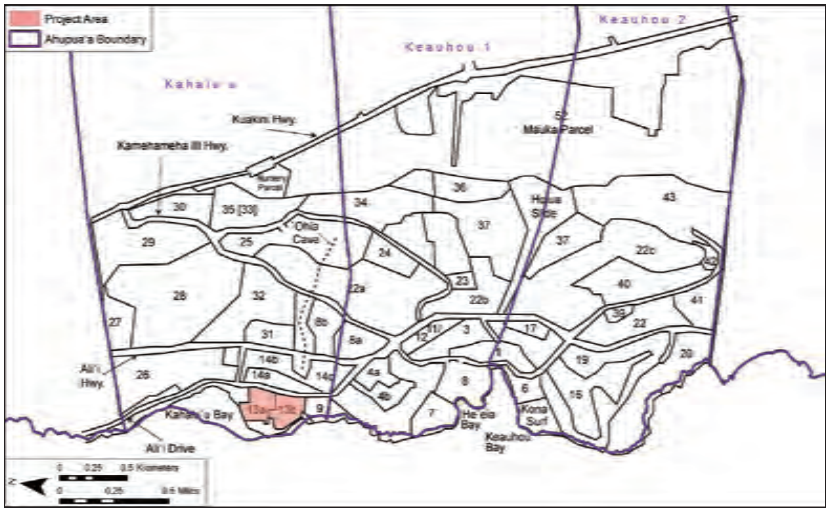


Figure 27. Tracing of a Kamehameha Investment Corporation (KIC) map of development parcels for the Keauhou Resort, showing the project area within parcels 13a and 13b

Table 4. Previous Archaeological Work Conducted in Kahalu‘u Ahupua‘a, *makai* of Kuakini Highway; Entries in Bold Fall within the Project Area

Source	Location of Study	Nature of Study*
Stokes 1906-1907 (Stokes and Dye 1991, edited edition)	***Heiau* of Hawai‘i Island**	**Visited numerous *heiau* within Kahalu‘u, reassessing some of Thrum's earlier work there; observed petroglyphs, cluster assigned SIHP #s -11875 and -12954**
Reinecke 1930	**Survey of Kahalu‘u**	**This early survey of Kahalu‘u, building off the early work of Thrum and Stokes, noted *heiau*, abundant springs, agriculture, and habitation of the area.**
Sterling 1960	**Sites between Ku‘emanu Heiau and Paniau Point, Kahalu‘u**	**Brief descriptions of archaeological structures along the shore**
Barrera 1971	**KIC Development Parcels 4, 7, 11, 12, 13b, 17, and 18, Keauhou-Kona**	**Inventory-level and reconnaissance: documented 17 new sites, and conducted follow-up investigations at some sites found during the Emory et al. (1971) study, including Sites D4-34/SIHP # -01616, D4-52 and D4-53 within Parcel 13b**
Crozier 1971a	Kamehameha III Rd, Kahalu‘u and Keauhou	Archaeological survey: six discrete historic properties comprising 366 features recorded; one excavated unit contained late nineteenth century ceramics
Crozier 1971b	Kamehameha III Rd, Kahalu‘u and Keauhou	Archaeological excavations: 13 pits excavated in three feature areas; several hydration rinds dated site to AD 1110-1150 and AD1670-1710
Emory et al. 1971	**KIC Development Parcels 1, 7, 9 and 13b, Kahalu‘u and Keauhou 1st and 2nd**	**Archaeological survey: brief survey revealed existence of several previously unrecorded sites on the coast between Kahalu‘u and Keauhou Bays, including some within the project area; study also documented some larger monumental sites in the vicinity, including the Ke‘ekū (D4-3; SIHP # -03818) and Mākole‘a Heiau (D4-5; SIHP # -03819), and the Lonoikamakahiki Residence; within Parcel 13b documented one house site (D4-49), one stone wall (D4-47), one pond (D4-52), one grave platform (D4-34; SIHP # -01616), and two petroglyph fields (D4-53, D4-54)**

Source	Location of Study	Nature of Study*
Ching et al. 1973	Ali‘i Hwy Corridor Kahalu‘u and Keauhou 1st	Archaeological investigation of previously surveyed areas and alternate routes for Ali‘i Dr: a total of 139 historic properties with 298 component features recorded
Kirch 1973	KIC Development Parcel 9, Kahalu‘u	Archaeological excavations: salvage excavations at three sites consisting of a large stone construction, pre-historic midden deposit and one historic burial crypt
Rosendahl, P. 1975	Ali‘i Hwy Extension, Keauhou	Reconnaissance survey of extension area
Mann 1977	North of Kahalu‘u Bay, Kahalu‘u	Archaeological reconnaissance: investigation of 10,000 sq ft survey area located within a residential area; documented site complex comprising features within a walled enclosure; interviews indicated possible association with the Kuakini family; concluded site was not considered to have any "especial historical, religious or archaeological value," and that the features were "in no way unique"; further "exploratory" work recommended prior to development of parcel
Rosendahl, P. 1979	Keauhou Gardens, Keauhou 1	Archaeological reconnaissance survey: north and south clusters are only remaining features of once numerous features known to have been present within and adjacent to Keauhou Gardens
Soehren 1979a	TMK: [3] 7-8-014:021, Kahalu‘u	Reconnaissance: considerable sub-surface (pre-Contact) archaeological material throughout parcel with a *mauka-makai* trail; conclusion, prime residential location
Soehren 1979b	TMK: [3] 7-8-014:038, Kahalu‘u	Archaeological reconnaissance: no archaeological or historical features observed on the parcel.
Hammatt and Folk 1980	751 acres in Keauhou and Kahalu‘u	Archaeological survey: describes 320 historic properties and site complexes
Rosendahl, P. 1980	TMK: [3] 7-8-010:004 (por.), Kahalu‘u	Archaeological test excavations at SIHP # -7702: lava tube cave shelter; seven test units with 384 portable artifacts recovered
Soehren 1980a	TMK: [3] 7-8-014:045, Kahalu‘u	Reconnaissance: no archaeological features observed on parcel
Soehren 1980b	TMK: [3] 7-8-010:004 (por.), Lot C-1, Kahalu‘u	Reconnaissance: no archaeological features observed on parcel
Soehren 1980c	West Hawai‘i Housing Foundation, Kahalu‘u	Intensive archaeological survey: three features recorded on parcel; two others noted outside project area to the north

Source	Location of Study	Nature of Study*
Soehren 1980d	TMK: [3] 7-8-014:086 and 087, Kahalu‘u	Archaeological reconnaissance: Parcel 86 contains abundant evidence of former Hawaiian habitation; Parcel 87 contains similar but much less evidence of former Hawaiian habitation
Rosendahl and Severance 1981	Southern portion of Kahalu‘u Bay including a major part of the Kahalu‘u Beach Park, Kahalu‘u	Archaeological reconnaissance survey: 14 previously identified cultural features; five new archaeological features identified; new features consist of artificial, man-made concavities (pre-historic Hawaiian features) formed into *pāhoehoe* shelf
Hommon and Rosendahl 1983	Ali‘i Dr Realignment Corridors, Kahalu‘u and Keauhou 1st	Archaeological investigation of previously surveyed areas and alternate routes for Ali‘i Dr: total of 139 historic properties with 298 component features recorded
Rosendahl, M. 1983	KIC Development Parcel 8, Kahalu‘u and Keauhou 1st	Inventory survey and test excavation: nine historic properties recorded and six tested
Allen 1984a	KIC Development Parcel 26, Kahalu‘u	Archaeological inspection and evaluation of previously identified sites: 35 sites previously identified (Hammatt and Folk 1980) with 13 new sites recorded
Allen 1984b	KIC Development Parcel 14b, 14c and two historic preserves, Kahalu‘u	Archaeological reconnaissance and evaluation of previously identified sites: seven sites previously identified in Parcel 14b (Hammatt and Folk 1980) with ten new sites recorded; four sites were previously identified in Parcel 14c (Hammatt and Folk 1980) with one new site recorded
Allen 1984c	Site 7889 Complex lies within KIC Development Parcel 26a and 26b, Kahalu‘u	SIHP # -7889 complex information: four large platforms located at base of steep slope enclosed by V-shaped wall
Bath and Rosendahl 1984	HELCO Substation, Kahalu‘u	Inventory survey and testing: six habitation/agricultural sites recorded; two C14 dates (AD 1400-1515; 885-1790) and one volcanic rind date (AD 1742-1778) determined
Rosendahl, P. 1984	KIC Development Parcel 14, Kahalu‘u	Archaeological field inspection: 42 previously recorded sites (Soehren 1979), 35 previously recorded sites (Hammatt and Folk 1980)
Rosendahl and Rosendahl 1984	HELCO Substation, Kahalu‘u	Reconnaissance survey: seven habitation/agricultural sites recorded

Source	Location of Study	Nature of Study*
Shun and Walker 1984	Keauhou Well “A” Site, Kahalu‘u	Intensive survey and testing: identified three prominent features in addition to large section of Kona Field System
Hammatt and Borthwick 1985	Kamehameha III Rd, North Kona	Archaeological survey: identified ten habitation and agricultural complexes
Landrum and Rosendahl 1985	Kahalu‘u Bay Villas Condominium Site, Kahalu‘u	Archaeological salvage research excavations: focused on five previously designated individual features (SIHP #s -7704, -7898C, -7899A, -7899B, and -7899C)
Cordy 1986a	**Kapuanoni Heiau, Kahalu‘u**	**Archaeological fieldcheck of Kapuanoni Heiau: found *heiau* (SIHP # -10997) had been altered; present exterior wall is not the original wall; recommended further study to better determine nature**
Cordy 1986b	**Hāpaiali‘i Heiau, Kahalu‘u**	**Archaeological fieldcheck of Hāpaiali‘i Heiau: found *heiau* (SIHP # -03817) damaged but two-thirds of it still intact and remainder can be restored; restoration scope of work submitted separately to Keauhou Beach Hotel**
Hay et al. 1986	Kahalu‘u Habitation Cave (SIHP # -7702), Kahalu‘u	Data recovery: extensive excavations at SIHP # -7702, coastal cave habitation continuous
Rosendahl, M. 1986	Hawai‘i Preparatory Academy Site, Kahalu‘u	Reconnaissance survey: 14 previously recorded sites confirmed; five new sites recorded; sites were agriculture/habitation complexes
Rosendahl, P. 1986a	TMK: [3] 7-8-014:090, 091, 021, 2,470 sq ft, Kahalu‘u	Archaeological reconnaissance survey: further archaeological work recommended due to project area being within Kahalu‘u Historical District
Rosendahl, P. 1986b	TMK: [3] 7-8-014:092, 10,735 sq ft, Kahalu‘u	Archaeological reconnaissance survey: further archaeological work recommended due to project area being within Kahalu‘u Historical District
Rosendahl, P. 1986c	Keauhou Circle K, Kahalu‘u	Archaeological reconnaissance survey: previously identified archaeological remains confirmed and recorded; no further fieldwork required
Cordy 1987	KIC Development Parcel 10, *mauka* of Kamehameha III Rd, Kahalu‘u and Keauhou	Comments on development: discussed cart road, agricultural complex, enclosure, and housing complex
Rosendahl, P. 1988	TMK: [3] 7-8-014:090, 091, 092, Kahalu‘u	Archaeological reconnaissance survey: previously presented in Rosendahl 1986a and 1986b

Source	Location of Study	Nature of Study*
Walker and Rosendahl 1989	**Azabu Keauhou Resort, Kahalu‘u**	**Archaeological reconnaissance survey for Environmental Impact Statement: 87 previously recorded sites with 23 new identified sites; documented five new sites within present project area, including two stone-lined wells (Sites 51 and 52), a midden scatter (Site 50), a habitation site, vicinity of Po‘o Hawai‘i Pond (Site 53), and an enclosure (Site 57)**
Athens 1990a	Nursery parcel between Kamehameha III Rd and Kuakini Hwy, Kahalu‘u	Reconnaissance survey: identified eight sites including mounds, alignments, walls, terraces (studied in more depth in Lutfy and Athens 1991b)
Athens 1990b	KIC Development Parcel 35 [once 33], Kahalu‘u	Reconnaissance survey: described five sites, lava tube, railroad berm, ranching walls, agricultural mounds (studied in more depth in Lutfy and Athens 1991a)
Tomonari-Tuggle 1990	KIC Development Parcel 26, Kahalu‘u	Inventory survey: 58 sites documented
Tuggle 1990	**Azabu Kona Resort, Kahalu‘u**	**Historic preservation mitigation Phase I: study updated findings of Walker and Rosendahl (1989) and included new SIHP numbers (former midden scatter reclassified as an enclosure [-12950], two wells [combined under -12951], enclosure north of midden scatter [-12957], wall and house site [combined under -12955]); data recovery conducted at several habitation sites within project area, with evaluations and further recommendations; recommendations for preservation at *heiau*, petroglyphs, and Po‘o Hawai‘i**
Athens 1991	Keauhou Mauka Lands, KIC Development Parcel 52, Kahalu‘u and Keauhou 1st and 2nd	Archaeological inventory survey: 126 historic properties initially recorded
Barrera 1991	TMK: [3] 7-8-014:036, Kahalu‘u	Archaeological reconnaissance: appeared mechanically cleared, no findings
Lutfy and Athens 1991a	KIC Development Parcel 35 (once 33), Kahalu‘u	Inventory survey: identified four new sites, SIHP #s -5151 (lava tube), -15152 (ranching), -1553 and -15154 (traditional agriculture), and -7214 (railroad berm)
Lutfy and Athens 1991b	Nursery parcel between Kamehameha III Rd and Kuakini Hwy, Kahalu‘u	Archaeological inventory survey: identified five sites, SIHP #s -15157 and -15158 (ranching), -15154 and -15155 (traditional agriculture), and -7214 (railroad berm)

Source	Location of Study	Nature of Study*
Burtchard 1992 a–c	KKRC Mechanics’ Yard [in KIC Development Parcel 34], Kahalu‘u	Field inspection: identified mounds, lava tube, possible terrace platform features in area between Kamehameha III Hwy and Kuakini Hwy
Burtchard 1992d	KIC Development Parcel 35 [once 33], Kahalu‘u	Cave mapping: documented burial cave site SIHP # -16045
Chiogioji and Hammatt 1992	Kahalu‘u Beach Park, Kahalu‘u	Archaeological assessment: *heiau*, *ali‘i*, and *kahuna* residence, enclosure walls, ceremonial sites, royal bathing pond and canoe landing and shed; archaeological sites presently remaining are northern portion of royal bathing pond and remnants of enclosure walls
Denham et al. 1992	*Makai* of Kuakini Wall, TMK: [3] 7-8-014:032, Kahalu‘u	Inventory survey with subsurface testing: three new significant historic sites identified and one previously identified site (the Great Kuakini Wall) recorded
Charvet-Pond and Rosendahl 1993	‘Ōhi‘a Cave (SIHP # -7962), Kahalu‘u	Archaeological consulting: listed archival material and analysis on ‘Ōhi‘a cave
Goodfellow 1993	‘Ōhi‘a Cave (SIHP # -7962), Kahalu‘u	Scope of work, schedule, and inventory of archived materials: summary of PHRI field records and inventories for ‘Ōhi‘a Cave
O’Hare and Rosendahl 1993	*Makai* Portion of ‘Ōhi‘a Cave (SIHP # -7962), Kahalu‘u	Inventory survey: mapping and study of *makai* portion of SIHP # -7962, reported 21 burial clusters with minimum number of individuals (MNI) of 67, reported five C^{14} dates of AD 1474-1955, 1664-1955, modern, 1678-1940, and 1660-1955
Burtchard et al. 1994	KIC Development Parcel 35 [once 33], Kahalu‘u	Survey and documentation of two sites; data recovery at one site
Tomonari-Tuggle 1994	‘Ōhi‘a Preserve, Kahalu‘u	Archaeological inventory survey of surface structures above ‘Ōhi‘a Cave (SIHP # -7962)
Burtchard et al. 1996	Keauhou Mauka Lands, KIC Development Parcel 52, Kahalu‘u and Keauhou	Archaeological inventory survey-narrative site data (Volume 2): 126 historic properties regrouped into 76 large complexes
Henry et al. 1997	Ali‘i Hwy Corridor Kahalu‘u into Keauhou 1st	Data collection–phased intensive archaeological survey: massive study documenting numerous sites
Anderson 1998	Helani Church Lot, Kahalu‘u	Archaeological inventory survey: identified four sites, SIHP #s -7277 (church), -7707 (historic school and church meeting house), -7706 (‘Ōhi‘amukumuku Heiau), and -21404 (a lava tube with skeletal remains); one modern C^{14} date

Source	Location of Study	Nature of Study*
Haun et al. 1998	Ali‘i Hwy Corridor Kahalu‘u into Keauhou 1st	Intensive archaeological survey final report: recorded 535 features at 136 historic properties across seven *ahupua‘a*
Walker and Rosendahl 1998	Three adjacent parcels (TMKs: [3] 7-8-014:090, 091, 092), Kahalu‘u	Limited archaeological data recovery: included detailed recording at sites and excavation of four test units at two sites; sparse midden with limited range of prehistoric artifacts (275)
Dega 2000	Helani Church Lot, Kahalu‘u	Burial testing: 16 trenches excavated, one burial was encountered (SIHP # -7707); prior AIS identified and recorded (Anderson 1998)
McEldowney and Smith 2001	Helani Church Lot, Kahalu‘u	Field inspection and assessment of lava tubes: verification and resolution of certain issues pertaining to SIHP #s -21404 and -21396
Walker and Rosendahl 2002	Azabu Keauhou Resort Mauka Parcel, Kahalu‘u	Inventory survey: described 254 sites containing 532 component features
Jones et al. 2003	KIC Development Parcel 26, Kahalu‘u	Burial testing study: five sites tested with human remains identified at four sites
Moore et al. 2003	Two KIC Development Parcels (TMKs: [3] 7-8-010:004 (por.) and 7-8-014:056), Kahalu‘u	Archaeological inventory survey: 14 sites comprised of 56 individual features identified
Jones et al. 2004	KIC Development Parcel 26, Kahalu‘u	Archaeological inventory survey: 45 pre-Contact archaeological sites re-identified; total of ten test units excavated at eight sites; five features tested positive for human remnants
Garrett et al. 2006	KIC Development Parcel 50, Kahalu‘u	Inventory survey: 23 sites with 204 component features recorded, mainly agricultural and or habitation complexes typical of Kona Field System
Dye and Ayau 2007	**Ke‘ekū and Hapaiali‘i Heiau**	**Preservation plan: documentation and restoration of Ke‘ekū and Hapaiali‘i Heiau, with goal of returning heiau appropriate cultural use; included burial treatment plan for remains found at Hāpaiali‘i**
Dye and Ayau 2008	**Mākole‘ā and Kapuanoni Heiau and Po‘o Hawai‘i Pond**	**Preservation plan: documentation and restoration of Mākole‘ā and Kapuanoni Heiau and Po‘o Hawai‘i Pond, with goal of returning heiau to appropriate cultural use and to stabilize and restore Po‘o Hawai‘i as habitat for native animals**
Loubser and Rechtman 2008	Keauhou Lot 14C (TMK: [3] 7-8-010:093), Kahalu‘u	Archaeological data recovery investigation: mitigated adverse effects to SIHP #s -7827, -7829, and -7830

Source	Location of Study	Nature of Study*
Tulchin and Hammatt 2008	Edge of Kamehameha III Rd adjacent to Keauhou Shopping center, KIC Development Parcel 31a, Kahalu‘u	Archaeological inventory survey: documented two historic properties, prehistoric foot trail remnant and agricultural feature remnants
Kalawe and Dye 2010	**Mākole‘ā Heiau**	**Archaeological investigations during restoration: included plane table mapping of pre-restoration remnant, comparisons with existing maps of site, and limited archaeological excavations to inform restoration effort**
McDermott and Hammatt 2010	KIC Development Parcel 50, Kahalu‘u	Inventory survey: 23 historic properties comprised of 204 component features identified within project area
Garrett et al. 2011	KIC Development Parcel 50, Kahalu‘u	Inventory survey: 23 sites with 204 component features recorded, mainly agricultural and/or habitation complexes typical of Kona Field System
Dye 2012	**Ke‘ekū Heiau**	**Archaeological investigations during restoration: included plane table mapping of pre-restoration remnant, comparisons with existing maps of site, and limited archaeological excavations to inform restoration effort**

*All SIHP numbers are prefixed “50-10-37-”

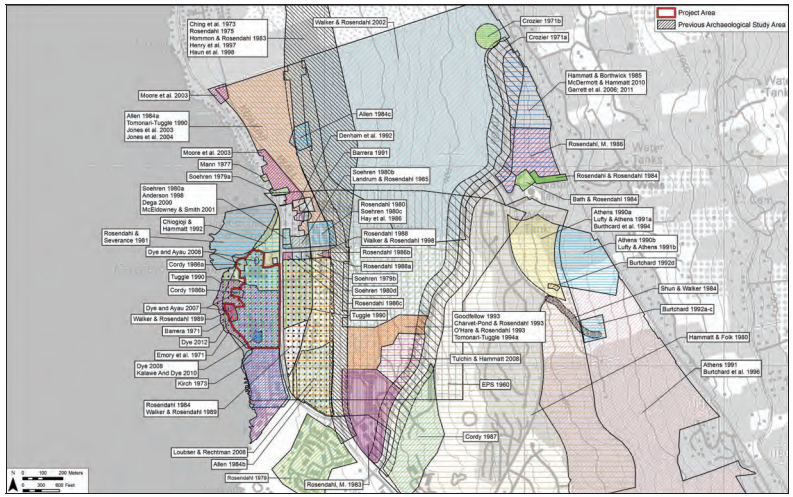


Figure 28. Portion of 1996 Kealakekua USGS 7.5-Minute topographic quadrangle, showing previous archaeological studies of Kahalu'u Ahupua'a (*makai* of Kuakini Highway)

4.2 Previous Archaeological Studies within the Project Area

Including the earliest coastal surveys (e.g., Stokes 1906-1907 and Reineke 1930), nine archaeological studies have been conducted within the present project area (see entires in bold in Table 4). These studies are briefly summarized below in chronological order, and most are shown on Figure 29. It should be noted that, while the present project area is understood to be defined on the *makai* side by the high-tide line, these previous studies typically extended beyond this limit into the sea, leading to the documentation of sites within the surf zone (e.g., the Pāokamenehune, Ulupalakua, the Kamalalawalu Petroglyph field).

4.2.1 Stokes 1906-1907 (1991 with Tom Dye, editor)

John F.G. Stokes was given the task by the Bishop Museum in 1906 of recording the coastal *heiau* of Hawai'i Island, building upon the preliminary work of Thomas G. Thrum (see Table 4; not shown on Figure 28 and Figure 29). Visiting the sites of more than 100 *heiau* island-wide, he drew "plans of more than forty of the best preserved foundations, and collected as much oral data as possible" (Stokes and Dye 1991:12).

Stokes recorded the *heiau* of Halela'au, Ku'emanu, 'Ōhi'amukumuku, Kapuanoni, Hanakalau'ai, Hāpaiali'i, Ke'ekū, Mākole'ā, Paoumi or Poumi, a smaller Ke'ekū located east of the Government Road, and Ka'io'ena or Keahiolo in Kahalu'u (Stokes and Dye 1991:67-83). He drew maps at Halela'au, Ku'emanu, Hāpaiali'i, Ke'ekū, Paoumi, and Keahiolo; photographs were taken at Hāpaiali'i and Ke'ekū (Stokes and Dye 1991:72-79). He noted that 'Ōhi'amukumuku was no longer standing (the stones had likely been used to build area church buildings), and that no structure or "history" remained for Hanakalau'ai (Stokes and Dye 1991:70-71). Furthermore, though he did not actually visit the site of the smaller Ke'ekū, he concluded that it functioned as an agricultural *heiau* (Stokes and Dye 1991:83). While Mokuahi'ole was on the list of Kahalu'u *heiau* from Thrum, based on local information and structural appearance Stokes determined it was rather the residence of Ke'eaumoku (Stokes and Dye 1991:71).

Stokes also observed a number of petroglyphs—also known as the "Ke'ekū petroglyphs"—southwest of the *heiau* on a *pāhoehoe* flat that is submerged at high tide. One of the component anthropomorphic glyphs was said to represent Kamalalawalu, the Maui king believed to have been sacrificed at Ke'ekū by Lonoikamakahiki (Stokes and Dye 1991:77, 79; see Section 3.3.3). Two site numbers have been assigned for this cluster of petroglyphs: SIHP #s -11875 and -12954; this site appears to fall just outside the bounds of the present project area (see Figure 2).

4.2.2 Reinecke 1930

J.E. Reinecke carried out an extensive survey of coastal portions of Keauhou and Kahalu'u for Bishop Museum (see Table 4; not shown on Figure 28 and Figure 29). He recorded numerous sites within Kahalu'u; however, his descriptions vary in detail and the sites were typically plotted on a small scale. In his report, Reineke (1930:1) mentions that "the little inlet Malailena" was considered to represent the traditional southern boundary of Kahaluu, while "the modern boundary line runs from Paniau Point to Keahiolo Heiau." He divided the "rest of the land of Kahaluu" into several sections:

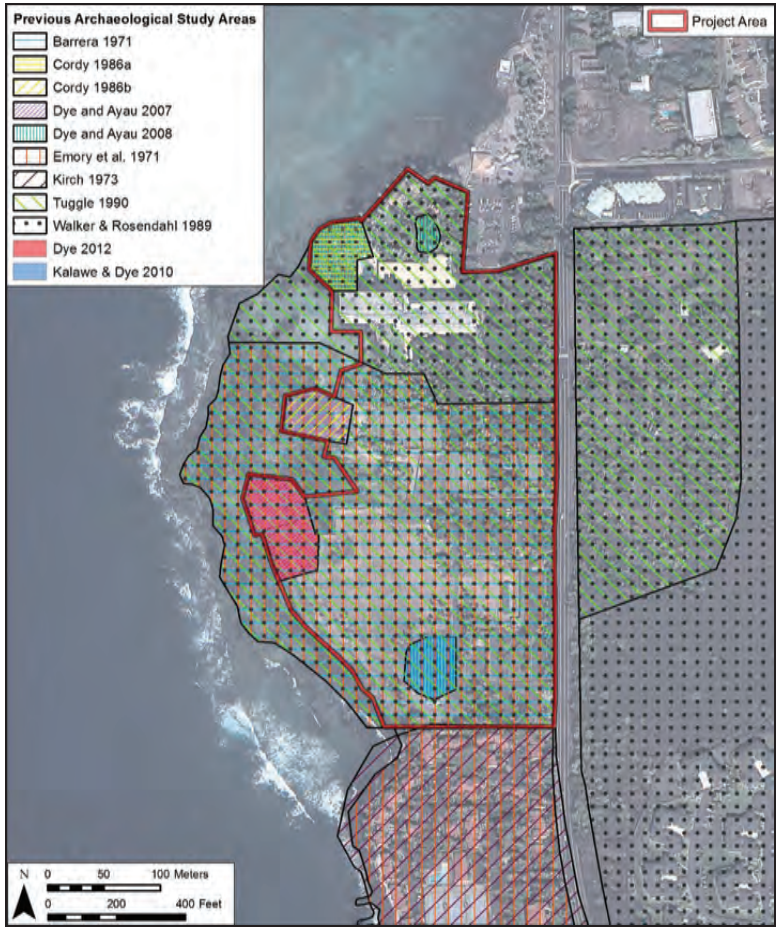


Figure 29. 2010 aerial photograph (Google Earth 2010) showing previous archaeological studies within and immediately adjacent to the present project area

> (1) the beach strip, which is covered by a Bishop Estate map, scale 1:1000; (2) the mixed pahoehoe and a-a flow on the south of Kahaluu, noteworthy for its pits excavated in the solid pahoehoe, possibly for planting, and merging into (3) the thickly overgrown older flow in middle and northern Kahaluu; (4) the mauka section of coffee plantations and ohia growth, not touched by this survey. [Reineke 1930:1]

Reineke (1930:1) noted that “[n]ext to the numerous *heiau* and the abundant springs, the most noticeable feature of this district is the caves.” He also discusses the difficult task that would have been the construction of the breakwater, and how “[s]ince the breakwater has been broken down, the beach line has receded.” His descriptions of the major shoreline sites are fairly detailed, and include references to observations made by Stokes and Thrum where applicable.

4.2.3 Sterling 1960

This early Bishop Museum study (see Table 4; not shown on Figure 28 and Figure 29) summarized the background history given by Reineke (1930) and provided brief descriptions “of some of the more important sites” “concentrated in the shore area between Ku‘emanu Heiau (St. Peter’s Church) and Paniau Point” (Sterling 1960:2). The report included a sketch map showing the locations of these sites (see Figure 21).

4.2.4 Emory et al. 1971

This preliminary survey, which included historical research by Dorothy Barrère, was undertaken by the Bishop Musuem at KIC Development Parcels 1, 7, 9 and 13b (see Table 4, Figure 28 and Figure 29). (Of these, Parcel 13b overlaps the present project area; see Figure 27.) This work was initiated due to development related to the tourist boom in and around Kailua-Kona at that time; Emory et al. (1971:iii) write that “. . . a large percentage of the Hawaiian archaeological sites has been eradicated, and the remainder is threatened by loss as never before.” Furthermore, the report notes that archaeological research “up to now has been able to do little more than disclose the surface appearance of sites” Emory et al. (1971:iii). The investigation concluded that there remained “an immediate need for further survey and test excavations between Keauhou and Kahalu‘u Bays, *makai* . . . of Alii Drive” (Emory et al. 1971:12).

It was under this study that Bishop Museum numbers were assigned to certain sites in the project area, some of which were preserved in the later SIHP numbering system (see Section 4.3). The archaeological survey documented a total of 47 sites, and revealed the existence of several previously unrecorded sites.

Within KIC Parcel 13b, one house site (D4-49), one stone wall (D4-47, then identified as the Kuakini Wall), one pond (D4-52, Keawehala), two *heiau* (D4-3 [SIHP # -03818], Ke‘ekū; D4-5 [SIHP # -03819], Mākole‘a), one grave platform (D4-34 [SIHP # -01616]), and two petroglyph fields (D4-53; D4-54) were noted (Emory et al. 1971:15). The locations of these sites were plotted on a contour map (Figure 30), and substantial discussions of the sites, including functional evaluations and recommendations, were given. In Parcel 13b, scatters of coral and waterworn cobbles (*‘ili‘ili*) were thought to “indicate the former existence of other sites upland of the two heiau”; according to Emory et al. (1971:16) “most of this area was bulldozed in 1968, including all but a small section of the historic Kuakini wall.”

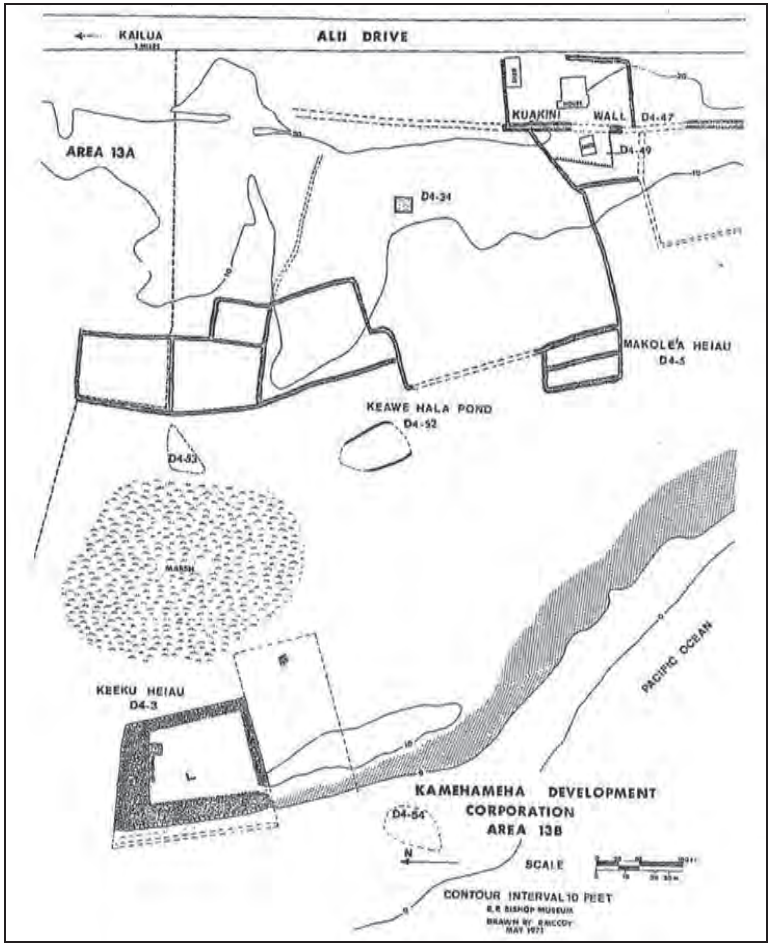


Figure 30. Map from Emory et al. (1971:17) showing the location of sites documented within KIC Parcel 13b

Clearing, restoration and preservation were recommeded for Ke‘ekū Heiau (D4-3 [SIHP # -03818]) and Mākole‘a Heiau (D4-5 [SIHP # -03819]) (Emory et al. 1971:19, 21). As hotel development necessitated the destruction of the potential burial platform (D4-34 [SIHP # -01616]), dismantling by an archaeologist was recommended (Emory et al. 1971:21). Excavation was recommended for the platform at D4-49, and further recordation was recommended for Keawehala Pond (D4-52 and the petroglyph fields D4-53 and D4-54—preservation was recommended if possible for the latter as well) (Emory et al. 1971:22-24).

4.2.5 Barrera 1971

Later that same year the Bishop Mueum (Barrera 1971; see Table 4, Figure 28 and Figure 29) returned to conduct excavation at sites documented during the Emory et al. (1971) survey of KIC Development Parcels 7 and 13b. Furthermore, a series of preliminary walk-through surveys were conducted on KIC Development Parcels 4, 11, 12, 17, and 18 “with the aim of determining the nature and extent of archaeological remains in the specified areas” (Barrera 1971:1).

Within KIC Development Parcel 13b, excavation was undertaken at a large stone platform (SIHP # D4-34/-01616), further observations were made at Keawehala Pond (SIHP # D4-52), and a small petroglyph field (SIHP # D4-53) was recorded. SIHP # D4-34/-01616 was found to be constructed over a lava bubble and to contain a sedimentary deposit; according to Barrera 1971:12, “Although no skeleton was found, a human phalange was found in the platform fill, suggesting that a corpse had been placed on top of the platform.”

The report contains a summary of recommendations for the sites documented under the 1971 surveys, including the sites in Parcel 13b (Berrera et al. 1971:38). As noted in Section 4.2.4 above, Ke‘ekū Heiau and Mākole‘a Heiau were recommended for preservation as historical monuments. Following the excavation of the platform at SIHP # D4-34/-01616, no further work was recommended, although archaeological monitoring was recommended for its planned destruction. Preservation was recommended for the section of the Kuakini Wall facing the paved house site (D4-49) and extending 15 ft beyond each side of the paved area (which was also recommended for preservation). The petroglyph field at SIHP # D4-54 was recommended for preservation. No further work was recommended for Keawehala Pond, or for the petroglyphs at SIHP # D4-53.

4.2.6 Cordy 1986a

In response to damage induced by high seas in 1986, the DNLR undertook an investigation of Kapuanoni Heiau (Cordy 1986a; see Table 4, Figure 28, and Figure 29). This study included historical research followed by an archaeological field check to assess the state of Kapuanoni (SIHP # -10997). Background research yielded little information specific to this *heiau*, beyond that documented in the early surveys of Stokes and Reineke (see Section 3.3.3). The archaeological fieldcheck showed that Kapuanoni remained in virtually the same state as it had been when Kekahuna mapped it in 1952, indicating the site was not drastically disturbed by construction activities related to the adjacent hotel. In addition, Cordy (1986a) made the following observations:

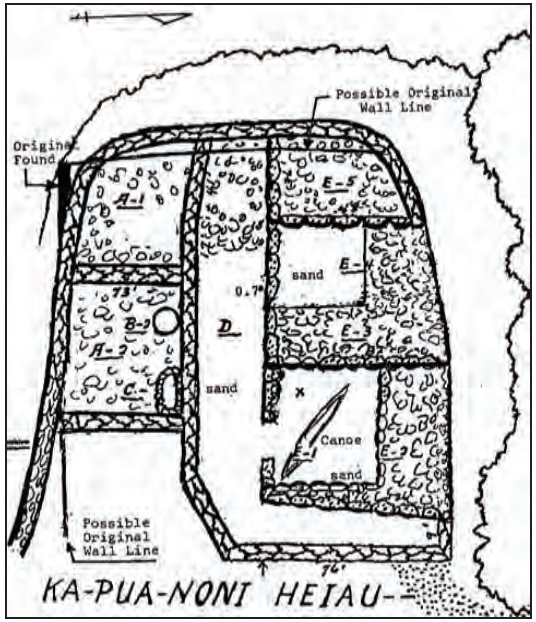


Figure 31. Portion of Kekahuna’s (1952) map of Kapuanoni Heiau showing Cordy’s (1986a:10) annotations

> The fieldcheck shows that Kapuanoni has definitely been altered. The exterior wall is clearly not the original wall. The original wall seems to have once been rectangular in shape. At some point in time, it was moved in, had its corners curved, and been reinforced with cement. Also, interior walls have been restored. However, the internal features and deposits still seem to be present, and the original wall foundation is visible.
>
> Future research at this heiau would be desirable. The original foundations need to be completely traced out. Also, excavations in the midden deposits and in the stone architecture are needed to try to determine the heiau’s age, whether prior building stages are present, and whether the site was a heiau, a residence, or a combination residence-heiau. [Cordy 1986a:12]

4.2.7 Cordy 1986b

That same year, and for the same reasons, Cordy also conducted investigations for Hāpaiali‘i Heiau (Cordy 1986b; see Table 4, Figure 28, and Figure 29). Background research yielded similar results as at Kapuanoni Heiau. The archaeological fieldcheck showed that Hāpaiali‘i Heiau (SIHP # -03817) exhibited some damage, but that much of it was still intact, including “at least the basal course of the facing alignments . . . around all the walls of the heiau” (Cordy 1986b:11). Cordy’s assessment was that the *heiau* could be restored. Cordy (1986b) noted that:

> A scope of work for restoration has been submitted separately to the Keauhou Beach Hotel. It calls for archaeological mapping and excavation of the damaged areas and then for restoring the facings and fill to their original height and removing vegetation. The excavations are needed to check for possible facings that might indicate earlier building phases and are needed to try and recover datable material, so the heiau can be better dated. [Cordy 1986b:15]

4.2.8 Walker and Rosendahl 1989

In 1988 Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological reconnaissance survey for the Environmental Impact Statement (EIS) for the proposed Azabu Keauhou Resort project (Walker and Rosendahl 1989; see Table 4, Figure 28, and Figure 29). The 70-acre project area comprised two study areas (Study Areas 2 and 3) separated by Alii Drive; Study Area 3 coincides with KIC Parcel 13a and 13b, within the present project area. Overall, 110 sites were documented, of which 23 were newly identified.

This study clarified the earlier interpretation of site SIHP # D4-47/-12955 as the Kuakini Wall by Emory et al. (1971). This wall segment was confirmed during the 1988 survey, and the Kuakini Wall was discovered to be “actually situated a short distance inland” (Walker and Rosendahl 1989:4). According to the report, “Sites D4-34 [SIHP 01616, platform] and -52 [pond] apparently were destroyed during construction of the Kona Lagoon Hotel. Site D4-53 [petroglyphs] . . . may also have been destroyed, or it may be hidden in the low cover of weeds which surrounds the brackish-water pond northwest of the Kona Lagoon Hotel” (Walker and Rosendahl 1989:5).

Five sites were newly identified within Study Area 3. These included Temporary Site #s 50, a midden and *‘ili‘ili* scatter; 51 and 52, wells; 53, the Po‘o Hawai‘i Pond; and 57, an enclosure. All of these sites were interpreted to be “prehistoric” or “prehistoric-historic” and associated with habitation. The locations of these sites were indicated on a map within the report (Figure 32).

Walker and Rosendahl (1989) summarized Study Area 3 as follows:

> In Study Area 3 the general areas of Kapuanoni and Makolea heiau and the area of Po‘o Hawaii have been extensively altered. In addition, Kapuanoni Heiau has been rebuilt historically with concrete and has been partially incorporated into Keauhou Beach Hotel. Hapaialii Heiau, also in Study Area 3, has been naturally eroded historically by storm surf. Despite the historic land modifications in Study Area 3, the sites in the area still contain excellent potential in terms of interpretive development, scientific research value, and cultural values. [Walker and Rosendahl 1989:33]

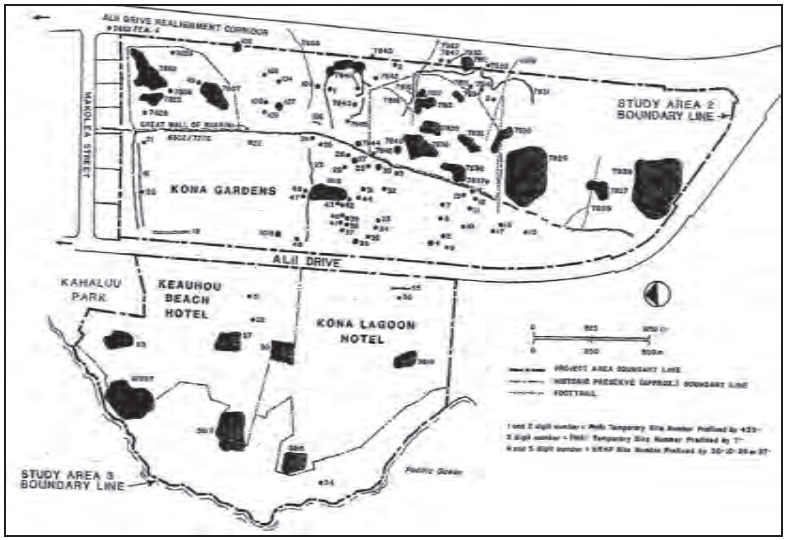


Figure 32. Map from Walker and Rosendahl (1989:25) showing the location of sites documented within Study Areas 2 and 3

4.2.9 Tuggle 1990

Following preparation of a data recovery plan (Tuggle 1989) based on results of the Walker and Rosendahl (1989) survey, International Archaeological Research Institute, Inc. (IARII) undertook Phase I of historic preservation mitigation for proposed improvements for the Azabu Kona Resort Property (Tuggle 1990; see Table 4, Figure 28, and Figure 29). Phase I included archaeological field investigations involving a data recovery plan and a preservation plan. According to Tuggle (1990:i), “Data Recovery sites were mapped and test excavated. Preservation sites were mapped in detail.” The report presented SIHP numbers for the sites recorded under the Walker and Rosendahl (1989) study (Figure 33), and up-to-date site descriptions and historical analyses.

The 1990 fieldwork included data recovery at the midden scatter identified the previous year (now termed an enclosure related to LCA 5966, SIHP # -12950); at the two wells (now combined under SIHP # -12951); at the enclosure north of the midden scatter (SIHP # -12957); and at a wall and house site (now combined under SIHP # -12955) (Tuggle 1990:6).

SIHP # -12950 was recommended for a Phase II of data recovery, with the intent of locating a house foundation from the nineteenth century and obtaining artifacts from the same period (Tuggle 1990:36). The excavation of three tests units at the site indicated deposits in the area are shallow and highly disturbed. The south wall of the site was disturbed by construction of the Kona Lagoon Hotel, while the northern and eastern walls were in good condiditon with indications of having been rebuilt. According to Tuggle (1990:36), “There are no surface indications of the two houses said to have existed in 1848.”

Excavation at the wells (SIHP #s -12951A and B) yielded few finds; unearthed midden and flake materials appeared to be part of secondary depositions. The wells were reinterpreted as historic sites (as opposed to prehistoric-historic). While no further work was recommended, it was suggested that “provision should be made for the accidental encounter of intact cultural deposits that could exist in the area” (Tuggle 1990:37).

The wall and house site at SIHP # -12955 were reinterpreted as historic features (as opposed to prehistoric and prehistoric-historic), as they were discovered to represent LCA 5632. Excavation of a test unit at the “old terrace location” indicated a “complex history of occupational deposition and feature construction” representing “an extensive time range” (Tuggle 1990:37-38). Detailed data recovery was recommended “if the the area is to be affected by any project activities”; as no such activities were planned at the time, Tuggle (1990:38) recommended that the site be placed under an interim category of Conditional Preservation.

At the time of the 1990 study, SIHP # -12957 (corresponding to LCA 5693) was being used as a landscaped garden. As at SIHP # -12955, excavation at this site confirmed a complex history of ongoing use and occupation in the historic area; the site was recommended for conditional preservation as the proposed project would have no effect, and monitoring of any earth-moving around the site was recommended (Tuggle 1990:38-41).

Several of the sites within the project area were recommended for Exhibition (or Preservation with Interpretation). For the purposes of the 1990 investigation, this meant “collecting baseline information for future preservation action” (Tuggle 1990:49). These sites included Hāpai‘ali‘i,

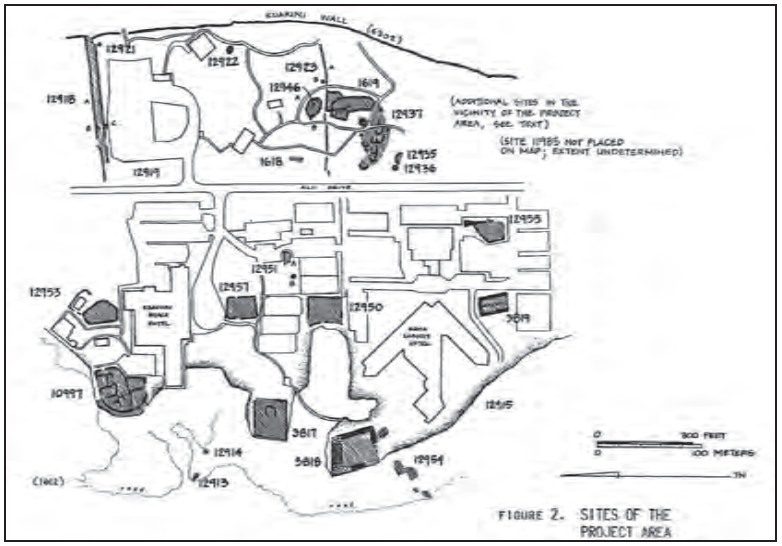


Figure 33. Map from Tuggle (1990:3) showing the location of sites documented within the project area using SIHP numbering

Ke‘ekū, Mākole‘a, and Kapuanoni Heaiu (SIHP #s -03817, -03818, -03819, and -10997, respectively); and Po‘o Hawai‘i (SIHP # -12953). At these sites, information was collected primarily through detailed mapping. Determination of appropriate buffer zones was recommended for the four *heiau*, with exterior testing to better determine the site boundaries. Buffers were also recommended for the Ke‘ekū Petroglyphs (referred to in this report as SIHP # -12954, though referred to as SIHP # -11875 in Tuggle [1989]) (Tuggle 1990:49).

Regarding Po‘o Hawai‘i (SIHP # -12953), understood to represent “a walled pond and associated area commonly considered an ali‘i residential locale,” Tuggle (1990:62) writes “excavation should be conducted here as part of a long-range preservation plan to determine if there are any intact deposits.” Tuggle notes that any such deposits “would be among the most important in Kahalu‘u, possibly containing a cross-section of the entire history of the region” (Tuggle 1990:62).

Tuggle (1990:65) also discusses for the first time SIHP # -12915, a sand dune area south of Ke‘ekū “noted as a burial area by members of the Kahalu‘u community.” Archaeological monitoring was recommended for any earth-moving activities in this area.

4.2.10 Kalawe and Dye 2010

T.S. Dye & Colleagues, Archaeologists, Inc. undertook archaeological investigations in preparation of the restoration of Mākole‘ā Heiau (Kalawe and Dye 2010; see Table 4, Figure 28, and Figure 29). These invesitgations included a summation of background research for the site; plane table mapping of the remnant at that time; a comparison of the plane table maps with the maps of Stokes (1906) and Kekahuna (1952); and limited excavation “primarily to establish the stratigraphic position of the *heiau* structure and to obtain *suitable dating material* with which to estimate a construction date” (Kalawe and Dye 2010:3). Radiocarbon samples were obtained from two of the four test pits, with results indicating that the *heiau* was constructed between AD 1550 and 1819. Some faunal remains were also documented during the excavation work. In addition, two artifacts were collected from the surface, including a basalt and coral abrader.

4.2.11 Dye 2012

Similarly, T.S. Dye & Colleagues, Archaeologists, Inc. undertook archaeological investigations in preparation of the restoration of Ke‘ekū Heiau (Dye 2012; see Table 4, Figure 28, and Figure 29). These invesitgations included a summation of background research for the site; plane table mapping of the remnant at that time; a comparison of the plane table maps with the maps of Stokes (1906) and Kekahuna (1952); limited excavation “in areas where the original lines of the *heiau* are not firmly established . . . to expose buried foundation stones and other features”; creation of a foundation layout for the restoration work; and participation in the restoration work “to record evidence for earlier structures that might exist within the walls and platform of the *heiau*” (Dye 2012:4-5). Five test units and one “long trench” were undertaken. These excavations indicated “the northern end of the east wall was built over older cultural deposits. Charcoal collected from the buried cultural deposits was identified but did not yield suitable dating materials” (Dye 2012:19). A trolling lure point was recovered from the excavation in this area of the *heiau*; excavation in the interior did not yield evidence of cultural deposits (Dye 2012:19).

4.3 Sites Previously Recorded Within the Project Area

Thirteen sites have been recorded within the present project area, taking into consideration the subsumation of temporarily numbered features into single SIHP sites, and including those sites no longer present. These sites are summarized in Table 5 and are indicated on a 2010 aerial photograph (Figure 34) and tax map plat (Figure 35). Table 5 lists the SIHP number as well as other site numbers where applicable; the place name associated with the site where applicable; past archaeological studies under which the site was documented; the formal site type and function; the probable site age; the significance evaluation and recommendation (most current as determined through research into previous archaeological studies); and the present status of the site and/or any other applicable comments.

Of the 13 sites in the project area, four are recognized as part of the Kahalu‘u Historic District (SIHP # -04150; see Figure 8). These include SIHP # -03817 (Hāpaiali‘i Heiau), SIHP # -03818 (Ke‘ekū Heiau), SIHP # -03819 (Mākole‘ā Heiau), and SIHP # -Ha-D4-34/-01616 (burial platform destroyed by the Kona Lagoon Hotel construction).

In 2009, T.S. Dye & Colleagues, Archaeologists, Inc. was contracted by Kamehameha Schools-Land Assets Division (KS-LAD) for the Archaeological Information Consolidation Project (AICP). This project was designed to manage the large amount of data on the Kahalu‘u and Keauhou 1 and 2 area for future planning and development (Komori 2009:2). The project resulted in three informational databases: one for previous archaeological reports, another for previously recorded sites, and a third containing Geographic Information System (GIS) data for the subject *ahupua‘a*. Table 5 represents a synthesis of information found in these databases and current background research. The following brief site descriptions come verbatim (excepting negligible editorial changes) from the AICP site database. Expanded site descriptions, taken from the most recent applicable archaeological publication(s), can be found in Appendix B of the AISP.

4.3.1 SIHP # 50-10-37-03817 (Hāpaiali‘i Heiau)

Hāpaiali‘i Heiau (see Table 5, Figure 34 and Figure 35) was first recorded by Stokes in 1906. Reinecke (1930) includes Stokes’ 1906 notes about the *heiau* in his report. Cordy (1986) documents the *heiau* as a rectangular, high platform measuring approximately 29 m by 39 m, 1,131 sq m; maximum height is 2.4 m. On top of the *heiau* are a pavement and three-sided enclosure.

4.3.2 SIHP # 50-10-37-03818 (Ke‘ekū Heiau)

Ke‘ekū Heiau (see Table 5, Figure 34 and Figure 35) is an irregularly shaped quadrilateral *heiau* enclosure formed by thick, high walls, with an open court on the south, 56 by 44 m (Haun 2004), and first recorded by Stokes in 1906. Reinecke (1930) includes Stokes’ 1906 notes about the *heiau* in his report. The site was said to be used for human sacrifices and as a *pu‘uhonua* (place of refuge). (This site also includes the adjacent Hale O Papa.)

Table 5. Sites Previously Recorded Within the Project Area

SIHP Number	Other Site Number	Site Name	Past Studies	Site Type	Site Function	Site Age	Significance Evaluation*	Recommendation(s)	Status and Comment(s)
50-10-37-03817	50-Ha-D4-2, H-00165-25	Hāpaiali‘i Heiau	Stokes 1906-07; Reinecke 1930; Sterling 1960; Cordy 1986b; Walker and Rosendahl 1989; Tuggle 1990	Enclosure, *heiau*, pavement, platform	Ceremonial, religious	Pre-Contact; built AD 1200s or 1300s–1400s	Walker and Rosendahl (1989): A, B, and C	Restoration, preservation	Restored
50-10-37-03818	50-HA-D4-3, H-00073-4, H-00165-24	Ke‘ekū Heiau + Hale O Papa	Stokes 1906-07; Reinecke 1930; Sterling 1960; Emory et al. 1971; Walker and Rosendahl 1989; Tuggle 1990; Haun and Henry 2004a, b; Dye 2012	Depression, enclosure, *heiau*, platform	Ceremonial, religious	Pre-Contact; built AD 1200s to 1300s	Walker and Rosendahl (1989): A, B, and C	Restoration, preservation	90% restored; nominated to Hawai‘i Register of Historic Places (HRHP) 24 July 1972
50-10-37-03819	50-Ha-D4-5, H-00073-6, H-00165-22	Mākole‘ā Heiau or Ke‘ekua-pua‘a Heiau	Stokes 1906-07; Reinecke 1930; Sterling 1960; Emory et al. 1971; Walker and Rosendahl 1989; Tuggle 1989, 1990; Haun and Henry 2004a, b; Kalawe and Dye 2010	Enclosure, *heiau*, pavement, wall	Ceremonial, religious	Pre-Contact; likely post AD 1550	Walker and Rosendahl (1989): A, B, and C	Restoration, preservation	Restored; nominated to HRHP 24 April 1972
50-10-37-10997	H-00073-2, H-00165-41	Kapuano ni Heiau	Stokes 1906-07; Reinecke 1930; Sterling 1960; Cordy 1986a; Walker and Rosendahl 1989; Tuggle 1990	Enclosure, *heiau*, pavement	Ceremonial, religious	Pre-Contact	Walker and Rosendahl (1989): A, B, and C	Restoration, preservation	Not yet restored

SIHP Number	Other Site Number	Site Name	Past Studies	Site Type	Site Function	Site Age	Significance Evaluation*	Recommendation(s)	Status and Comment(s)
50-10-37-12915	H-01426-AZK-7	--	Tuggle 1990	Sand dune	Probable burial	Unknown, likely pre-Contact	None found	Archaeological monitoring for any earth-disturbing activity; will be placed in a Conservation category if proven as a burial site (i.e., if remains are exposed at a furture date)	No current information on exact location of burials; listed as “probable site” (as of 1990)
50-10-37-12950	PHRI 439-50, H00769, H01426	--	Walker and Rosendahl 1989; Tuggle 1990	Complex	Habitation	Historic; dates from nineteenth century	Walker and Rosendahl (1989): A	Additional data recovery	Site is remnant of a *kuleana* lot (LCA 5966), shown on Kekahuna’s (1952) sketch as home of the caretaker of twin *mo‘o* sisters of Keawehala Pond
50-10-37-12951	PHRI 439-51, PHRI 439-52, H-00769, H-01426	--	Walker and Rosendahl 1989; Tuggle 1990	Faced well complex (Features A and B)	Habitation	Historic; dates from nineteenth century	Walker and Rosendahl (1989): A	No further work recommended for wells	Present though likely modified in modem times

SIHP Number	Other Site Number	Site Name	Past Studies	Site Type	Site Function	Site Age	Significance Evaluation*	Recommendation(s)	Status and Comment(s)
50-10-37-12953	PHRI 439-53, H-00165-43, H-00748-11881	Po‘o Hawai‘i	Reinecke 1930; Walker and Rosendahl 1989; Tuggle 1990	Complex including walled pond and adjacent habitation area	Habitation	Unknown	Walker and Rosendahl (1989): A, B, and C	Restoration, preservation	Not yet restored; adjacent Kalakāua’s Residence reconstructed in the 1970s
50-10-37-12955	PHRI 439-55, PHRI 439-56, 50-Ha-D4-47, 50-Ha-D4-49	--	Emory et al. 1971; Walker and Rosendahl 1989; Tuggle 1990; Haun and Henry 2004a, b	Complex	Boundary, habitation	Historic; dates from early 1800s to the mid-1900s	Walker and Rosendahl (1989): A	Conditional preservation *until* additional data recovery can be conducted	Site is remnant of a *kuleana* lot (LCA 5632:1) granted to Keikiho‘o-kama; mistakenly identified by Emory et al. (1971) as containing portion of Kuakini Wall

SIHP Number	Other Site Number	Site Name	Past Studies	Site Type	Site Function	Site Age	Significance Evaluation*	Recommendation(s)	Status and Comment(s)
50-10-37-12957	PHRI 439-57	--	Walker and Rosendahl 1989; Tuggle 1990	Complex	Habitation	Historic; probably dates from mid- to late nineteenth century	Walker and Rosendahl (1989): A	Conditional preservation with archaeological monitoring of earth-moving activities in area outside site *until* additional data recovery can be conducted	Site is remnant of a *kuleana* lot (LCA 5693)
50-10-37-Ha-D4-34 / 50-10-37-01616	50-Ha-D4-34	--	Emory et al. 1971; Barrera 1971	Platform	Possible burial	Unknown	None found	N/A	Destroyed by construction of Kona Lagoon Hotel (per Walker and Rosendahl 1989:24)
50-10-37-Ha-D4-52	50-Ha-D4-52	Keawehala Pond	Emory et al. 1971; Barrera 1971	Stone-lined pond	Bathing pool	Unknown; likely pre-Contact	None found	N/A	Traditionally considered to be home of twin *mo'o* sisters; filled for the Kona Lagoon Hotel; site now a level landscaped area (per Walker and Rosendahl 1989:24)

SIHP Number	Other Site Number	Site Name	Past Studies	Site Type	Site Function	Site Age	Significance Evaluation*	Recommendation(s)	Status and Comment(s)
50-10-37-Ha-D4-53	50-Ha-D4-53	--	Emory et al. 1971; Barrera 1971	Petroglyph field	Rock art / communication	Unknown; likely pre-Contact	None found	N/A	Likely destroyed by construction of Kona Lagoon Hotel; location not confirmed by Walker and Rosendahl (1989:24)

*The criteria for evaluating site significance have changed since Walker and Rosendahl (1989) presented evaluations for nearly all of the sites within the project area. As more recent evaluations could not presently be found, the 1989 evaluations are listed herein (current significance evaluation criteria are given in Section 8). The criteria employed by Walker and Rosendahl (1989) are as follows:

General Significance Categories:

A = Important for information content, further data collection necessary (PHRI=research value)

X = Important for information content, no further data collection necessary (PHRI=research value, SHPO=not significant)

B = Excellent example of a site type at local, region, island, state, or national level (PHRI=interpretive value)

C = Culturally significant (PHRI=cultural value)

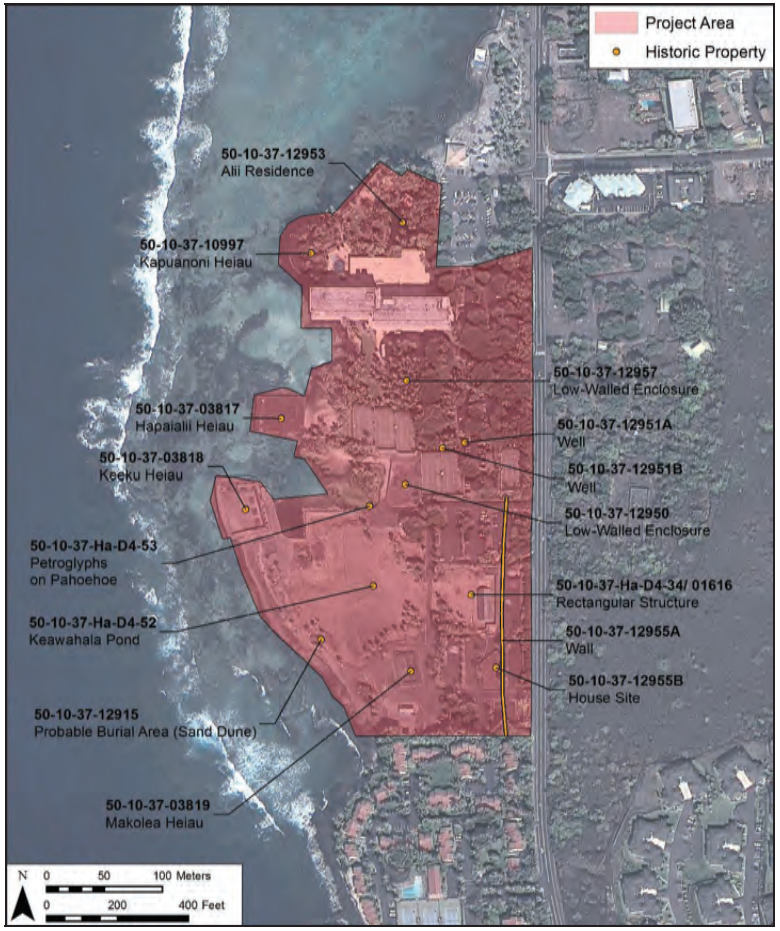


Figure 34. 2010 aerial photograph (Google Earth 2010) showing sites previously recorded within the project area

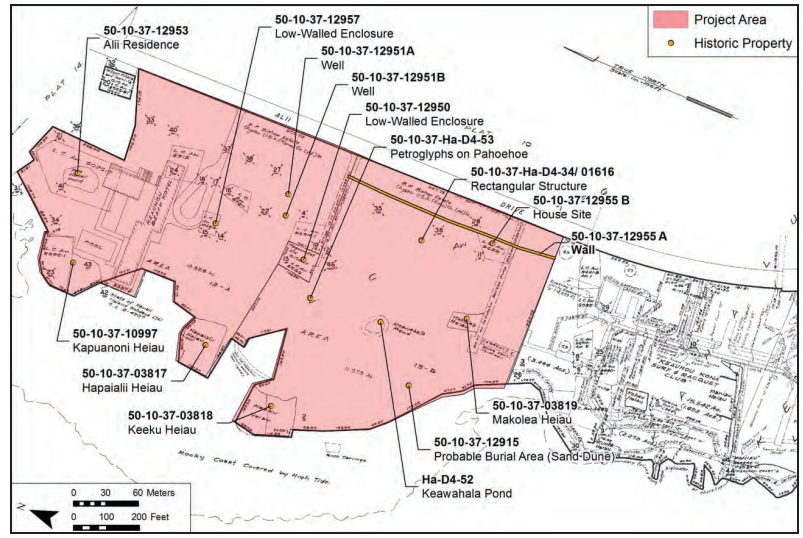


Figure 35. Tax map plat 7-8-013 (Hawai‘i TMK Service) showing sites previously recorded within the project area

4.3.3 SIHP # 50-10-37-03819 (Mākole‘ā Heiau)

Mākole‘ā Heiau or Ke‘ekuapua‘a Heiau (see Table 5, Figure 34 and Figure 35) was described by Stokes in 1906. Reinecke (1930) includes Stokes’ 1906 notes in his report. It is an irregular quadrilateral enclosure constructed of *pāhoehoe*. The walls vary from 1-2 m in height and reach a maximum width of 3 m. An interior wall divides the court into two sections.

4.3.4 SIHP # 50-10-37-10997 (Kapuanoni Heiau)

Kapuanoni Heiau (see Table 5, Figure 34 and Figure 35) was recorded by Stokes in 1906; it measures approximately 30 by 46 m (1,380 sq m) with walls approximately 2 m high. There are two internal divisions—a set of three pavements and a set of two enclosures. Traditions suggest it was used as a *heiau* for general prayers.

4.3.5 SIHP # 50-10-37-12915 (Probable Burial Area—Sand Dune)

This site is classified as the dune area along the coast south of Ke‘ekū Heiau (see Table 5, Figure 34 and Figure 35). There are probably burials as indicated by members of the Kahalu‘u community, but they have not been specifically identified. Tuggle (1990) lists the site as a “probable site.”

4.3.6 SIHP # 50-10-37-12950 (Low-Walled Enclosure—LCA 5966)

Walker and Rosendahl (1989) define site as a “midden area and *‘ili‘ili* scatter” low-walled enclosure, representing the remains of *kuleana* parcel LCA 5966 [see Table 5, Figure 34 and Figure 35]. Site area measures c. 30 x 23 m. Tuggle (1990) indicates that despite extensive disturbance and modern trash, further work is recommended. Midden and *‘ili‘ili* scatter in a roughly rectangular plan. Bordered to the south and to the east by wall foundations. The south wall is collapsed and measures c. 0.5 – 0.6 m wide and 0.2 – 0.3 m high.

4.3.7 SIHP # 50-10-37-12951 (Well Complex)

Walker and Rosendahl (1989) define the site as a “midden area and *‘ili‘ili* scatter” low-walled enclosure, representing the remains of *kuleana* parcel LCA 5966 (see Table 5, Figure 34 and Figure 35). The site area measures approximately 30 m by 23 m. Tuggle (1990) indicates that despite extensive disturbance and modern trash, further work is recommended. Midden and *‘ili‘ili* scatter was observed in a roughly rectangular plan. The site is bordered to the south and to the east by wall foundations. The south wall is collapsed and measures approximately 0.5-0.6 m wide and 0.2-0.3 m high.

4.3.8 SIHP # 50-10-37-12953 (Ali‘i Residence—Po‘o Hawai‘i Pond)

Po‘o Hawai‘i Pond (see Table 5, Figure 34 and Figure 35) is a brackish water pond with a retaining rock wall along its perimeter, identified on current tax maps as LCA 6026:2. Reinecke (1930) and Kekahuna (1952) identify the area of this site as a residence for ancient royalty and as a bathing area for the *ali‘i*. The site area measures approximately 34 m by 23 m by 0.9 m. It is listed in H-00748 (Tuggle 1989) as site 11881.

4.3.9 SIHP # 50-10-37-12955 (House Site/Wall—LCA 5632:1)

The site contains two features originally recorded as two separate sites (see Table 5, Figure 34 and Figure 35). Feature A (BPBM D4-47/PHRI 439-55) is a wall mistakenly identified as the Great Wall of Kuakini by Emory et al (1971). Feature B (BPBM D4-49/PHRI 439-56) is a house site which was left as a landscaped island when an adjacent parking lot was built; it measures approximately 26 m by 16 m by 0.2 m. The west and south sides, 26 m by 13 m long, are well defined by a rock wall 20 cm high.

4.3.10 SIHP # 50-10-37-12957 (Low-Walled Enclosure—LCA 5693)

This is a low-walled enclosure (see Table 5, Figure 34 and Figure 35) measuring 30 m by 23 m by 1 m, bi-faced and core-filled on the east, south, and west sides. The retaining wall on the north end appears to be of recent construction. The wall is 0.6-1 m high and has an average width of 0.9 m. The site is the location of *kuleana* parcel (LCA 5693). Tuggle (1990) indicates a high probability of encountering remnant deposits with further survey.

4.3.11 SIHP # 50-10-37- Ha-D4-34 (also known as SIHP No. -01616, Rectangular Structure)

The rectangular structure is 80 cm by 70 cm, outlined by stones with three sides constructed of waterworn stones; the fourth side is lined with *‘a‘ā* and filled with sand to the top of the sides (see see Table 5, Figure 34 and Figure 35).

4.3.12 SIHP # 50-10-37- Ha-D4-52 (Keawehala Pond)

Keawahala [Keawehala] Pond (see Table 5, Figure 34 and Figure 35) is located at the limit of the high-tide zone between Ke‘ekū and Mākole‘ā Heiau. Roughly oval in shape, it measures approximately 20 m by 30 m. The wall has a 50 cm wide break on the west side. Wall width is 1.3-3.5 m and height is 80-110 cm above the bottom of the pond.

4.3.13 SIHP # 50-10-37- Ha-D4-53 (Petroglyphs on Pāhoehoe)

Twenty petroglyphs are pecked into an area of exposed *pāhoehoe*, 19 m by 20 m (see Table 5, Figure 34 and Figure 35).

4.4 Background Summary and Predictive Model

Kahalu‘u Ahupua‘a is suggested to have been initially settled sometime around AD 900 (Burtchard et al. 1996). Early settlement was marine resource-oriented, with habitation focused around Kahalu‘u Bay. By AD 1300, upland areas at least 4,000 ft inland were cultivated. Settlement and cultivation activities in Kahalu‘u expanded between the fourteenth and sixteenth centuries, during which Kahalu‘u Ahupua‘a became a self-sufficient socio-economic land unit. With the neighboring *ahupua‘a* of Keauhou, Kahalu‘u was the home to many high chiefs, as evidenced through traditional histories and the construction of significant *heiau* and residential complexes.

During the historic period, the population in Kahalu‘u rapidly declined due to introduced diseases and demographic shifts to the urban centers at Kailua-Kona and Ka‘awaloa. During the first half of the nineteenth century, Keauhou Bay was utilized as an anchorage for ships, where

vessels would replenish stocks of firewood, sandalwood, and various food stocks supplied by the abundance of the Kona Field System.

The best data related to land use in the historical period comes from government land records of the mid-1800s. Fifty-six Land Commission Awards (LCAs) were granted within Kahalu‘u, seven within the project area. The settlement pattern evidenced by the *kuleana* data indicates coastal house lots with associated upland agricultural plots. The coastal house lots were all *makai* (west) of the Kuakini Wall and the agricultural plots were *mauka* (east) of the present day Kuakini Highway. Māhele data for the LCAs within the project area reflect the “idle” nature of the coastal lands up to this time.

Lacking sufficient water and easily developable land, the Kona Coast of Hawai‘i was largely spared the changes associated with plantation agriculture that affected so much of Hawai‘i. However, the economic opportunities created by this commercial agriculture elsewhere were another pull for relocation away from Kahalu‘u. The uplands of Kahalu‘u became more important as the century drew to a close with the growth of coffee cultivation, with small towns springing up along the belt highway during the early twentieth century.

Tourism grew almost exponentially in the decades after WWII and radically changed the face of Kahalu‘u. Hotels and resorts sprung up in Kahau‘u and Keauhou in response to an influx of visitors flying into the new airport in Kailua Kona. In 1968 and 1975, respectively, the Outrigger Keauhou Beach Resort and the Kona Lagoon Hotel were constructed within the project area, disturbing in whole or in part several archaeological features. Since the early 1980s development has continued with residential subdivisions, shopping centers, golf courses, and more.

The Kona Lagoon Hotel was demolished in 2004. Over the next several years, a shift began toward education and recognition of the cultural importance of this area. From 2007 to 2009 Hāpaiali‘i, Mākole‘ā, and Ke‘ekū Heiau were restored (Ke‘ekū Heiau is 90% restored). A preservation plan has also been completed for the restoration of Kapuanoni Heiau and the Po‘o Hawai‘i Pond.

Keauhou/Kahalu‘u is one of the most studied areas in Polynesia, and the great majority of the studies have been conducted *makai* of Kuakini Highway (Belt Highway 11). Virtually all of the archaeological studies undertaken found not only evidence of human occupation, but also evidence of permanent habitation and agricultural development in areas that have not been graded.

The major coastal *heiau* of Kahalu‘u (including those within the project area) were the subject of some of the earliest archaeological surveys on Hawai‘i Island (e.g., Stokes 1906-1907, Reineke 1930). In the 1950s, Henry Kekahuna drew detailed maps of the Kahalu‘u coastline annotated with extensive handwritten notes; to this day these maps prove to be an invaluable resource. During the 1970s and 1980s archaeological studies took place in response to the construction of the Outrigger Keauhou Beach Resort and the Kona Lagoon Hotel, and to damage wrought by high seas. These surveys documented a handful of additional sites within the current project area, related to either the traditional history of Kahalu‘u as a cheifly center or to the nineteenth century occupation of the area brought on by the Māhele, and provided further insight into the major sites previously recorded there.

Archaeological monitoring was undertaken for the demolition of the Kona Lagoon Hotel in 2004. The Outrigger Keauhou Beach Resort ceased operation in October 2012 and is slated for demolition to make way for the proposed project.

Section 5 Results of Fieldwork

5.1 Overview

The fieldwork component of the archaeological inventory survey was accomplished on 22–24 October 2013, 8 and 25 November 2013, 6–31 January 2014, 11 February 2014, and 25 March 2014 by CSH archaeologists Trevor Yucha, B.S., Fred LaChance, B.A., Johnny Dudoit, B.A., and Olivier Bautista, B.A. under the general supervision of Hallett H. Hammatt, Ph.D. (principal investigator). The fieldwork required approximately 42 person days to complete. The fieldwork included pedestrian survey and documentation of surface features; a Ground Penetrating Radar (GPR) Survey; layout, excavation and documentation of test trenches; and core sampling.

In addition to the tasks discussed above, CSH observed a geotechnical survey undertaken within the project area by Hirata and Associates, Inc. This work was observed by archaeologist Johnny Dudoit, B.A., on 18–27 March 2014, requiring an additional 6 person days to complete. The observations recorded by CSH are presented in Appendix D and summarized in Section 7.

Eight previously identified historic properties were documented during the inventory survey investigation (Table 6). No new historic properties were encountered. Furthermore, while two previously recorded sites within the project area were known to have been destroyed (SIHP # -Ha-D4-34/01616 [rectangular structure] and -Ha-D4-53 [Keawehala Pond]) the current survey also did not locate three previously recorded sites: SIHP # -12915 (dune burials), -12950 (low-walled enclosure), and -HaD4-53 (petroglyphs). The latter two sites were likely impacted by developments near the center of the project area. SIHP # -12915 is believed to still be present but buried. The current status of all the historic properties within the project area is summarized in Table 6.

Figure 36 through Figure 38 depict the locations of the eight confirmed historic properties within the project area, as well as the locations of the five uncomfirmed historic properties previously documented in the project area. Also shown are the locations of the 29 test trenches (T-01 through T-29), shovel test (STP-1), and two core sampling areas (C-1 and C-2) investigated during the AIS.

The following sections provide the results of the GPR survey, updated historic property descriptions, and the results of subsurface testing and sediment core sampling. Section 6 provides the results of laboratory analysis for materials collected during the subsurface and sampling work.

Table 6. Historic Properties Assessed during the Current AIS

SIHP Number	Other Site Number(s)	Site Name	Site Type	Site Function	Site Age	Status and Comment(s)
50-10-37-03817	50-Ha-D4-2, H-00165-25	Hāpaiali‘i Heiau	*Heiau*	Ceremonial, religious	Pre-Contact; built AD 1200s or 1300s-1400s	Confirmed as restored and documented during the current investigation
50-10-37-03818	50-HA-D4-3, H-00073-4, H-00165-24	Ke‘ekū Heiau + Hale O Papa	*Heiau* complex	Ceremonial, religious	Pre-Contact; built between AD 1200s to 1300s	Ke‘ekū confirmed as 90% restored and documented during the current investigation; however, previously restored Hale O Papa damaged by the 2011 tsunami and requires re-restoration; this feature fully mapped and documented
50-10-37-03819	50-Ha-D4-5, H-00073-6, H-00165-22	Mākole‘ā Heiau or Ke‘ekua-pua‘a Heiau	*Heiau*	Ceremonial, religious	Pre-Contact; likely post- AD 1550	Confirmed as restored and documented during the current investigation
50-10-37-10997	H-00073-2, H-00165-41	Kapuanoni Heiau	*Heiau*	Ceremonial, religious	Pre-Contact	Confirmed and documented during the current investigation in anticipation of future restoration
50-10-37-12915	H-01426-AZK-7	Probable Burial Area (Sand Dune)	Sand dune	Probable burial	Unknown, likely pre-Contact	Not confirmed during the current investigation; believed to be present but buried
50-10-37-12950	PHRI 439-50, H00769, H01426	--	Complex	Habitation	Historic; dates from nineteenth century	Not confirmed during the current investigation; believed to be destroyed

SIHP Number	Other Site Number(s)	Site Name	Site Type	Site Function	Site Age	Status and Comment(s)
50-10-37-12951	PHRI 439-51, PHRI 439-52, H-00769, H-1426	--	Faced well complex (Features A and B)	Habitation	Historic; dates from nineteenth century	Confirmed and documented during the current investigation
50-10-37-12953	PHRI 439-53, H-00165-43, H-00748-11881	Po‘o Hawai‘i	Complex including walled pond and adjacent habitation area	Habitation	Unknown (over 50 years)	Confirmed and documented during the current investigation in anticipation of future restoration
50-10-37-12955	PHRI 439-55, PHRI 439-56, 50-Ha-D4-47, 50-Ha-D4-49	--	Complex	Boundary, habitation	Historic; dates from early 1800s to the mid-1900s	Confirmed and documented during the current investigation in anticipation of future restoration
50-10-37-12957	PHRI 439-57	--	Complex	Habitation	Historic (probably dates from mid to late nineteenth century) and modern	Confirmed and documented during the current investigation
50-10-37-Ha-D4-34 / 50-10-37-01616	50-Ha-D4-34	--	Platform	Possible burial	Unknown	Not confirmed during the current investigation; believed to be destroyed
50-10-37-Ha-D4-52	50-Ha-D4-52	Keawehala Pond	Stone-lined pond	Bathing pool	Unknown; likely pre-Contact	Not confirmed during the current investigation; believed to be destroyed
50-10-37-Ha-D4-53	50-Ha-D4-53	--	Petroglyph field	Rock Art / communica-tion	Unknown; likely pre-Contact	Not confirmed during the current investigation; believed to be destroyed

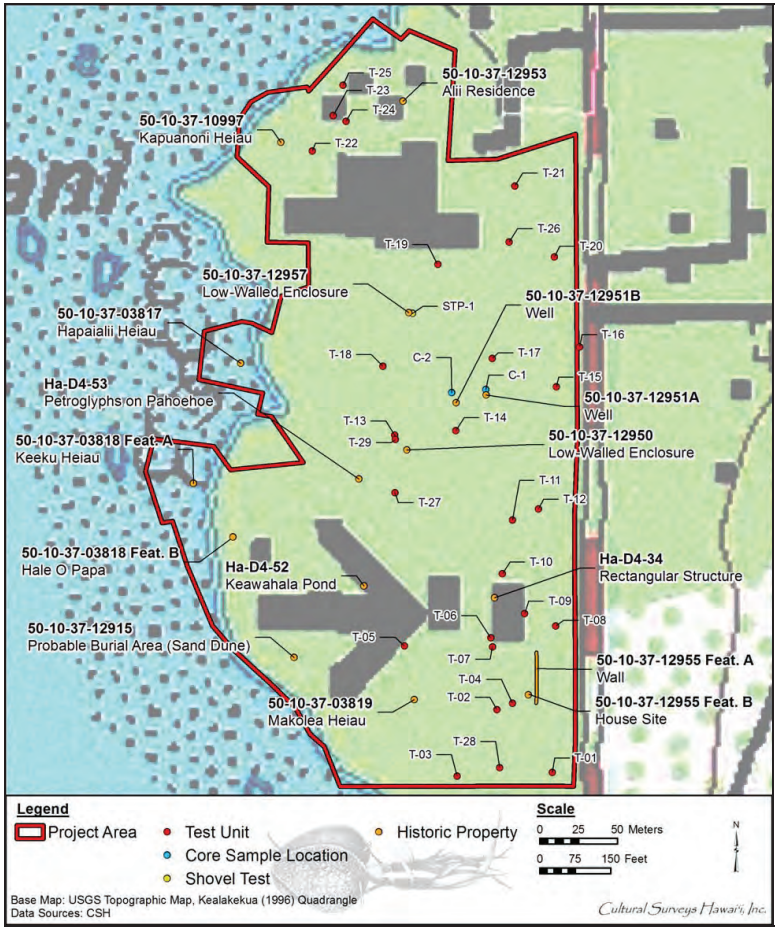


Figure 36. Portion of the 1996 Kealakekua USGS 7.5-Minute Topographic Quadrangle, showing the locations of historic properties, test trenches (T-#), core sample locations (C-#) and a shovel test point (STP-1) within the project area

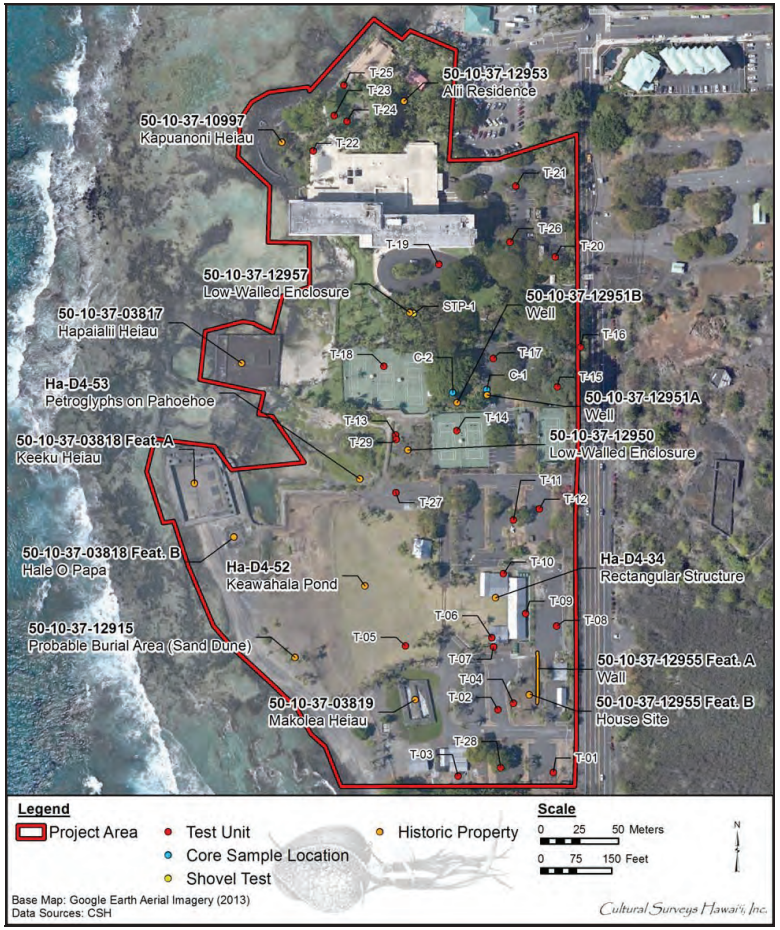


Figure 37. Aerial photograph showing the locations of historic properties, test trenches (T-#), core sample locations (C-#) and a shovel test point (STP-1) within the project area (Google Earth 2013)

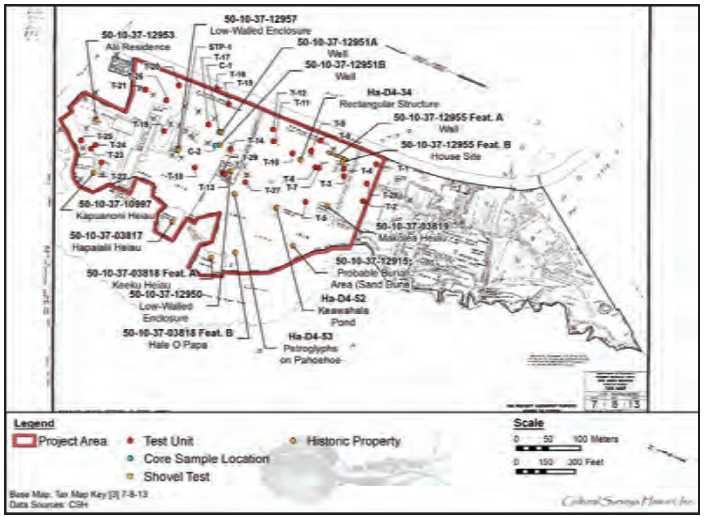


Figure 38. Tax Map Key (TMK) 7-8-013, showing the the locations of historic properties, test trenches (T-#), core sample locations (C-#) and a shovel test point (STP-1) within the project area (Hawai‘i TMK Service 2009)

5.2 Ground Penetrating Radar

A GPR survey was conducted within the project area prior to subsurface testing in an attempt to define the local stratigraphy and to prospect for buried cultural deposits. Seven discrete locations (Grids 1–7) within the project area were surveyed with GPR (Figure 39) prior to the first phase of subsurface testing. Fieldwork was conducted on 8 November 2013 by CSH archaeologists Frederick LaChance B.A. and Oliver Bautista B.A. under the overall direction of the project’s principal investigator Hallett H. Hammatt, Ph.D.

5.2.1 Background

Ground-penetrating radar data are acquired by transmitting pulses of electromagnetic energy in the radar frequency range, into the ground via a sending antenna. Each time a radar pulse encounters a material with a different density, electrical conductivity, or chemical composition a portion of the radar energy will reflect back to the surface and be recorded via a receiving antenna. The remaining radar energy will continue to pass into the ground to be further reflected, until it finally dissipates with depth. Reflection features may include discrete objects, stratigraphic layering, or other subsurface anomalies such as disturbances associated with utility installation or human interment.

The effectiveness of GPR is highly dependent on local soil conditions. The penetration depth of GPR is determined by antenna frequency and the electrical conductivity of the earthen materials being profiled (Daniels 2004). Soils having high electrical conductivity rapidly attenuate radar energy, restrict penetration depths, and severely limit the effectiveness of GPR (USDA NRCS GPR Methodology n.d.). The electrical conductivity of soils increases with increasing water, clay, and soluble salt contents.

GPR suitability maps created by the National Resource Conservation Service (NRCS) were reviewed in an attempt to anticipate the predominant soil matrix within the project area and to assess the relative suitability of GPR application. Figure 40 shows the project area on the NRCS GPR Suitability Map for Hawai‘i. The project area is shown to predominantly traverse lands within the “Not Rated” GPR suitability range. The absence of a rating is likely attributed to the presence of surface *pāhoehoe* flows and lack of non-imported soils within the project area. The NRCS provides the following discussion when defining their GPR suitability categories:

> Areas dominated by mineral soil materials with less than 10 percent clay or very deep organic soils with pH values < 4.5 in all layers have very high potential for GPR applications. Areas with very high potential afford the greatest possibility for deep, high resolution profiling with GPR. However, depending on the ionic concentration of the soil solution and the amounts and types of clay minerals in the soil matrix, signal attenuation and penetration depths will vary. With a 200 MHz antenna, in soils with very high potential for GPR, the effective penetration depth has averaged about 16.5 feet. However, because of variations in textural layering, mineralogy, soil water content, and the ionic concentration of the soil water, the depth of penetration can range from 3.3 to greater than 50 feet.

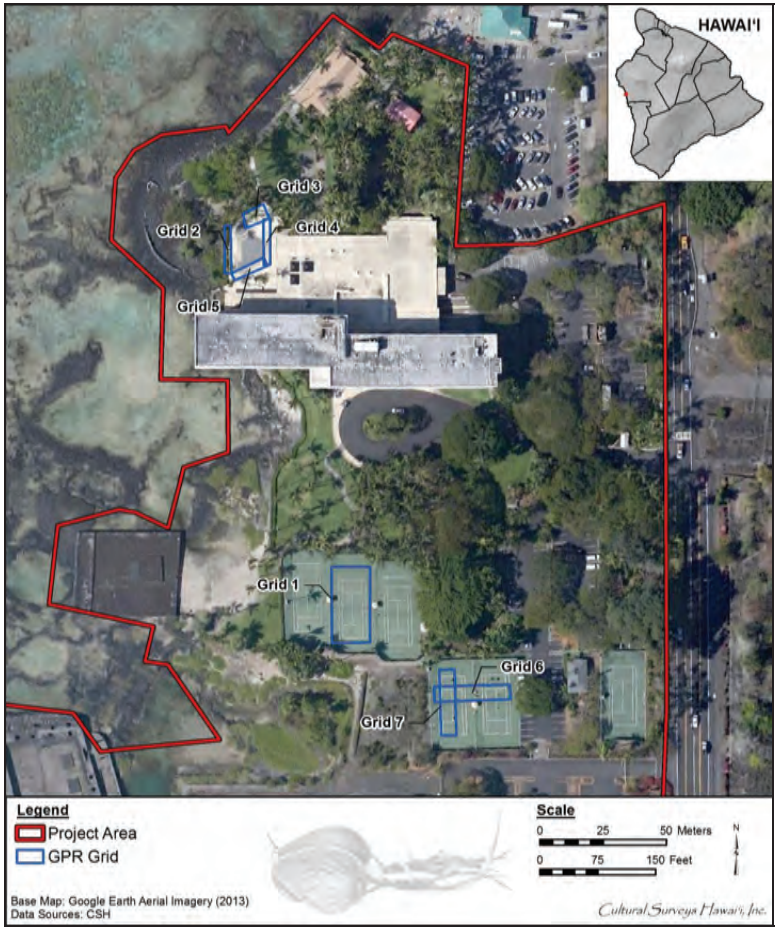


Figure 39. Aerial photograph showing the location of GPR grids within the project area

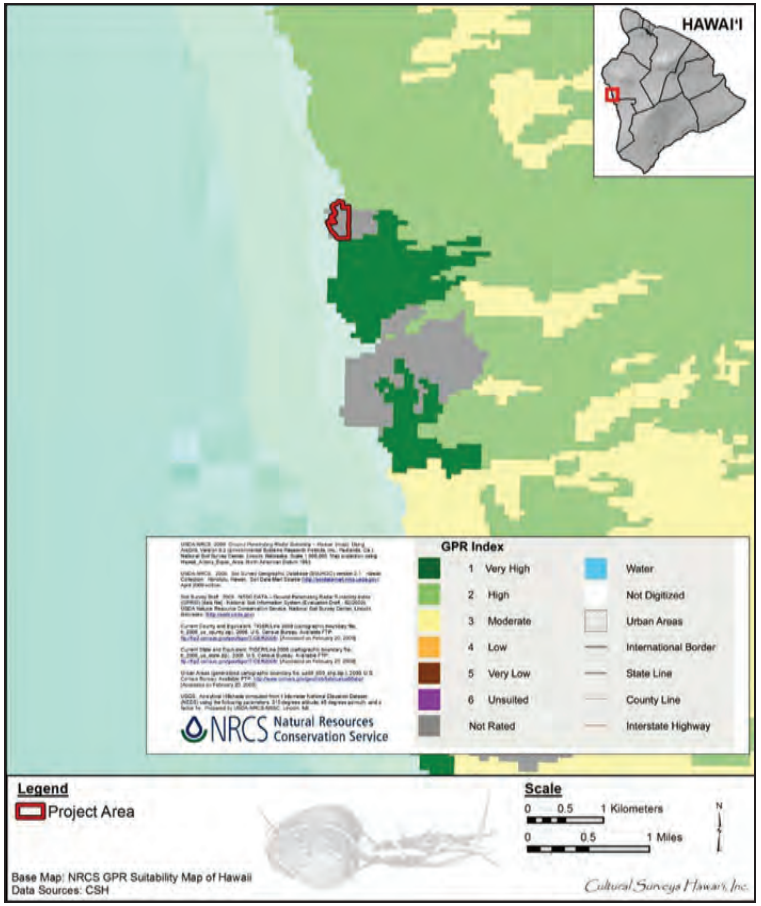


Figure 40. GPR suitability map (source: National Resource Conservation Service) showing the location of the study area

> Areas dominated by mineral soils with 18 to 35 percent clay or with 35 to 60 percent clay that are mostly low-activity clay minerals have moderate potential for GPR. Low activity clays are principally associated with older, more intensely weathered soils. In soils with moderate potential for GPR, the effective penetration depth with a 200 MHz antenna has averaged about 7 feet with a range of about 1.6 to 16 feet. Though penetration depths are restricted, soil polygons with moderate potential are suited to many GPR applications.
>
> Mineral soils with 35 to 60 percent clay, or calcareous and/or gypsiferous soils with 18 to 35 percent clay have low potential for GPR. Areas with low potential are very depth restrictive to GPR. In soils with low potential for GPR, the depth of penetration with a 200 MHz antenna has averaged about 1.6 feet with a range of about 0.8 to 6.5 feet. Areas that are unsuited to GPR consist of saline and sodic soils. These soil map units are principally restricted to arid and semiarid regions and coastal areas of the United States. [USDA NRCS GPR Methodology n.d.]

Note the estimated depth penetration by the NRCS is based on the use of a 200MHz antenna. The current survey utilizes a 400MHz antenna, which balances radar penetration depth with image resolution, so all projected depth estimates by the NRCS must be cut in half. Thus average depth penetration would be 1.0 m (3.5 ft) in moderate suitability areas and 0.2 m (0.8 ft) in low suitability areas.

5.2.2 Survey Methodology

The GPR survey was conducted using a Geophysical Survey Systems, Inc. (GSSI) SIR-3000 system equipped with 400 MHz radar antenna, which was moved along transects within a survey grid (Figure 41). Due to computer interpolation software (Radan 7; see Post-processing section below) it was only necessary to run data collection transects along one axis of each survey grid (X or Y). In order to standardize the data collection process all transects were run in the Y direction, originating from an arbitrary southwest corner of the grid (Figure 42). Transect spacing was 50 cm. GPS points were taken at the corners of the GPR grid using a Trimble Pathfinder Pro XH (with sub-meter post-processed horizontal accuracy). The size of the GPR grids was dictated by obstacles near the surveyed excavation margins including trees, signs, curbs, etc.

5.2.3 Data Collection Parameters

GPR data collection parameters were held constant throughout the survey (Table 7). USDA soil survey data indicated the majority of the project area consists of *pāhoehoe* lava flows (rLW). A dielectric constant of 12.0 was used throughout the project area during fieldwork as an average to analyze the *pāhoehoe* bedrock, natural sand, and imported fill soils. The dielectric constant was adjusted during post-processing once known depths are determined as a form of signal calibration.

Figure 41. Stock photograph showing an example of a GPR grid and antenna

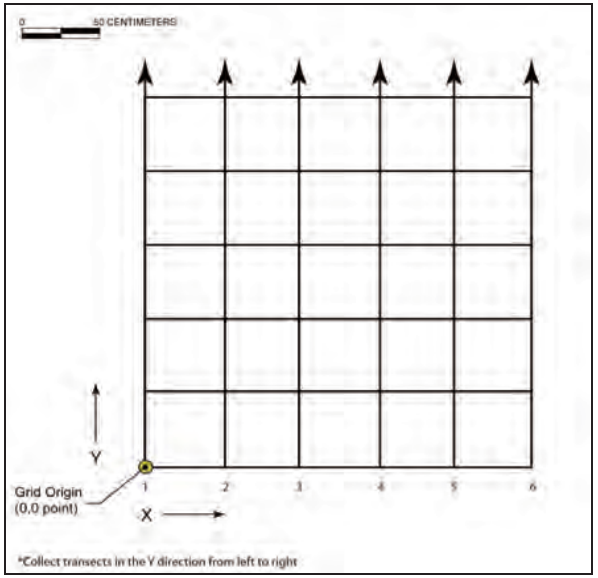


Figure 42. Transect alignment and spacing

Table 7. GPR Data Collection Parameters

Parameter	Settings
Antenna	400 MHz
Transmission rate	120KHz
Samples	512
Format	16-bit
Range	47 nanoseconds
Dielectric	12.0
Rate	120
Scans per unit	75 per meter
Low pass filter	750MHz
High pass filter	200MHz

5.2.4 Post-processing

All collected radar data were post-processed using RADAN 7, which is an industry standard for GPR data processing.

RADAN 7 was utilized to generate two-dimensional depth profiles from the collected GPR data. These profiles illustrate the geometry of the reflections recorded during data collection. An analysis of these profiles can determine whether the radar energy is reflecting from a flat stratigraphic layer (seen as a distinct horizontal band on a profile), a discrete buried object (seen as a hyperbola in profile), or from stratigraphic irregularities such as subsurface disturbances associated with utility installation or human interment (also seen as hyperbolas, but usually more ephemeral and consisting of clustered reflections).

Position correction was utilized to remove unwanted surface “noise” from GPR profiles. High and low pass filters were applied to remove any excess background “noise” generated from nearby power lines, radio frequencies, etc. during data collection. Gain (signal amplification) was also applied to accent poorly defined or ephemeral reflection typically associated with subsurface cultural deposits.

RADAN 7 was also used to generate amplitude slice maps from the collected GPR data. Amplitude slice-maps are a three-dimensional tool for viewing differences in radar reflection amplitudes across a given surface at various depths. Amplitude slice maps can be thought of as plan view maps or excavation level records that display GPR data at user-defined depth intervals. Reflected radar amplitudes are of interest because they measure the degree of physical and chemical differences in buried materials, which in turn can indicate the presence of stratigraphic interfaces, descrete buried objects (e.g., basalt boulders, utility lines, burial caskets), or stratigraphic irregularties (i.e., subsurface anomalies associated with burial pits, fire pits, buried irrigation ditches, etc.). The amplitude slice maps are also important because they allow the visulization of radar reflections throughout the entire data set collected at a survey area at a given depth. This gives size and shape to collected radar reflections, which can aid in the interpretation of identified subsurface anomalies.

Amplitude slice maps are generated through the comparison of radar reflection amplitudes recorded in vertical depth profiles, which correspond to individual transects collected within a survey grid along the X-axis (note that while transects are collected in the Y-direction, they are actually located within the X-axis). In this method, amplitude variations are analyzed at each location where a radar reflection was recorded. Reflection amplitude data from the X-axis is then used to interpolate reflection data onto the Y-axis.

5.2.5 Interpretation and Results

5.2.5.1 Slice Map Analysis

GPR slice maps are a three-dimensional tool for imaging radar reflection amplitudes across an axial plane at various depth intervals. Slice maps can essentially be thought of as a GPR plan view of the survey area. By combining and interpolating transect profiles in a plan view, slice maps give shape to anomalous signal returns that extend into multiple profiles. For this project, slice maps were primarily used to locate signal shapes that may represent buried structures like

walls, foundations, crypts, etc. Slice map results were also used to distinguish subsurface stratigraphy dominated by *pāhoehoe* lava flows and areas with soil deposits.

For this project, slice maps were generated in RADAN 7 using Color Table 1 which is able to display very subtle changes in reflectivity as well as highly contrasting reflection transitions. Figure 43 is an annotated example of a GPR slice map used for this project and a guide for interpretation.

5.2.5.2 Profile Analysis

Following post-processing, interpretation of GPR profiles began with locating and identifying reflection interfaces. It was important to determine if changes in reflectivity represent actual subsurface transitions/features or signal interferences. Interferences in signal return can result from random electromagnetic noise (i.e., cellular devices, ELF emissions from power lines), harmonic signal resonance, standing surface water, etc. Signal interference can take the visual form of regularly repeating reflections or random noise that will display a “digitized” or discontinuous look on the GPR profiles. Transmitted signals can also harmonically resonate, which will cause repeating signal horizons and false increases in reflectivity. Harmonic resonance is often caused by the transmitted signal encountering a metal object creating a “ringing” effect. Rough surface topography can also cause the GPR antennae to lose contact or “uncouple” the transmitted signal from the surface, effectively scattering the signal. Examples of signal interference can be seen at the bottom of Figure 44. Signal filters can be applied to remove interference during post-processing but should be kept to a minimum to avoid losing subtle signal changes that can offer information. Once the determination of clean signal versus interference had been made, GPR profile analysis for this project was approached in three ways: locating signals representing discrete subsurface objects, identifying sediment material based on reflectivity and signal texture, and determining stratigraphy based on reflectivity transitions.

Discrete Objects

The reflected signal generated by a discrete buried object is generally hyperbolic in form. The apex, or top of a hyperbola, represents the origin of the object. In general, larger objects form larger hyperbolas and the width of the hyperbolic apex is relative to the diameter or width of the object. This method of analysis is used to locate utilities, cultural deposits, building structures, etc. It is important to consider the data collection transect orientation and spacing carefully when applying this method. Objects located between collection interval lines may be missed or misread. Features aligned parallel to the collected signal transect will form continuous horizontal reflections. For instance, a pipe that runs parallel to the collected transect will appear as a horizontal line on the GPR profile. A good example of a hyperbolic reflection created by a discrete object (utility pipe) is located on Figure 44.

Sediments

GPR data can be used as a non-invasive method to determine subsurface sedimentation based on signal reflectivity and texture. Signal reflectivity is affected by variations in material density, compaction, geochemistry of sediment material, water content, etc. These factors ultimately determine material conductivity and signal attenuation. Less conductive materials like sand or

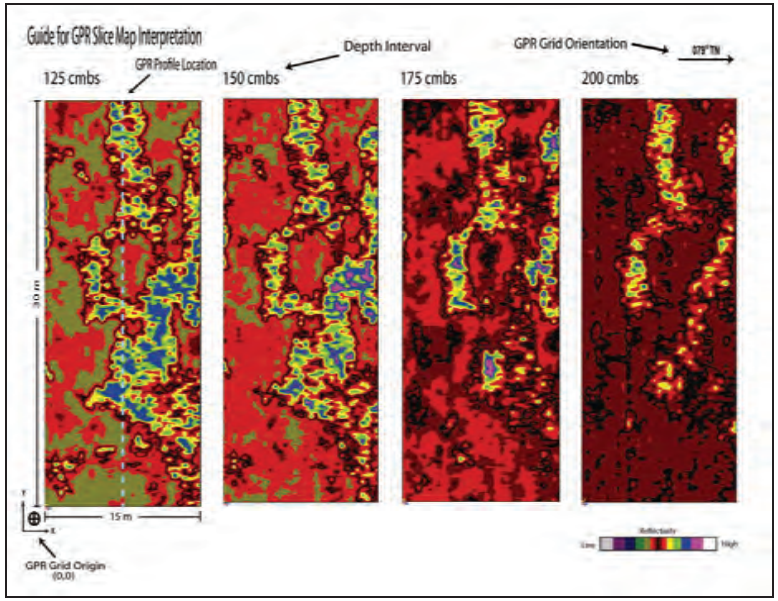


Figure 43. Guide for GPR slice map interpretation

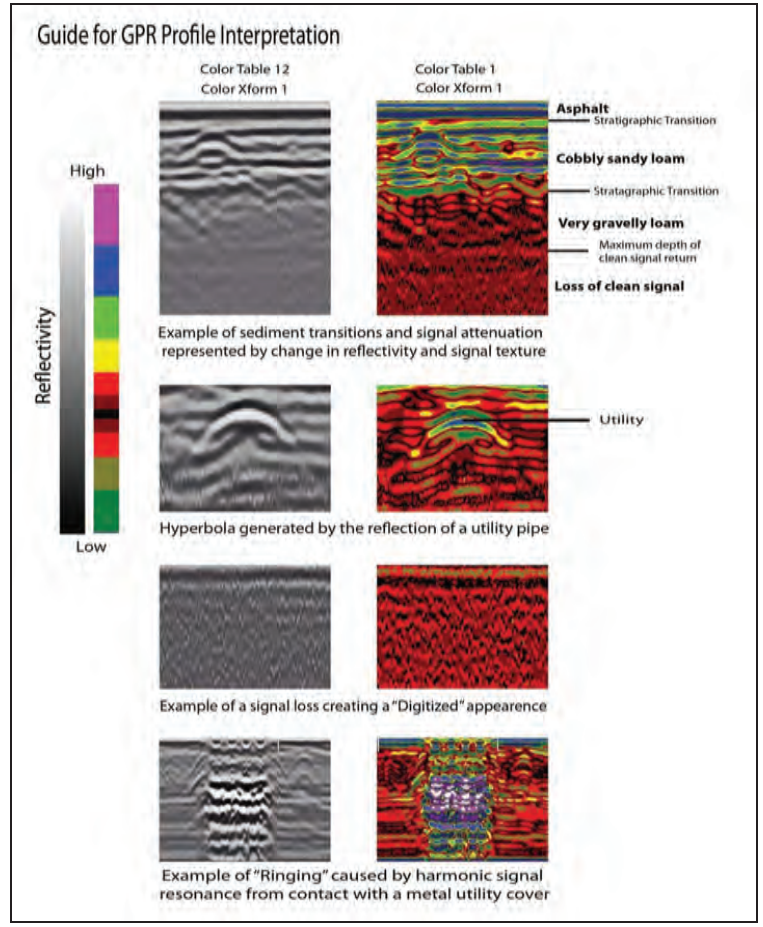


Figure 44. Guide for GPR profile interpretation

gravel have a greater degree of reflectivity. Conductive materials like silt or clays attenuate the transmitted signal and are less reflective. Signal texture is a way to describe signal patterns created by changes in signal shape and reflectivity.

Recognition of patterns in signal texture and reflectivity requires a great deal of experience and can be somewhat subjective in nature. While clear patterns are emerging from the results of this survey, it is difficult to quantitatively assess accuracy of this method. Using GPR analysis for determination of sediment material should be viewed as an approximation but when coupling the GPR data with soil surveys and results from previous archaeological research in the vicinity of a project area, useful information on sedimentation for a project area can be attained in a non-invasive way.

Stratigraphy

In recent years, GPR analysis has developed into a method for determining subsurface stratigraphic sequences by analyzing changes in signal reflectivity. Stratigraphic transitions can be represented by abrupt changes in reflectivity. These changes are often in the form of horizontal banding sequences as observed in the GPR profiles. As previously stated, signal transitions can be caused by variations in material density, compaction, geochemistry of sediment material, water content, etc. Figure 44 shows two distinct stratigraphic transitions based on reflectivity and horizontal banding. The first transition occurs directly below the top layer of the highly reflective asphalt. A second transition is observed bounding the higher reflectivity “cobbly sandy loam” and lower reflectivity “very gravelly loam.” GPR data is also useful for locating vertical or cross-cutting stratigraphic transitions such as utility excavations or vertical sediment truncations.

Using GPR data as a non-invasive means of evaluating stratigraphic sequences can aid in determining the relative chronology of sediment deposition within a project area. This method of analysis can be coupled with GPR sediment analysis to determine the probability of encountering natural sediments in a project area. In urban areas, several stratigraphic layers could imply multiple depositional fill events associated with historic land use. Consequently, a project area containing multiple fill events may indicate a lower probability of encountering well preserved in situ natural deposits.

5.2.6 *Makai* Tennis Court Survey (Grid 01)

Survey Grid 01 was located within the *makai* bank of tennis courts located near the center of the project area (Figure 45). Signal profiles for Grid 01 display two distinct reflectivity patterns (Figure 46). One signal is dominated by high reflectivity and multiple hyperbolic reflections. This pattern likely represents *pāhoehoe* lava flows which have low conductivity and multiple reflective internal structures. A second signal pattern is observed in the profile that may represent pockets of sediment accumulation with lower reflectivity. The low reflectivity and greater signal attenuation may be attributed to sediments with conductive clays and/or salts. The dramatic vertical truncations representing the signal changes could imply a wall or shear manmade structure. However, after reviewing the slice maps for this grid, the signal shapes in plan view are likely associated with natural variations in *pāhoehoe* lava flow lobes as seen in the more *makai* tidal flats adjacent to the survey area (Figure 47 and Figure 48).

Figure 45. Aerial photograph of the *makai* tennis courts survey area overlaid with 75 cmbs slice maps

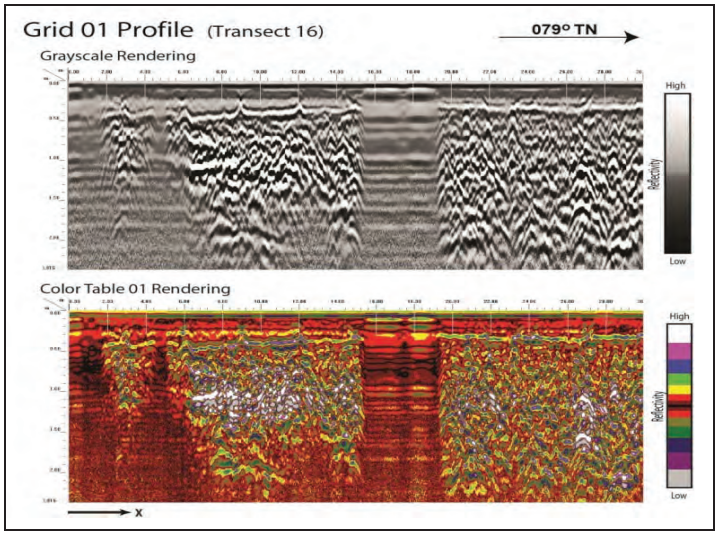


Figure 46. Grid 01 GPR signal profile

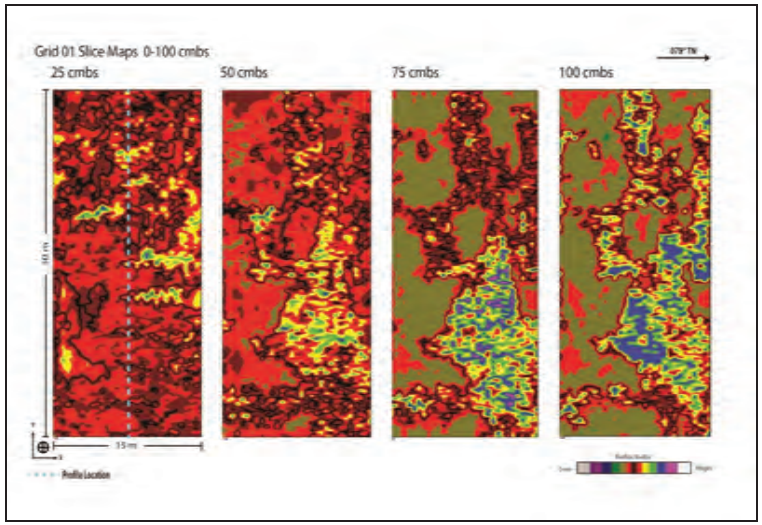


Figure 47. Grid 01 slice maps (0-100 cmbs)

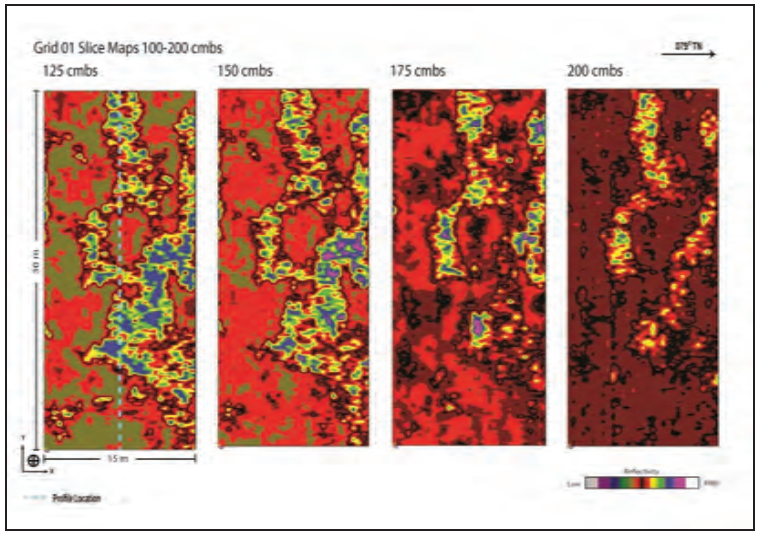


Figure 48. Grid 01 slice maps (100-200 cmbs)

5.2.7 Pool Deck Survey (Grids 02–05)

The pool deck survey was located on the decks of the filled-in swimming pool within the northwestern portion of the former Keauhou Beach Resort building footprint (Figure 49). A primary objective of this survey was to use GPR analysis to look for evidence of intact stacked basalt walls associated with the Kapuanoni Heiau. Prior to the GPR fieldwork, survey marks were applied to the pool deck by Keone Kalawe (cultural consultant for this project) that represents potential wall locations based on current stone alignments and the 1952 sketch of the project area by Henry Kekahuna (see Figure 11).

5.2.7.1 Grid 02 Analysis

Grid 02 slice maps display an anomalous signal shape in the eastern portion of the survey grid between 9 m and 14 m from the transect origin (Figure 50). Signal profiles for this transect (Transect 04) display highly reflective and repetitious patterns usually associated with rebar or steel mesh used in concrete reinforcement. The anomalous shape could be associated with a subsurface structure like a pump room or may be a structural element of the pool deck. The remainder of the survey grid shows regularly spaced hyperbolic reflections originating at 25 cmbs which is also likely associated with steel reinforcement for the pool deck.

The signal profiles for Grid 02 suggest the survey area has relatively uniform stratigraphy and is likely comprised of fill material. A distinct increase in reflectivity is noted at around 100 cmbs and may represent basalt bedrock (Figure 51). There is no clear evidence for intact stacked basalt walls within the Grid 02 survey area.

5.2.7.2 Grid 03 Analysis

Grid 03 slice maps display a linear anomaly that transects the survey grid from the northeastern corner of the survey area to 5 m from the origin of Transect 01 (Figure 52). The linear anomaly originates at 20 cmbs and is seen in profile as a highly disturbed area with steel reinforcement. This signal pattern may represent structural elements of the pool deck or a utility. The remainder of the survey grid shows regularly spaced hyperbolic reflections originating at 25 cmbs also likely associated with steel reinforcement for the pool deck.

The signal profiles suggest the Grid 03 survey area has relatively uniform stratigraphy and is likely comprised of fill material (Figure 53). There is no clear evidence for intact stacked basalt walls within the Grid 03 survey area.

5.2.7.3 Grid 04 Analysis

Grid 04 slice maps display an anomalous signal area in the northern portion of the survey grid that is likely associated with structural elements of the pool deck or utilities (Figure 54). The signal pattern in the area suggests the presence of steel reinforcement and a high degree of sediment disturbance. The remainder of the survey grid shows regularly spaced hyperbolic reflections originating at 25 cmbs also likely associated with steel reinforcement for the pool deck. The signal profiles for Grid 04 suggest the survey area has relatively uniform stratigraphy and is likely comprised of fill material (Figure 55). There is no clear evidence for intact stacked basalt walls within the Grid 04 survey area.

5.2.7.4 Grid 05 Analysis

Grid 05 slice maps display no clear anomalous signal shapes and show the area is relatively uniform (Figure 56). The entire survey grid shows regularly spaced hyperbolic reflections originating at 25 cmbs also likely associated with steel reinforcement for the pool deck.

The signal profiles for Grid 05 suggest the survey area has relatively uniform stratigraphy and is likely comprised of fill material (Figure 57). There is no clear evidence for intact stacked basalt walls within the Grid 05 survey area.

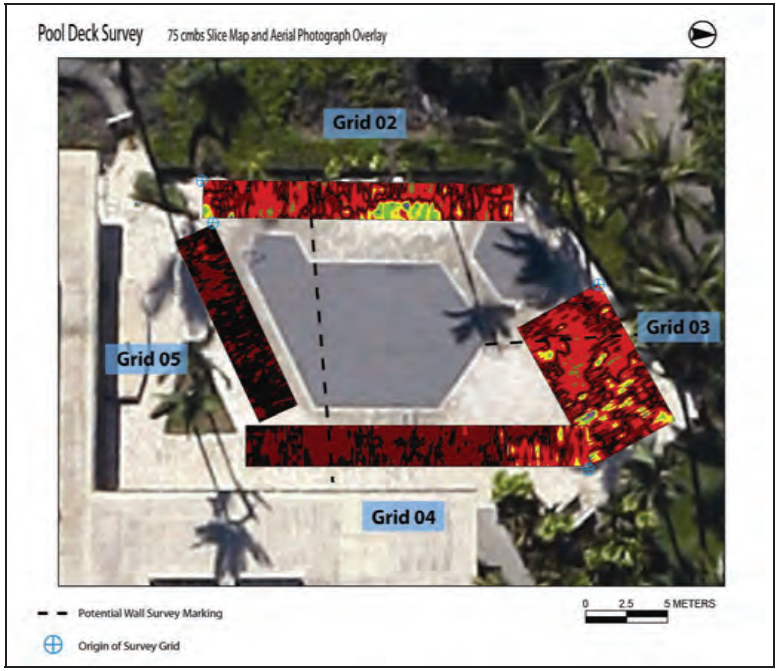


Figure 49. Aerial photograph of the pool survey area overlaid with 75 cmbs slice maps

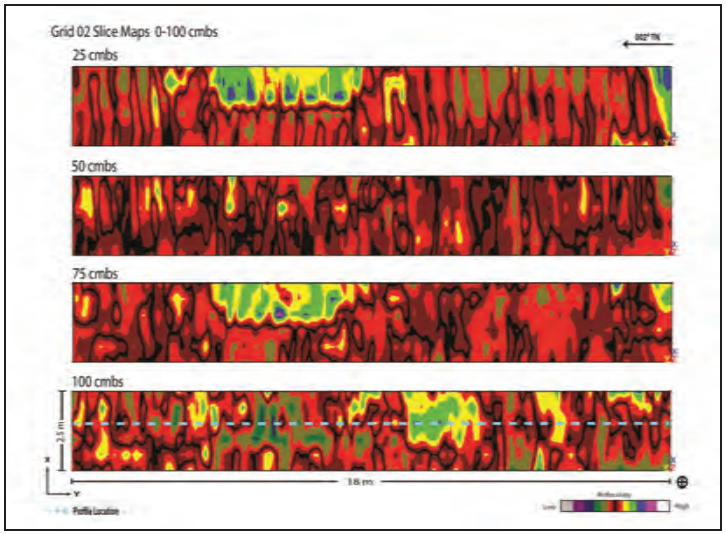


Figure 50. Grid 02 slice maps

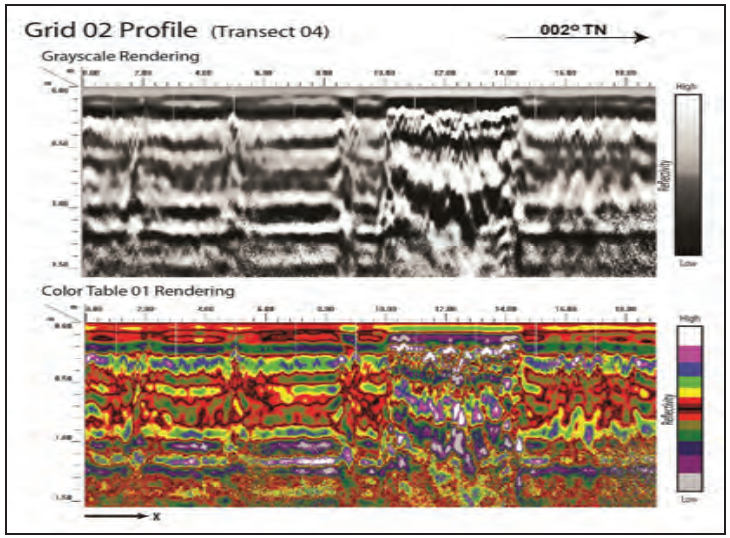


Figure 51. Grid 02 GPR signal profile

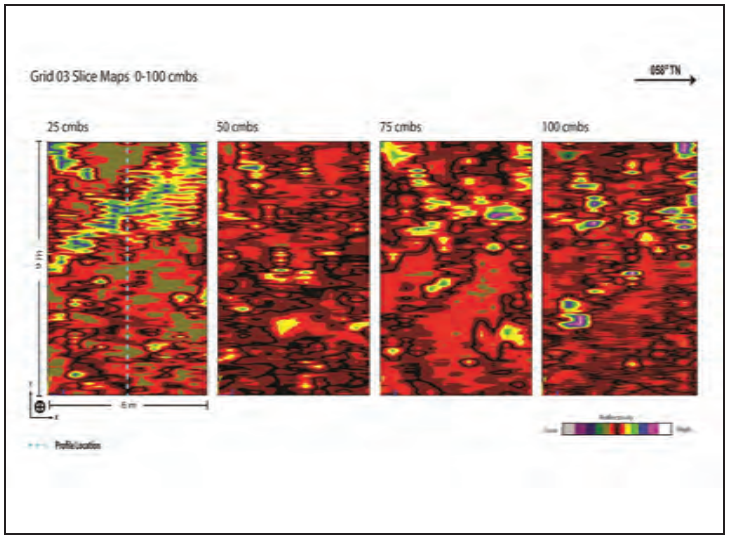


Figure 52. Grid 03 slice maps

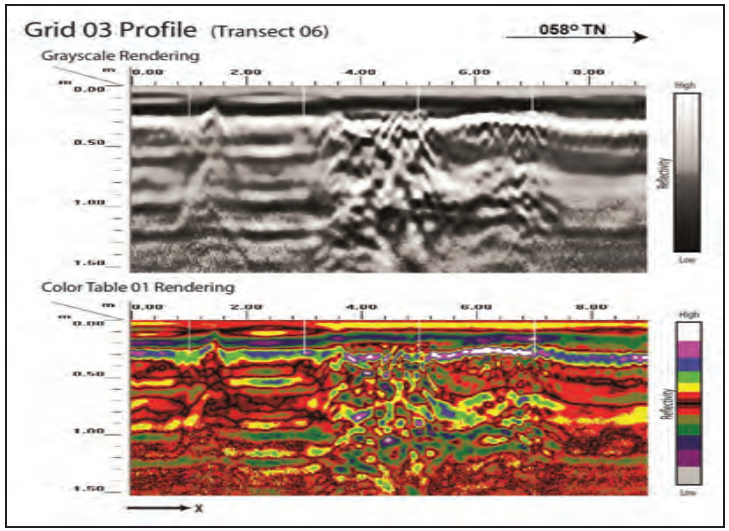


Figure 53. Grid 03 GPR signal profile

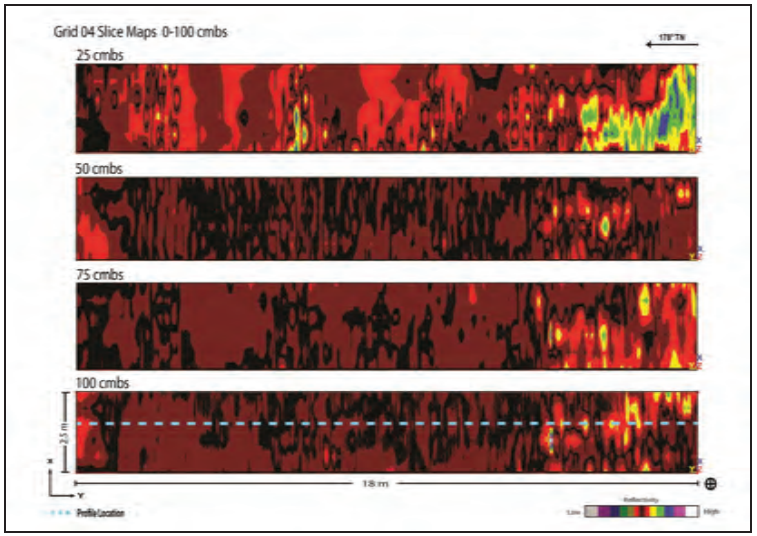


Figure 54. Grid 04 slice maps

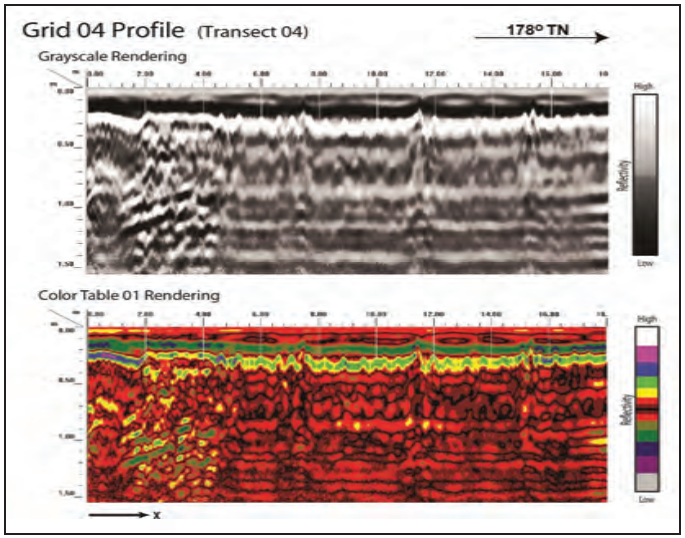


Figure 55. Grid 04 GPR signal profile

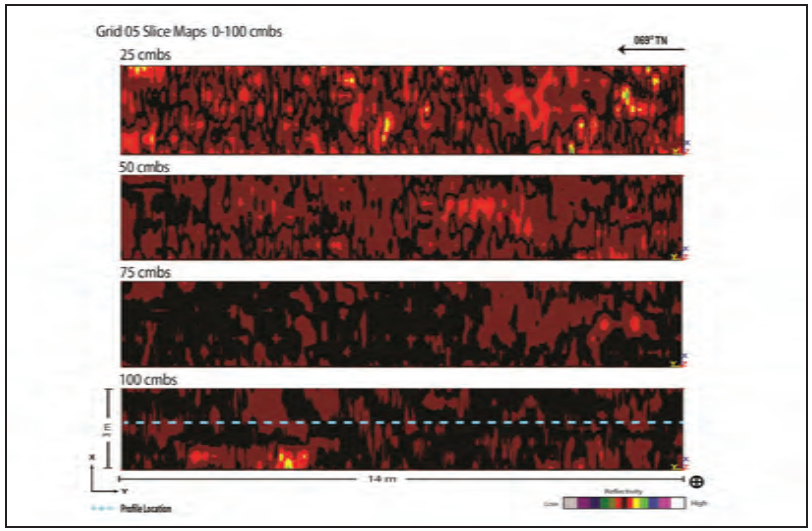


Figure 56. Grid 05 slice maps

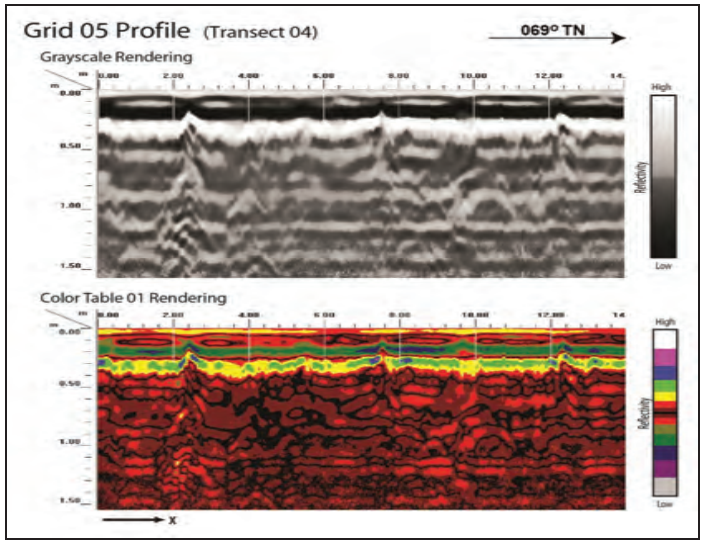


Figure 57. Grid 05 GPR signal profile

5.2.8 Mauka Tennis Courts Survey

The *mauka* tennis courts survey was conducted in the tennis court bank located near the central portion of the project area (Figure 58). (This area is referred to in the GPR survey as the "*mauka* tennis courts" because it is the most inland of the two court areas examined with GPR; this court should not be confused with another located more *mauka* within the project area). One objective of this survey was to use GPR analysis to look for evidence of a potential post-Contact cemetery thought by some to be located beneath this tennis court bank (Grid 06). Another objective of this survey was to look for subsurface features that may be associated with LCA 5694 which encompassed the area that is currently the western half of the tennis court bank (Grid 07).

Grid 6 signal returns revealed the survey grid is dominated by two distinct signal patterns (Figure 59, Figure 60, and Figure 61). The western half of the grid is dominated by highly reflective, multiple hyperbolic signal returns likely representing *pāhoehoe* lava flows which have low conductivity and multiple reflective internal structures. This is consistent with the *pāhoehoe* exposed adjacent to the west of the *mauka* tennis court bank. Clean signal returns extend beyond 200 cmbs which is further evidence of basaltic bedrock that allows for good signal penetration.

The eastern half of Grid 06 is dominated by lower overall reflectivity and flatter signal topography suggesting the area contains material more conductive and of greater depositional uniformity (Figure 59, Figure 60, and Figure 61). This signal response could be associated with clay or salt-rich fill material or possible salt-inundated sandy sediments. A set of linear anomalies is noted in both the slice maps and profiles within the eastern half of Grid 06 that display higher reflectivity and multiple hyperbolic reflections similar to what is seen in the western portion of the survey grid. This similarity in signal returns suggests the liner anomalies may represent basalt rock deposits. A basalt rock deposit could include stacked walls, former foundations, or a type of marker. The low reflectivity soil coupled with the possible basaltic rock alignment in this area does increase the probability that this area may contain the conditions for human interment.

Grid 7 GPR results are dominated by highly reflective, multiple hyperbolic signal returns (Figure 62, Figure 63, and Figure 64). The signal pattern is consistent with what was seen in the western half of Grid 06 which likely represents *pāhoehoe* lava flows with low conductivity and multiple reflective internal structures. Signal profiles and slice maps for Grid 07 suggest the entirety of the survey grid consists of *pāhoehoe* lava flows. The Transect 7 signal profile (Figure 64) shows a larger hyperbolic signal reflection relative to the rest of the profile centered at 25 m from the profile origin. This signal anomaly may represent a lava flow lobe and is observed in the other Grid 07 transects, seemingly at random locations within the survey grid.

Figure 58. Aerial photograph of the *mauka* tennis courts survey area overlaid with 75 cmbs slice maps

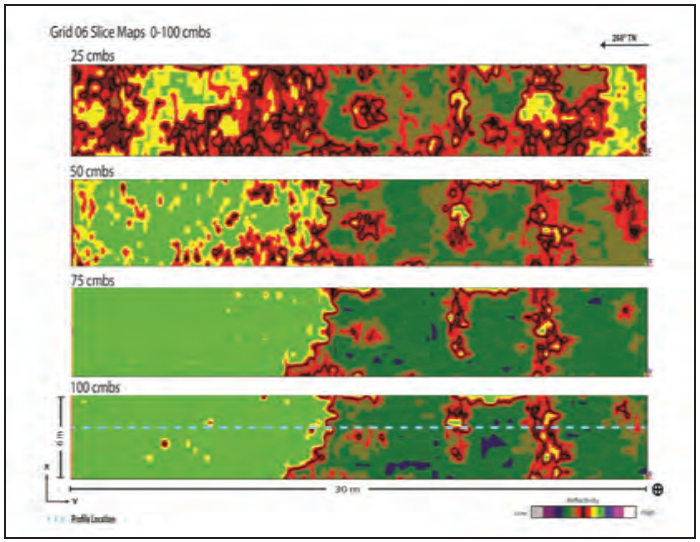


Figure 59. Grid 06 slice maps (0-100 cmbs)

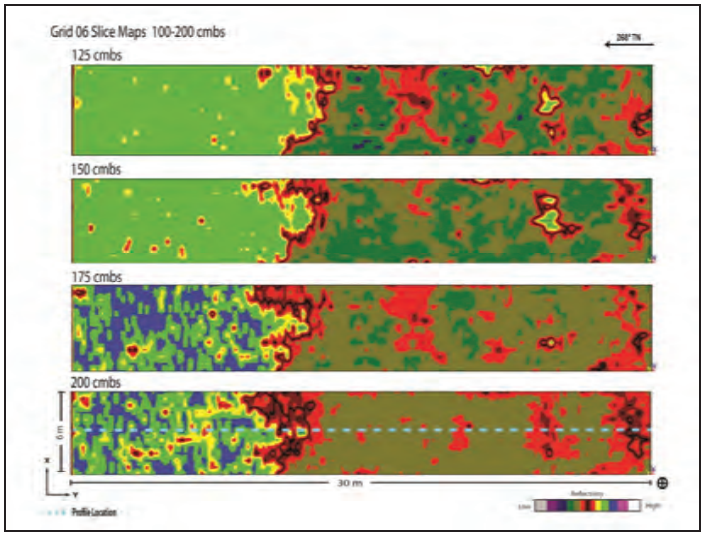


Figure 60. Grid 06 slice maps (100-200 cmbs)

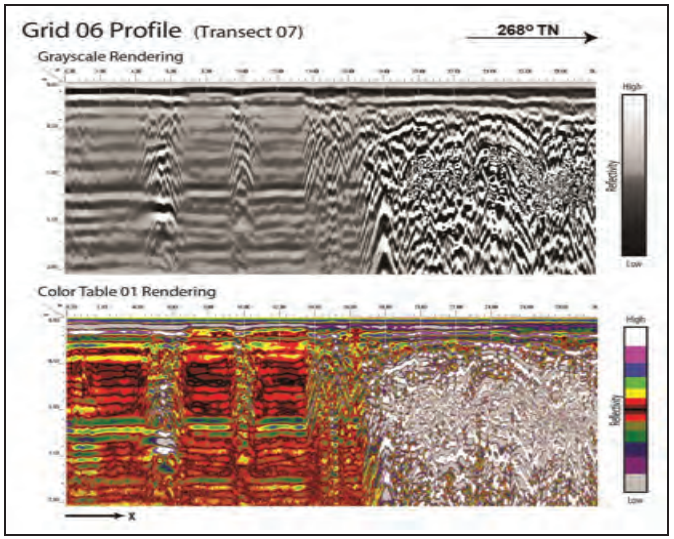


Figure 61. Grid 06 GPR signal profile

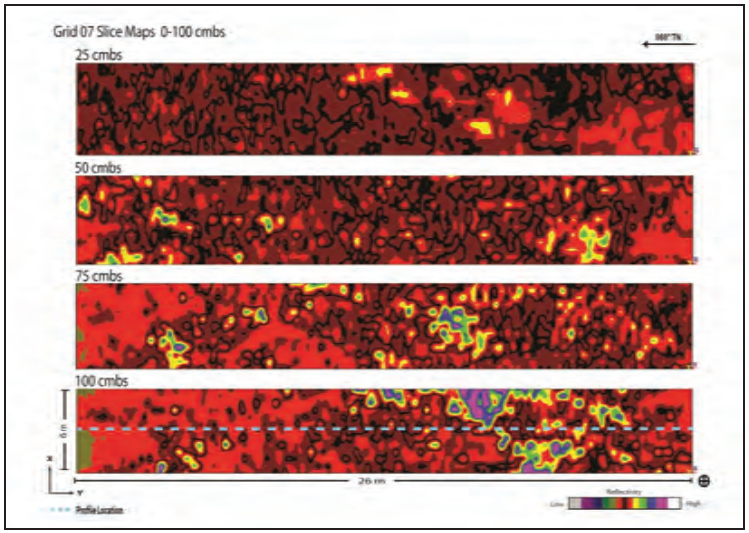


Figure 62. Grid 07 slice maps (0-100 cmbs)

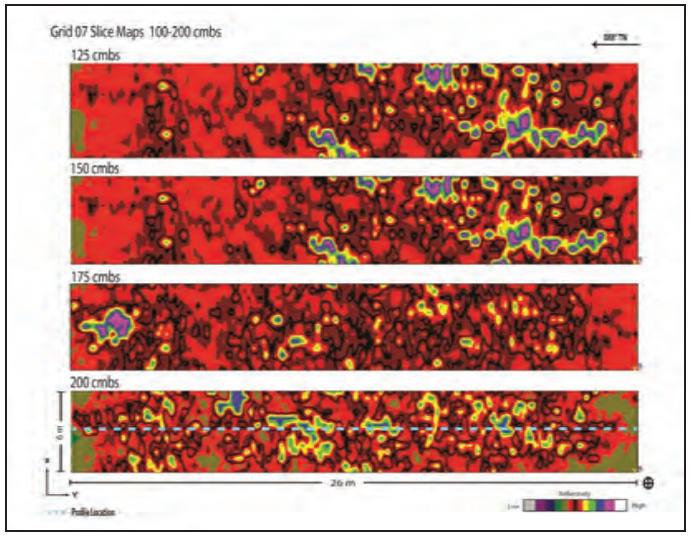


Figure 63. Grid 07 slice maps (100-200 cmbs)

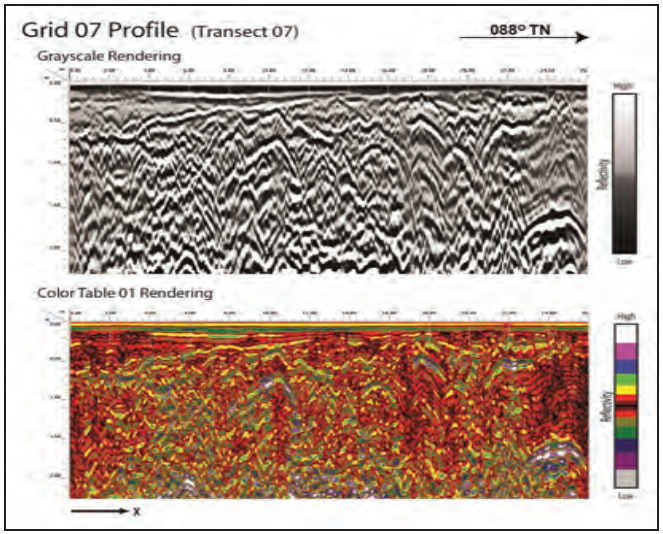


Figure 64. Grid 07 GPR signal profile

5.2.9 GPR Summary

A GPR survey was conducted within the project area prior to subsurface testing in an attempt to define the local stratigraphy and to prospect for buried cultural deposits. Seven discrete locations (Grids 01–07) within the project area were surveyed with GPR (see Figure 39) prior to the first phase of subsurface testing.

Survey Grids 02 through 05 were located on the decks of the filled-in swimming pool within the northwestern portion of the former Keauhou Beach Resort building footprint. A primary objective of this survey was to use GPR analysis to look for evidence of intact stacked basalt walls associated with the Kapuanoni Heiau. No clear evidence for intact stacked basalt walls (Kapuanoni Heiau remnants) was identified within Survey Grids 02 through 05.

Survey Grids 06 and 07 were located in the *mauka* tennis court bank near the central portion of the project area. One objective of this survey was to use GPR analysis to look for evidence of a potential post-Contact cemetery thought by some to be located beneath this tennis court bank (Grid 06). Another objective of this survey was to look for subsurface features that may be associated with LCA 5694 which encompassed the area that is currently the western half of the tennis court bank (Grid 07). The western half of Survey Grid 06 appeared to be *pāhoehoe* lava flows. The eastern half of Grid 06 was interpreted as clay or salt-rich fill material or possible salt-inundated sandy sediments. A set of linear anomalies was noted that may represent basalt rock deposits. A basalt rock deposit could include stacked walls, former foundations, or a type of marker. The low reflectivity soil coupled with the possible basaltic rock alignment in this area indicated an increased probability that this area may contain the conditions for human interment. Grid 07 GPR results were consistent with *pāhoehoe* lava flows.

5.3 Historic Property Descriptions

5.3.1 SIHP # 50-10-37-03817 (Hāpaiali‘i Heiau)

FUNCTION:	Ceremonial, religious
SITE TYPE:	*Heiau*
DIMENSIONS:	40.0 m by 33.0 m
CONDITION:	Restored
LIKELY AGE:	Pre-Contact; constructed between AD 1200s-1400s

DESCRIPTION: SIHP # -03817, or Hāpaiali‘i Heiau, was previously recorded by Stokes (1906-1907; see also Stokes and Dye 1991), Reinecke (1930), Sterling (1960), Cordy (1986b), Walker and Rosendahl (1989), and Tuggle (1990). Some of these studies included mapping. This *heiau* was the first in the project area to be restored, following a preservation plan specific to both Hāpaiali‘i and Ke‘ekū (Dye and Ayau 2007; see Appendix C). Restoration of Hāpaiali‘i followed preliminary archaeological studies at the site including detailed mapping. The map (Figure 65), which was informed by past documentation at the site and identified the remnant features of the *heiau*, was intended to serve as a base for reconstruction.

The preservation plan for Hāpaiali‘i (Dye and Ayau 2007:2-3) cites a portion of Stokes' description of the *heiau*. According to Stokes (Stokes and Dye 1991), Hāpaiali‘i is

> Located on the beach 1000 feet south of Kahalu‘u Bay. Kahelo benchmark bears 161°07'20", 16,757 feet. Keauhou wharf bears 335°10'57", 6,479 feet. Hāpaiali‘i is a high platform *heiau* with vertical walls. The retaining walls on the north, west, and east are built of very large blocks of stone, squared by nature. The eastern retaining wall is composed of smaller blocks. The platform surface is rather roughly paved. East of the center, a pavement rises half a foot above the general level. This smaller pavement is composed of the same sized stones as the rest of the floor but is more carefully laid. To the east, again, and forming an enclosure (in conjunction with the small pavement) are three small walls; the western ends of the north and south walls are 1.5 feet high and the eastern portions 3.3 feet high, the height also of the eastern wall, The width of these walls is 3.5 feet. The inside corners of this enclosure on the east have been partitioned off.
>
> . . . The *heiau* was built upon a *pāhoehoe* flow which is covered every high tide. Most of the retaining walls have given way, but at the southwest corner, where the blocks are largest, the wall is still firm, and here a height of 8 feet was found. The lines of the walls are, however, definite. The local information was to the effect that this *heiau* was built by Maa, a *kahuna* of Maui, who left for Kaua‘i later. It was said to be much older than Ke‘ekū Heiau. The period of Maa was said to be later than that of Pa‘ao. The *heiau* was for prayers only.
>
> (*In Thrum's list is the following: 'Said to have been built by Kamehameha about 1782 after the battle of Moku‘ōhai. Hewahewa was its priest. Constructed of large stones, part on pahoehoe and part on sand. Only one corner of it, close to the shore, remains' (I907a:44). W.T.B.*). [Stokes and Dye 1991:71-74]

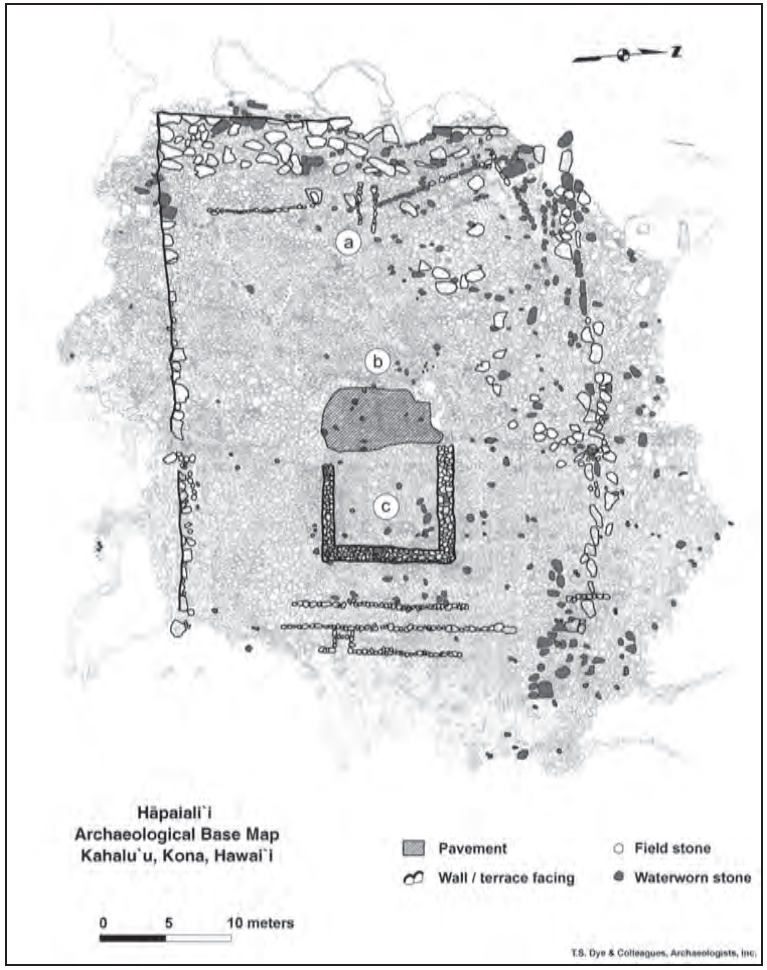


Figure 65. Plan view map of Hāpaiali‘i (SIHP # -03817) drawn prior to reconstruction (courtesy of client)

Most recently, Tuggle (1990) recorded the following:

> The temple has suffered major damage from wave action, particularly on the makai and north sides. Fortunately, the massive foundation stones of these two walls remain in place. The mauka side is largely covered in sand. [Tuggle 1990:53-55]

During the current AIS, CSH confirmed SIHP # -03817 within the project area (see Figure 37 and Figure 66). As indicated by the background research, the *heiau* is presently in a restored state. It measures overall approximately 40 m (east-west) by 33 m (north-south), extending into the high tide zone on all but its eastern side. The outer walls utilize massive basalt boulders for the foundational alignments, with mutilple courses of smaller stacked boulders forming the interior (not visible) and faced exteriors (Figure 67). The walls are core-filled using *‘a‘ā* klinker materials. They generally measure approximately 1.0 m thick at their level upper surfaces and range in height from 2.0 m along the eastern wall and 3.0 m along the western wall. The southern and northern walls are from 2.5 to 2.75 m high. The upper portion of the northern wall has begun to lean outward. The *heiau* is fronted on the inland eastern edge by a sand beach; it is along this wall that the *heiau* is accessed through a stepped opening approximately 1.0 m wide (Figure 68).

The majority of the interior is a platform flush with the exterior southern, eastern, and northern wall surfaces and paved with small- to medium-sized, compacted *‘a‘ā* klinkers. From the eastern entrance a stepping stone path of waterworn boulders leads across the pavement to and around an enclosure containing a single large water-rounded boulder laid near its center. The eastern or rear enclosure wall is slightly sloped on the *mauka* side wth a vertical *makai* face. This wall, which is of core-filled construction, is 1.0 m high and 1.0 m thick (Figure 69). The northern and southern enclosure walls are also 1.0 m thick, and taper downward from their interface at the eastern wall to a height of approximately 0.4 m at their western terminus. The interior of this enclosure is paved as around the exterior. The enclosure, which overall measures 10.0 m (north-south) by 9.0 m (east-west), is open on the *makai* side where it is fronted by a level platform measuring approximately 8.0 m long, 2.5 m wide and 0.3 m high (Figure 70). This feature is paved with *‘ili‘ili*. From this feature a stepping stone path leads to west to a platform running the entire length of the exterior *makai* wall at a width of 7.0 m. Stacked boulders create a step leading from the path up onto the platform (Figure 71). The surface of the platform is flush with the top of the exterior wall, rising 0.4 to 0.6 m above the interior pavement. Seven upright stones have been incorporated into this *makai* platform area, with one similar upright set into the pavement along the northern and southern walls (see Figure 66) and another near the *heiau* entrance along the eastern wall (see Figure 68).

It is currently proposed that this restored site will be mapped during school year 2014-2015 as part of *‘āina* (land)-based education activities, with the final map to be included in the project preservation plan.

Figure 66. Photo of the restored Hāpaiali‘i Heiau (SIHP # -03817) with Ke‘ekū Heiau visible in the background; view to southwest

Figure 67. Photo showing the stacked construction along the southern wall of Hāpaiali‘i Heiau (SIHP # -03817), with an upright stone visible on the platform surface just left of the photo scale; view to southwest

Figure 68. Photo showing the stepped entry along the eastern wall of Hāpaiali‘i Heiau (SIHP # -03817); view to west

Figure 69. Photo showing the rear wall of the interior enclosure at Hāpaiali‘i Heiau (SIHP # -03817), with the waterworn stepping stone path visible in the foreground and the western platform visible in the far background; view to west

Figure 70. Photo showing the platform fronting the interior enclosure at Hāpaiali‘i Heiau (SIHP # -03817), with the waterworn stepping stone path visible in the foreground and the large waterworn boulder within the enclosure visible in the background; view to east

Figure 71. Photo showing the stepping stone trail leading to the platform comprising the western end of Hāpaiali‘i Heiau (SIHP # -03817) and some of the component upright stones present there; view to west

5.3.2 SIHP # 50-10-37-03818 (Ke‘ekū Heiau + Hale O Papa)

FUNCTION:	Ceremonial, religious
SITE TYPE:	*Heiau* Complex
NUMBER OF FEATURES:	2
DIMENSIONS:	75.0 m by 50.0 m
CONDITION:	90% restored
LIKELY AGE:	Pre-Contact; constructed between AD 1200s-1300s

DESCRIPTION: SIHP # -03818, or Ke‘ekū Heiau, was previously recorded by Stokes (1906-1907; see also Stokes and Dye 1991), Reinecke (1930), Sterling (1960), Emory et al. (1971), Walker and Rosendahl (1989), Tuggle (1990), Haun and Henry (2004a and b), and Dye (2012). Some of these studies included mapping. This *heiau* was the third in the project area to be restored, following a preservation plan specific to both Hāpaiali‘i and Ke‘ekū (Dye and Ayau 2007; see Appendix D). Restoration of Ke‘ekū followed preliminary archaeological studies at the site including detailed mapping (Dye 2012; see Section 4.2.11). The map (Figure 72), which was informed by past documentation at the site and identified the remnant features of the *heiau*, was intended to serve as a base for reconstruction. Corresponding elevational drawings were also prepared (Figure 73). Hale O Papa, located approximately 6 m south of the main *heiau*, was not included in the Dye (2012) mapping effort.

The preservation plan for Ke‘ekū (Dye and Ayau 2007:2-3) cites a portion of Stokes’ description of the *heiau*. According to Stokes (Stokes and Dye 1991), Ke‘ekū is

> Located 150 feet southwest of Hāpaiali‘i Heiau. This is an imposing, heavy-walled enclosure surrounded on the west, north, and east by the sea at high tide. On the west and north, the walls reach a height of 10 and 11 feet, respectively, measured from the outside. From the inside, the four walls range in height from 6 to 6.5 feet, the same as the outside of the east and south walls.
>
> The entrance was on the south wall, in the southwest comer. The present floor is 3 feet above mean tide and composed of level sand, in which may be found traces of flat stone pavements and waterworn pebbles for filling in. There are no lines in the interior definite enough to measure, except the angle of stones northwest of the center. On the northern boundary of the floor, against the northern wall, is a bench of stones 2.5 feet wide and 1.5 feet high, which leads to the west from a house platform of the same height. This platform was said to be for the drum house (*hale pahu*). Other houses the same size and the same distance apart were said to have extended to the south, occupying the eastern portion of the *heiau*. The names of these houses were Hale Kailiili, Hale Mana, and Hale Wai Ea. No trace of their platform lines could be found, although there are many loose stones scattered around in the vicinity. These houses were said to have faced to the west, the portion occupied by the congregation.
>
> All the other *heiau* fittings were said to have been on the north wall, which is really a platform 121 feet long and 32 feet wide. Those mentioned by the informant were the *‘anu‘u*, *lele*, *luapa‘ū*, and all the idols. The *luapa‘ū* is indicated on the plan, in the interior northwest corner; its southern wall was

Figure 72. Plan view map of Ke‘ekū Heiau (SIHP # -03818) drawn prior to reconstruction (Dye 2012:27)

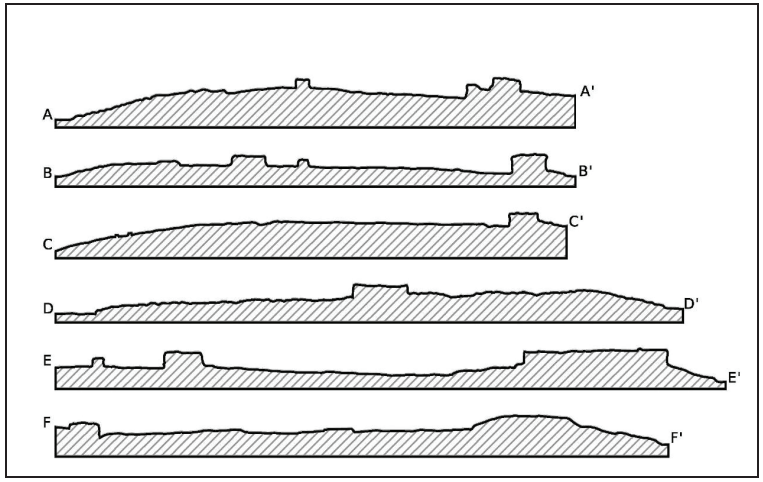


Figure 73. Cross sections of Ke‘ekū Heiau (SIHP # -03818), drawn prior to reconstruction (Dye 2012:29) (refer to Figure 72 for cross section locations

> broken down level with the sand. The position of the *‘anu‘u* was not known, but from the informant’s description of a very tall pole, formerly seen, I believe it was on the platform north of the *luapa‘ū*. Two other poles, formerly seen, were said to have been the supports of the *lele*; their reported positions are indicated by the blackened circles in the plan east of the *luapa‘ū*. Outside the *heiau*, to the south, are the remains of an enclosure said to have been the site of the *hale o Papa* . . . The construction of the walls of this *heiau* might be further remarked upon. As shown in the cross-sections in the plan . . . the portions of the walls exposed to the waves have been laid with a very heavy slope. On the north the outer slope is 5:11 horizontal to vertical [66°] and on the west 5:10 horizontal to vertical [63°]; this is, of course, a precaution for extra strength. However, the Hawaiian engineer looked still farther ahead and provided other features. By beginning with a moderately light wall as a ‘core’ and building other walls leaning against it, they have made not only a very strong platform but also one which would only collapse piecemeal. In practice, the wisdom of this procedure has been shown, for in many places the outer layer of the north and west wall has been broken down by the sea, yet the rest of the walls still stand solidly.
>
> It might be supposed that if strength were the main consideration the slope would have been repeated on the interior of the walls. However, the slope here is only 0.5:6.5 horizontal to vertical [86°], practically vertical for a dry-laid, loose-stone

> wall. Apparently, strength having been provided for in the mass of stone and the method of laying, the next consideration was a suitable appearance, and there is no doubt that a vertical face on an interior wall looks better than one sloping. The matter of appearance is not confined to the interior. A very large proportion of the stones in these walls are waterworn, and the smoothest of them have been selected for the facings, both exterior and interior. At present, the walls are in comparatively good condition. The southern end of the west wall (at the entrance) is much broken down, and some outer layers of the west and north walls have gone. The only break in the interior of the walls is the portion adjoining the *hale pahu*, which has been restored . . . The surface of the platform/wall on the north has been much disturbed, and there are several large cavities . . . Some of the natives explained that these are used for hiding stolen coconuts. According to the principal informant for this locality, there was originally a palisade of very high poles along the northern edge of this platform . . .
>
> Outside the entrance to the *heiau* and towards the southwest are a number of petroglyphs on the pahoehoe. One of them is said to represent Kamalalawalu . . . [Stokes and Dye 1991:74-79]

Most recently, Haun and Henry (2004a) recorded the following:

> It [Ke‘ekū] consists of a large rectangular enclosure with overall dimensions of 56.0 m long (north-south) and 44.0 m wide . . . The east and south walls of the enclosure vary in width from 4.0 to 5.0 m, with the north and west walls ranging in width 8.0 to 10.0 m, forming a wide platform area that averages 3.0 m in height. An entrance into the interior is situated along the southern wall at its western end. According to Stokes, ‘The present floor is level sand, 3 feet above mean tide, in which may be found traces of flatstone pavements and beach-worn pebbles for filling in’ (1991:75).
>
> The remnants of stone alignments have been documented outside of the enclosure to the south, paralleling the short axis of the structure. According to Emory et al. (1971:16-19), Stokes was told that this open-court area was the location of the Hale o Papa (House of Papa) or the part of the heiau where the chiefesses could carry on their worship (1971:16-19). [Haun and Henry 2004a:6]

During the current AIS, CSH confirmed SIHP # -03818 within the project area (see Figure 37 and Figure 74). The site consists of two main features. Feature A is Ke‘ekū Heiau (Figure 75), and Feature B is the associated Hale O Papa. Overall the site covers an area up to 75.0 m long and 50.0 m wide. CSH was asked not to walk upon or inside Ke‘ekū during the present fieldwork; abiding by this request, photos and measurments were only taken from the exterior, and many of the dimensions were approximated using the ruler tool in Google Earth.

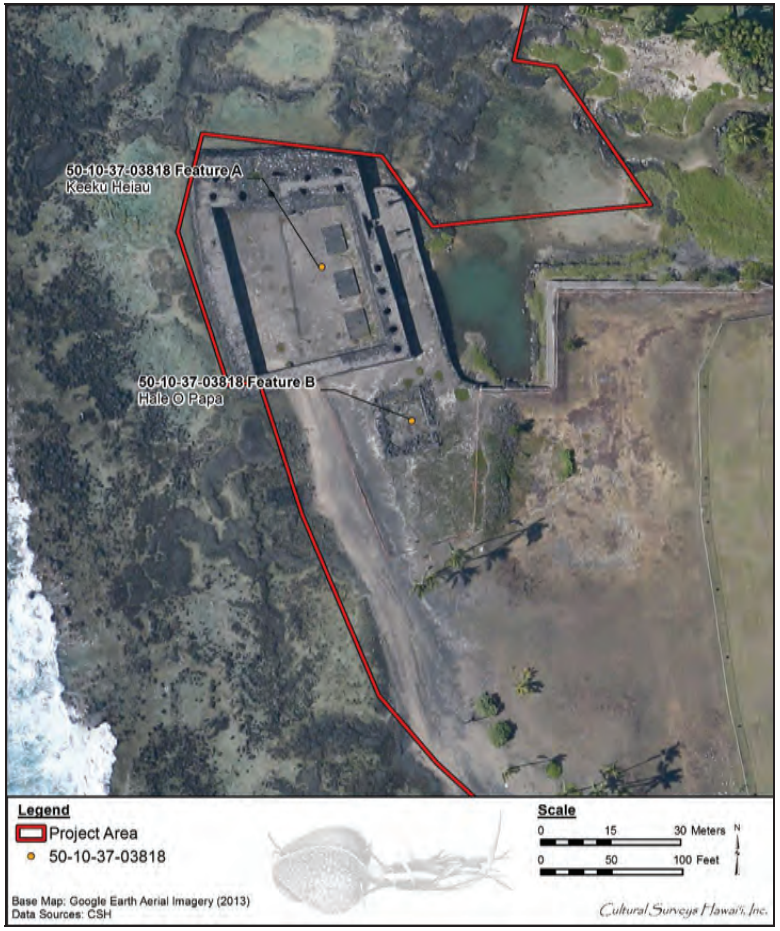


Figure 74. Aerial photograph showing the location of Ke‘ekū Heiau and Hale O Papa (SIHP # -03818) within the project area (Google Earth 2013)

Figure 75. Photo of Ke‘ekū Heiau (SIHP # -03818 Feature A); view to southwest

Feature A is Ke‘ekū Heiau (see Figure 74 and Figure 75). As indicated by the background research, Ke‘ekū is presently in a 90% restored state. The *heiau* is somewhat trapezoidal and oriented slighty off north-south with its long walls at 350/170 degrees. The walls are constructed similarly to Hāpaiali‘i, with large basalt boulders forming the foundational courses, and smaller stacked basalt boulders creating the interior and exterior faces. The walls, which are core-filled using sand, coral, and *‘ili‘ili* materials, exhibit very level surfaces. The *makai* or western wall measures approximately 55 m long, and is somewhat bowed along its exterior edge, with a maximum thickness of approximately 6.0 m and height of 3.5 m on the exterior and 2.25 to 2.5 m on the interior.

The eastern wall is shorter in length at approximately 45 m, with a maximum thickness of approximately 4.0 m and height of 2.0 m to 1.75 m on the exterior and about 2.5 m on the interior. The southern half of the eastern or *mauka* wall contains five constructed pits designed to support carved wooden *ki‘i* (tiki); these measure from 1.0 to 2.25 m wide and up to 2.0 m deep. This wall also contains a double-sided stepped entry located approximately 13 m from the northeast corner of the *heiau* (Figure 76). This entry is accessed from an exterior platform measuring approximately 14 m long, 7.5 m wide, and 0.6 m high. This platform has an overgrown paved level surface supporting two *ki‘i* measuring 2.5 m high, symbolizing the god Kū (Figure 77). The platform is generally rectangular excepting a curved northeastern corner; this end of the platform rises 1.0 m above the adjacent tidal *pāhoehoe* flat. This platform is accessed by a stone ramp located along the base of the eastern *heiau* wall that measures 2.0 m wide and 0.25 to 0.6 m high (see Figure 77). A rock wall extends from the outer edge of the entry platform south and then east forming a barrier against the adjacent tidal pools.

The southern wall of the *heiau* measures approximately 37.0 m long, 4.0 m thick and 2.5 to 3.0 m high on the exterior and 2.5 m on the interior (Figure 78). A narrow, level walkway is situated along the eastern half of the interior of the southern wall. This walkway is 0.25 m high and up to 1.0 m wide. The northern wall is of more complex construction. This wall measures approximately 36.0 m long, up to 12.0 m thick, and 3.0 to 3.25 m high on the exterior and 2.5 m on the interior. This wall exhibits a somewhat bowed exterior. Given its substantial dimensions, this wall serves as more of a platform. It exhibits a roughly paved level surface and contains several circular and square constructed pits to hold *ki‘i*. This wall also provides entry into the

Figure 76. Photo showing construction of the double-sided stepped entry along the eastern wall of Ke‘ekū Heiau (SIHP # -03818 Feature A); view to north

Figure 77. Photo showing the eastern entrance platform with *ki‘i* and access ramp at Ke‘ekū Heiau (SIHP # -03818 Feature A); view to north

Figure 78. Photo showing the southern wall of Ke‘ekū Heiau (SIHP # -03818 Feature A); view to west

heiau interior via a double-sided ramp accessed near its midpoint. The landing at the top of the ramp is situated 0.3 m below the north wall/platform surface, and has a curved southern face measuring up to approximately 2.0 m wide. The ramps leading downward to the west and east are generally 1.5 m wide and are neatly faced with paved surfaces of waterworn basalt cobbles.

The interior space mirrors the overall quadrilateral shape of the *heiau*, and contains a fairly level substrate of mixed sand and waterworn basalt and coral *‘ili‘ili*. Along the eastern wall are three evenly spaced, uniform plaforms. These platforms measure approximately 5.5 m long, 4.5 m wide and 0.3 m high. They are constructed of two to three courses of stacked and faced basalt cobbles and small boulders filled with a gravelly basalt material. The platforms are somewhat overgrown. A squarish *papamū* stone is present near the center of the southernmost platform. Based on Stokes’ 1906 map of Ke‘ekū Heiau (adapted in Stokes and Dye 1991:74) and Kekahuna’s 1952 map of Kahalu‘u (see Figure 13), these platforms represent (from north to south) foundations for the Hale Ka‘ili‘ili, Hale Mana, and Hale Wai Ea. Additional features indicated on the earlier maps (e.g., Kapu-ahi, Hale Pahu, buried spring) were not observed.

Feature B is the formerly restored Hale O Papa located immediately south of Ke‘ekū, which was presently confirmed to have been damaged by the 2011 tsunami. The feature was fully documented during the present investigation (Figure 79 and Figure 80). Situated on the same sand bar as Ke‘ekū, Hale O Papa is presently surrounded by *naupaka* to the east and southeast. It is described as a disturbed rectangular structure measuring approximately 14.0 m (northwest-southeast) by 11.5 m (northeast-southwest). The walls are generally constructed on

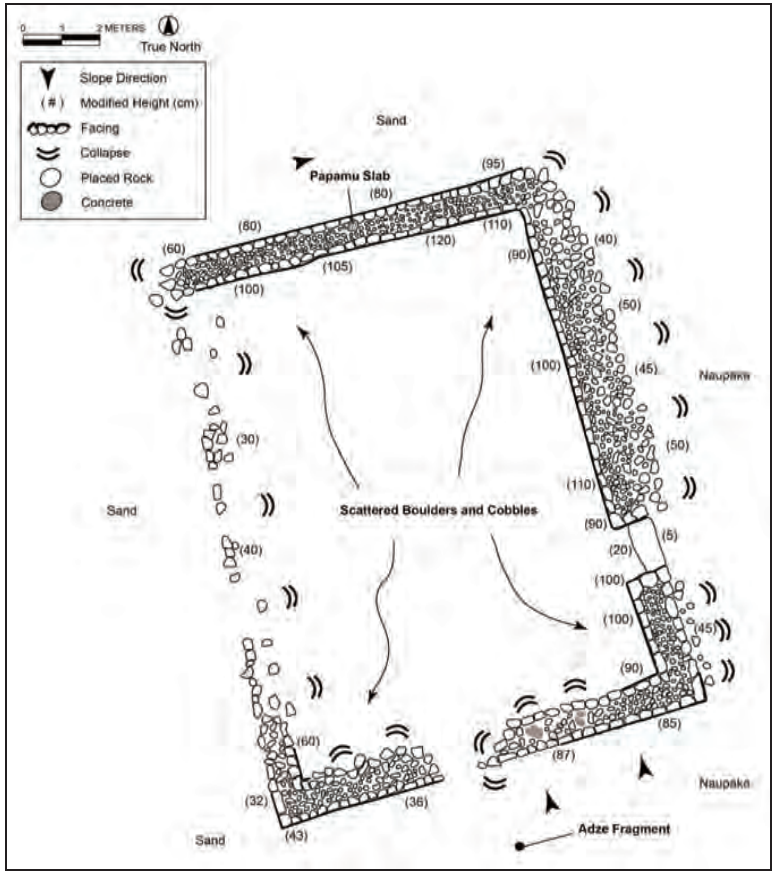


Figure 79. Plan view map of Hale O Papa (SIHP # -03818 Feature B)

Figure 80. Photo showing the disturbed Hale O Papa (SIHP # -03818 Feature B); note the nature of ocean-related damage to the *makai* side of the structure; view to north

basalt boulders and cobbles, with a core-fill of smaller materials that includes coral cobbles. A pre-tsunami aerial photograph (Figure 81) showing the intact, restored feature indicates its walls were of uniform construction. Presently the walls measure 0.9 to 1.0 m wide and 0.8 to 1.1 m high. The most intact wall is the northern wall. It exhibits both interior and exterior facing. A small boulder slab exhibiting a *papamū* was observed resting on the surface of this wall. The eastern wall is in fairly good condition, and exhibits interior facing. A 1.5-m-wide entry is observed along the eastern wall, with a large basalt slab acting as a landing. The eastern and western corners of the southern wall are fairly intact; the central portion of this wall has been largely blown out. Concrete chunks, one containing rebar, were observed within the construction of this wall. Approximtely 3.0 m south of the southern wall a broken basalt adze was observed on the surface. A largely buried remnant of foundational boulders comprises the western wall. The interior consists of fairly level sand, coral, and *‘ili‘ili* and contains rubble. Both the adze and the *papamū* were shown to and subsequently collected by KS staff.

It is currently proposed that Ke‘ekū will be mapped during school year 2014-2015 as part of *‘āina*-based education activities, with the final map to be included in the project preservation plan. It is unknown at this time when the re-restoration of Hale O Papa will occur.

Figure 81. Aerial photograph showing the 90% restored Ke‘ekū Heiau and Hale O Papa (SIHP # -03818) prior to a 2011 tsunami (Google Earth 2010); note the uniformity of the reconstructed Hale O Papa walls

5.3.3 SIHP # 50-10-37-03819 (Mākole‘ā Heiau)

FUNCTION:	Ceremonial, religious
SITE TYPE:	*Heiau*
DIMENSIONS:	28.0 m by 19.0 m
CONDITION:	Restored
LIKELY AGE:	Pre-Contact

DESCRIPTION: SIHP # -03819, or Mākole‘ā Heiau, was previously recorded by Stokes (1906-1907; see also Stokes and Dye 1991), Reinecke (1930), Sterling (1960), Emory et al. (1971), Walker and Rosendahl (1989), Tuggle (1989, 1990), Haun and Henry (2004a and b), and Kalawe and Dye (2010). Some of these studies included mapping. This *heiau* was the second in the project area to be restored, following a preservation plan specific to Mākole‘ā, Kapuanoni, and Po‘o Hawai‘i (Dye and Ayau 2008; see Appendix C). Restoration of Mākole‘ā followed preliminary archaeological studies at the site including detailed mapping (Kalawe and Dye 2010; see Section 4.2.10). The map (Figure 82), which was informed by past documentation at the site and identified the remnant features of the *heiau*, was intended to serve as a base for reconstruction. Corresponding elevational drawings were also prepared (see Figure 82).

According to Stokes (Stokes and Dye 1991:80), Mākole‘ā is

> Located 600 feet from the sea, on the same tidal flat as Kapuanoni Heiau, Hāpaiali‘i Heiau, and Ke‘ekū Heiau. The backwater which nearly encircles Ke‘ekū Heiau at high tide does not quite reach Mākole‘ā. Hāpaiali‘i Heiau bears 154° 45’, 829 feet.
>
> This is a walled *heiau*, apparently facing to the west. On the west side is a wall 5 feet wide and 4 feet high, from the ends of which broader walls gradually incline until the east wall is reached at a height of 6.5 feet. The stone in these walls is broken *pāhoehoe*. The floor of the enclosure is on a level with the ground outside but is paved with smooth beach pebbles. Dividing the interior compartment unevenly is a long low wall or platform that is .33 feet higher than the floor. It is of similar construction to the walls which it joins but is about 3 feet lower. Another feature is a pit in the southeast corner of the walls; it is 2.5 feet deep but was perhaps deeper formerly.
>
> The information was that the *heiau* had been built (or consecrated) by Lonoikamakahiki and that it was used for prayers in general. There is a small enclosure to the south with rather light walls. It is included in the plan in position, since there were no other structures nearby. It probably had a connection with the *heiau*. [Stokes and Dye 1991:80]

Most recently, Haun and Henry (2004a) recorded the following:

> The site is comprised of a large rectangular enclosure that is 27.0 m long (north-northwest by south-southeast) and 18.0 m wide . . . The walls range in width from 1.0 to 2.0 m and evidence a maximum height of 3.0 m. The interior of the enclosure is bisected by a north-south wall that divides the structure into two compartments. The interior floor is paved with basalt pebbles.

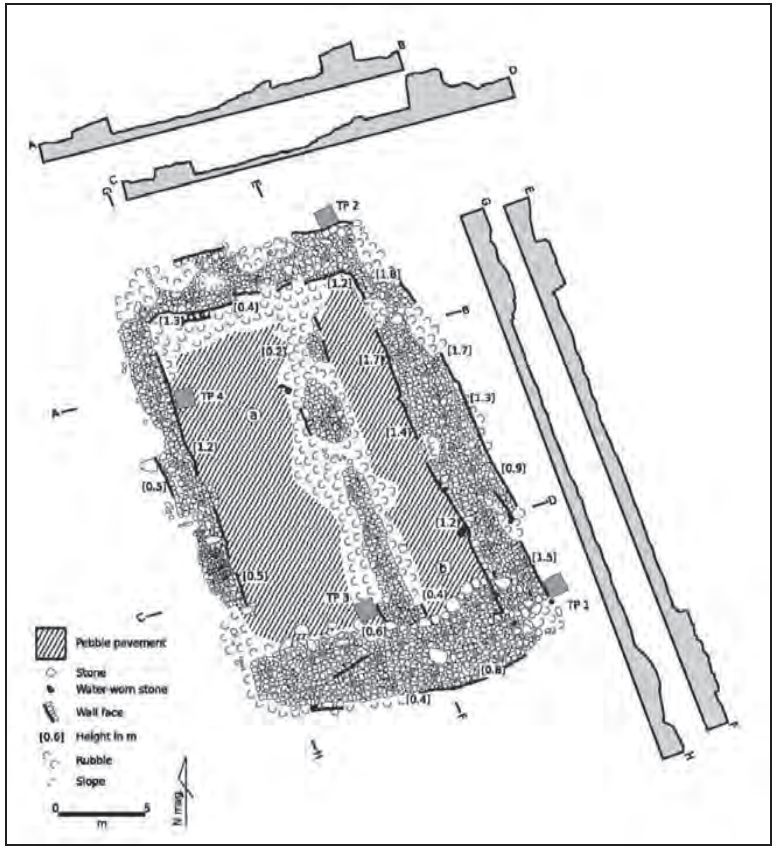


Figure 82. Plan view map of Mākole‘ā Heiau (SIHP # -03819), including cross-sections, drawn prior to reconstruction (Kalawe and Dye 2010:5)

> Stokes [and Dye] (1991) noted a c. 1.0 m deep pit on top of the enclosure wall at the southeastern corner. This pit was not observed by Walker and Rosendahl and appears, along with portions of the western wall, to have been disturbed bybulldozer activity associated with the construction of a road (1989:A-4). Kekahuna (1952) observed similar pits along the northern wall, which he interpreted as having been used to support images. A small enclosure was located to the south of the *heiau*, which Stokes indicated was likely an outpost associated with the main structure (1991:80). This structure also has been destroyed by the bulldozer activity . . . [Haun and Henry 2004a:8]

During the current AIS, CSH confirmed SIHP # -03819 within the project area (see Figure 37 and Figure 83). As indicated by the background research, the *heiau* is presently in a restored state. The site description penned by Haun and Henry (2004a:8) is generally accurate, though some of the dimensional details have changed in the subsequent restoration of the site. Mākole‘ā is oriented similarly to Ke‘ekū, forming in essence a parallelogram. Situated within a heavily disturbed area, it is surrounded by vegetation; there are signs that the vicinity of the *heiau* was inundated by the 2011 tsunami. The *heiau* generally measures 28 m long and 19 m wide, with heights along the main walls of 1.5 to 2.2 m on the exterior and 1.65 to 1.8 m on the interior. The main walls range in thickness from 3.0 to 3.5 m. The wall faces are of neatly stacked basalt boulders with a core-fill of cobbles. The constructed pit observed by Haun and Henry (2004a:8) at the southeast corner was confirmed; this pit measures 1.3 m wide and 1.0 m deep. A PVC pipe extends throught the pit east-west.

The westernmost 5 m of the northern wall extends up to 2.5 m beyond the main line of the wall, forming a large constructed pit measuring 2.25 wide by 1.6 m deep. Just south of this feature along the western or *makai* wall is the *heiau* entry, which measures approximately 1.45 m wide and is closed off by a wooden barricade. Along the northern wall from the entry to the bisecting wall is a paved landing or terrace measuring 1.5 m wide and 0.3 m high (Figure 84). The interior surface of both of the *heiau* compartments is presently covered in plastic tarpaulin intended to prevent vegetative growth. Where the ground surface is exposed it is seen to consist of sand, coral, and *‘ili‘ili*. At approximately 6.5 m wide, the *makai* compartment is somewhat larger than the *mauka* compartment, which measures approximately 4.5 m wide. Both compartments are of roughly the same length (approximately 22 m). The core-filled wall biseting the compartments is approximately 1 m thick and 1.5 m high (Figure 85). The *mauka* compartment is accessed via a constructed entry located along the interior wall approximately 5 m north of its intersection with the southern *heiau* wall. This entry is located on a terrace measuring approximately 1.5 m wide and 0.3 m high (Figure 86). The terrace is formed by a curved alignment of small basalt boulders containing level fill of small cobbles.

It is currently proposed that the restored Mākole‘ā will be mapped during school year 2014-2015 as part of *‘āina*-based education activities, with the final map to be included in the project preservation plan.

Figure 83. Photo of the restored Mākole‘ā Heiau (SIHP # -03819); view to southeast

Figure 84. Photo showing the terraced main entrance at Mākole‘ā Heiau (SIHP # -03819), with the bisecting wall and main eastern wall visible in the background; view to east

Figure 85. Photo showing the bisecting wall and interior compartments at Mākole‘ā Heiau (SIHP # -03819); view to south

Figure 86. Photo showing the terraced entry along the bisecting wall from the *makai* compartment of Mākole‘ā Heiau (SIHP # -03819); view to northeast

5.3.4 SIHP # 50-10-37-10997 (Kapuanoni Heiau)

FUNCTION:	Ceremonial, religious
SITE TYPE:	*Heiau*
DIMENSIONS:	50.0 m by 50.0 m
CONDITION:	Altered
LIKELY AGE:	Pre-Contact

DESCRIPTION: SIHP # -10997, or Kapuanoni Heiau, was previously recorded by Stokes (1906-1907; see also Stokes and Dye 1991), Reinecke (1930), Sterling (1960), Cordy (1986a), Walker and Rosendahl (1989), and Tuggle (1990). Some of these studies included mapping. This *heiau* is proposed for restoration under a preservation plan specific to Mākole‘ā, Kapuanoni, and Po‘o Hawai‘i (Dye and Ayau 2008; see Appendix C).

Cordy’s (1986a:11-12) investigation of Kapuanoni found it to be “virtually as Kekahuna mapped it [in 1952; see Figure 16]”:

> The same division A and E features are present, separated by an open sandy area. The features are the same shape as on [Kekahuna’s] map [see Figure 16]. Only two differences were noticed. One, the west part of the open area, between features A-1 and E-5, is filled with stone—in a platform-like appearance. Two, features E-3 and E-4 today are really one feature. They form a rectangular paving which is 30-40 cm higher than E-1/E-2 and 30 cm lower than paving E-5. A smaller rectangular sand area is present in the E-3/-4 paving. I would suspect that the sand area was E-4 and was incorrectly mapped.
>
> . . . [T]he three pavings on the north (E-1/E-2, E-3/E-4, and E-5) are all stepped up—each about 30-40 cm higher, from east to west. The rectangular sand area in E-3/-4 has the appearance of a house area within the larger paving. This area of these pavings looks very different functionally from A-1 and A-2. Indeed, one might be tempted to say that the pavings look like dwelling and associated activity areas, while the A-l/A-2 enclosures do not. To stretch this, one could suggest that A-1/A-2 was the heiau proper (following Kekahuna) and that the pavings were a dwelling area, perhaps the priest’s dwelling as there seems to be too few house features for a ruler’s residence. This functional interpretation actually might be compatible with an agricultural/fishing heiau, with A-1/A-2 as an [sic] appropriately smaller religious areas.
>
> Third, and equally important, a wall foundation line extends 8 meters out from the southwest corner, outside the present main wall to the edge of the tidal pool. This foundation is 1.7 meters wide and consists of stones (35 cm wide) set on edge. The foundation is likely to be a remnant of the original south wall of the heiau. If this alignment is followed east through the existing main wall and inside, a faint visual alignment can be seen in the interior. Also, a possible linear facing remnant appears visible west of A-1 and E-5 inside the heiau, and this may be the original west wall. These alignments indicate the original heiau was likely a rectangular walled heiau of about the same size. [Cordy 1986a:11-12]

Based on his observation of exposed marine shell midden and a piece of volcanic glass, Cordy surmised that additional deposits related to its use for habitation are located within the *heiau*. Regarding this function, Cordy writes that “only a few houses could have been present, which would make it unlikely that a ruler would have resided here” (Cordy 1986a:11). He concluded that “the hotel’s restoration did not greatly alter the heiau’s features,” but did note the following:

> The exterior wall is clearly not the original wall. The original wall seems to have once been rectangular in shape. At some point in time, it was moved in, had its corners curved, and been reinforced with cement. Also, interior walls have been restored. However, the internal features and deposits still seem to be present, and the original wall foundation is visible. [Cordy 1986a:12]

Tuggle’s subsequent (1990) investigation at Kapuanoni confirmed much of Cordy’s observations. Tuggle (1990) observed that:

> Most of the walls on the surface of the structure have been recently ‘rebuilt’ in one fashion or another . . .
>
> The Phase I mapping also identified a massive set of foundation stones outside the northwest (seaward) corner of the present structure. This may be part of the foundation of Kapuanoni before Lana‘i rebuilt it for a residence, or it may be the foundation of a structure earlier than that historically known as Kapuanoni. [Tuggle 1990:57]

During the current AIS, CSH confirmed SIHP # -10997 within the project area (see Figure 37 and Figure 87). Since the site has undergone some changes since it was recorded by Cordy (1986a) and Tuggle (1990), it was remapped (Figure 88) and photographed, and an updated site description was prepared. A test trench (T-22) was excavated in the pool deck area to identify any buried or otherwise disturbed structural remnants of Kapuanoni (see Section 5.3.4.1).

While the structural components of the other *heiau* in the project area were not featurized under the present study, those observed at Kapuanoni were. These components should be considered more accurately as sub-features. This method of documentation at Kapuanoni stemmed more from the need for an organizational approach in mapping and otherwise describing this *heiau* (which has not yet been restored) than from a typological difference. That is, SIHP # -10997 (consisting of Kapuanoni Heiau) is interpreted as a single feature (*heiau*) site, as is SIHP # -03819 (Hāpaiali‘i Heiau) or SIHP # -03819 (Mākole‘ā Heiau), as opposed to a complex site consisting of two or more related features (for example, Ke‘ekū and Hale O Papa at SIHP # -03818).

SIHP # -10997 is located to the north and west of the Outrigger Beach Hotel, on a promontory forming the southern end of Kahalu‘u Bay (see Figure 37). Kapuanoni is directly adjacent to the hotel pool, which has been filled with concrete. Vegetation observed at the site includes heliotrope, *noni*, *niu*, and *naupaka*. Overall the site measures 50 m (north/south) long by 50 m wide (east/west). It is generally bisected by a stone wall trending east to west and measuring 14 m long (east/west) by 1.0 to 1.5 m thick with a maximum height of 1.25 m. The portion of Kapuanoni Heiau to the south of this bisecting wall is considered by some to be Kapuanoni Heiau proper, while the portion north of the wall may have been used for habitation. For the organizational reasons discussed above the portion of the site south of the wall is referred to as

Figure 87. Photo overlooking Kapuanoni Heiau (SIHP # -10997); view to north

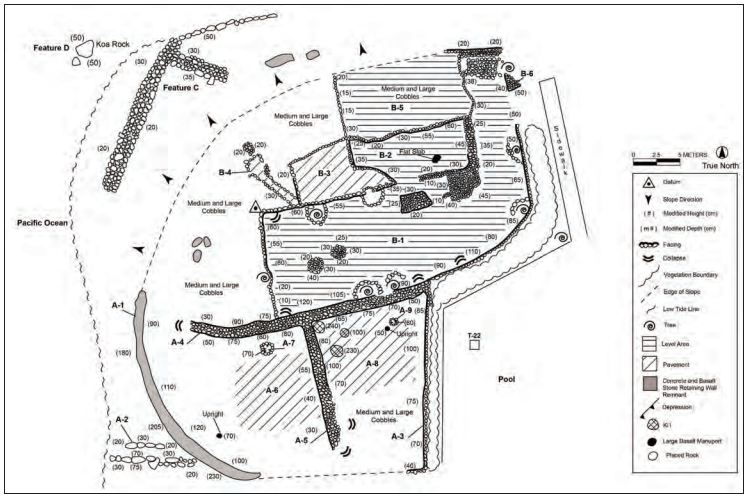


Figure 88. Plan view map of Kapuanoni Heiau (SIHP # -10997)

Feature A, while the portion to the north referred to as Feature B. Both Features A and B contains numerous sub-features. Features C and D are located within the tidal zone northwest of the main structure (see Figure 88).

Feature A represents the ceremonial portion of the *heiau* directly west of the pool south of (and including) the wall roughly bisecting the site (see Figure 87 and Figure 88). It contains the remnant walls of what was once a rectangular enclosure divided near its center by a wall trending north to south. Within this divided enclosure are numerous sub-features. Feature A-1 comprises the curved, restored *makai* wall constructed along the edge of the promontory described by Cordy (1986a:12) (see Figure 31, Figure 87 and Figure 89). This reconstructed wall segment has been severely damaged by tsunami and high surf. This wall measures 26.0 m long (north/south) by 1.0 m wide (east/west), with heights ranging from 0.9 to 2.3 m. From the southern end of A-1 parallel alignments of large upright basalt slabs (Feature A-2; see Figure 88 and Figure 89) extend from the base of the reconstructed wall into the high tide zone; these alignments likely represent the original foundation of Kapuanoni Heiau. Overall A-2 measures 6.8 m long (east/west) by 2.0 m wide (north/south) and 0.2 to 0.75 m high.

Feature A is defined on its *mauka* side by a modern wall built during construction of the pool. This wall (Feature A-3; see Figure 88) meaures 20.0 m long (north/south) by 2.0 m wide (east/west), with heights of 0.4 to 1.0 m. Feature A-4 is the wall that bisects the site and serves as the northern boundary for Feature A (Figure 90). The wall is constructed with neatly stacked and faced basalt cobbles and boulders. This wall measures 14.0 m long (east/west) by 1.0 to 1.5 m thick, with a maximum height of 1.25 m. Extending south from the central portion of this wall is the wall segment that divides the overall Feature A enclosure (Feature A-5; see Figure 88 and Figure 90). It is also constructed with neatly stacked and faced basalt cobbles and boulders. This wall segment measures 14.0 m long (north/south) by 1.0 m wide (east/west), with heights of 0.3 to 1.0 m.

Located within the enclosure west of A-5 is a remnant pavement (A-6; see Figure 88 and Figure 90) consisting of a slightly sloped area of waterworn basalt cobbles and corals. This pavement measures 8.0 m long (east/west) by 7.25 m wide (north/south). Immediately north of A-6 is a small, nearly circular pit with a lined interior of stacked and faced basalt cobbles (Feature A-7; see Figure 88). Feature A-7 measures 0.9 m long (east/west) by 0.85 m wide (north/south) with a depth of 0.70 m. The pit has been partially filled with cobbles, likely deposited by wave action. Situated between Features A-1 and A-6 is an isolated, uright waterworn basalt boulder. It is not known if this boulder was intentionally placed or the result of storm surf. The upright rises 0.7 m above the surrounding ground surface and measures 0.9 m long by 0.4 m wide and 0.38 m thick.

Located to the east of Feature A-5 is another pavement (Feature A-8; see Figure 88 and Figure 91). Consisting of a level deposit of waterworn corals and basalt pebbles and cobbles, Feature A-8 measures 7.65 m long (north/south) by 7.0 m wide (east/west). Three carved wooden *ki ‘i* are situated in the northwestern portion of Feature A-8. These *ki ‘i*, which are all in a deteriorated state, have a basal diameter of approximately 1.0 m and heights of up to 2.40 m. An upright waterworn boulder is also present near the northwest corner of the A-8 pavement (see Figure 88). The stone measures 0.65 m high by 0.45 m wide by 0.42 m thick, rising 0.5 m above the surrounding ground surface. Feature A-9 is a roughly circular pit located immediately

Figure 89. Photo showing Kapuanoni Heiau (SIHP # -10997) Features A-1 (background) and A-2 (at photo scale); view to north

Figure 90. Photo overlooking Kapuanoni Heiau (SIHP # -10997) Features A-4 through A-8; scale is 2 m; view to east

Figure 91. Photo overlooking Kapuanoni Heiau (SIHP # -10997) Features A-4, A-8 and A-9, with A-1 and A-6 visible in the background; view to west

adjacent to the upright boulder in the northeastern corner of the A-8 pavement (see Figure 88). This constructed pit measures 0.6 m wide (north/south) by 0.7 m long (east/west) with a depth of 0.6 m. The pit has been partially filled with small cobbles.

Feature B comprises the complex of sub-features north of the Feature A-4 wall thought to be associated with the later habitation area at Kapunanoni (Cordy 1986a:11-12) (Figure 92). This portion of the site has been more heavily impacted by hotel development and landscaping than Feature A. Directly adjacent to Feature A-4 and extending north is an L-shaped, level, sand-filled area (Feature B-1; see Figure 88 and Figure 92). Within this level area are numerous landscaping features constucted by the hotel, including six semicircular rock alignments around coconut trees and abutting the sides of B-1, two circular rock mounds and one rectangular rock mound (see Figure 88). These features do not appear on Kekahuna’s (1952) map or Cordy’s (1986) annotation of Kekahuna’s map (see Figure 16 and Figure 31). CSH consulted with KS grounds manager Victor, who confirmed these features are modern landscaping constructions. Feature B-1 measures 30 m long (east/west) by 11.0 to 30.0 m wide (north/south). The feature is bound to the west by a retaining wall that measures 11.0 m long (north/south), 0.6 m thick and 0.1 to 0.6 m high. The area to the west of this retaining wall is strewn with uneven and loose waterworn cobbles and boulders. Kekahuna’s 1952 map did not include this wall though Cordy did note it on his 1986 annotation (see Figure 16 and Figure 31).

Feature B-2 is located adjacent to the northeastern edge of B-1 (see Figure 88). The feature is an irregular-shaped, level sandy area bounded by low retaining walls associated with platforms to the west and north (B-3 and B-5) (see Figure 88 and Figure 93). A wall segment separates B-2 on the east with B-1, measuring approximately 5.0 m long, 1.0 m thick, and up to 0.45 m high. Feature B-2 is defined to the southwest by an accumulation of basalt cobbles that was not noted on previous maps; these materials were likely placed by hotel staff. This deposit contains a piece

Figure 92. Photo overlooking Kapuanoni Heiau (SIHP # -10997) Feature B; view to southwest

Figure 93. Photo of Kapuanoni Heiau (SIHP # -10997) Feature B-2, with B-5 visible in the background; view to northwest

of wood that Mr. Māhealani Pai has indicated once belonged to a canoe that was formerly a part of hotel landscaping; interestingly Cordy’s map (see Figure 31) indicated a canoe inside of an enclosure that is no longer present in this general area. B-2 is accessed between the edge of B-3 and the modern rock deposit (see Figure 88). Within Feature B-2 is a large, inset basalt slab. It measures 0.8 m long (north/south) by 0.5 m wide (east/west). Overall, Feature B-2 measures 12.5 m (east/west) by 5.0 m (north/south).

West of Feature B-2 is an irregular-shaped paved platform (Feature B-3; see Figure 88 and Figure 94). The surface is a level pavement of medium and large basalt waterworn cobbles. Feature B-3 measures overall 10.0 m long (east/west) by 6.0 m wide (north/south) and rises above the surrounding surfaces from 0.2 to 0.55 m. Its exterior is of stacked basalt boulders, exhibiting facing on the eastern, southern, and most of the western sides. The vicinity of this feature appears to have undergone significant change since Cordy mapped it in 1986 (see Figure 31).

Feature B-4 is a linear trail or pathway extending northwest from the southwest corner of B-3 to a small rock mound (see Figure 88 and Figure 95). It is lined with basalt cobbles and paved with corals and small waterworn pebbles. The trail measures 7.6 m long (northwest/southeast) by 0.8 to 1.2 m wide (northeast/southwest). The cobble alignments are 0.1 to 0.3 m high. The mound measures 0.6 m long (northwest/southeast) by 0.5 m wide (northeast/southwest) and 0.2 m high. It is constructed of an exterior ring of large cobbles with a fill of smaller rock materials. Numerous pieces of coral, shell, and small waterworn pebbles were observed on the mound and within its construction. This feature was not shown on Cordy’s 1986 annotation (see Figure 31), indicating it is a modern construction.

Immediately north of Feature B-2 is a square platform (Feature B-5; see Figure 88 and Figure 93). The platform rises 0.2 to 0.6 m above the surrounding ground surface. The extant portions of its exterior are of stacked basalt boulders, exhibiting facing on the southern side along the B-1 interface; this is where the platform exhibits its greatest height. While the southern, western, and eastern sides are intact, the northern edge has been obliterated by heavy surf. The surface of the platform is of level, medium and large basalt cobbles. An intact and formal construction extends from the northeast corner of the platform area, measuring 6.1 m long (east/west), 1.0 m thick and 0.2 m high. Directly below the southern side of this feature is an accumulation of basalt rubble, similar to that fronting B-2.

Located immediately east of the northern portion of B-1 and approximately 5.0 m east of B-5 is what appears to be a remnant wall segment (Feature B-6; see Figure 88 and Figure 96). It measures 2.5 m long (east/west) by 1.8 m wide (north/south) with a height of 0.4 to 0.5 m. It is constructed of stacked basalt cobbles and exhibits facing along its intact western and southern sides.

Feature C is a roughly F-shaped alignment of basalt boulders and cobbles neatly placed onto basalt bedrock, the “massive set of foundation stones” described by Tuggle (1990:57). The feature is situated just above the low-tide line approximately 12 m west of the corner of Feature B-5 (see Figure 88 and Figure 97). This remnant alignment may represent an older *heiau* that Kapuanoni Heiau was built over. The feature consists of two somewhat distinct portions. The northernmost portion is a single-stone-wide alignment oriented almost east-west beginning just beyond the northwest/southeast trending segment. This portion is up to 0.3 m wide and up to

Figure 94. Photo of Kapuanoni Heiau (SIHP # -10997) Feature B-3, with B-2, B-5, and B-6 visible in the background; view to east

Figure 95. Photo of Kapuanoni Heiau (SIHP # -10997) Feature B-4, stone-lined trail and mound; view to west-northwest

Figure 96. Photo of Kapuanoni Heiau (SIHP # -10997) Feature B-6; view to east

Figure 97. Photo showing a portion of Kapuanoni Heiau (SIHP # -10997) Feature C (note alignments under left end of scale); view to northeast

0.5 m high. The remainder of the feature forms a rough L shape. It is a more substantially constructed alignment, generally several stones across with a fairly consistent thickness of 2.0 m. This section ranges from 0.2 to 0.3 m high. Overall the feature measures 27.0 m (southwest/northeast) by up to 8.0 m wide.

Feature D is a large boulder in the ocean known as the “Koa rock.” It is situated approximately 7.0 m northwest of Feature C (see Figure 88 and Figure 98). The location and name of the feature was provided to CSH by Mr. Māhealani Pai during site documentation at Kapuanoni. The boulder measures 2.2 m long (northeast/southwest), 2.0 m wide (southeast/northwest) and 0.5 m high.

5.3.4.1 Test Trench 22 (T-22)

Test Trench 22 (T-22) was excavated with mechanical assistance just southeast of Kapuanoni Heiau within the former pool deck area (see Figure 37 and Figure 88). A 1.0 by 1.0 m (1.0 sq m) test unit was placed along the *makai* side of the pool in an attempt to determine the potential for any buried remnants or cultural deposits related to Kapuanoni or other land uses in this area. Figure 99 (left frame) shows the T-22 unit cut out (using a chop saw) prior to excavation. T-22 was excavated through three stratigraphic levels into a basalt boulder fill (see Figure 99 and Figure 100). The stratigraphy observed at this location consisted of concrete (Stratum I) atop two distinct, compacted fill layers (Stratum II and Stratum III) overlying a basalt boulder fill layer (Table 8). Given the sensitivity of the location of T-22, Mr. Māhealani Pai was on site during its excavation. In consultation with Mr. Pai, excavation at TU-22 was terminated upon reaching the large boulder fill, as its removal would require expansion of the unit, which would further disturb the area. No cultural materials were observed during the excavation of T-22.

Figure 98. Photo of Kapuanoni Heiau (SIHP # -10997) Feature D; view to north

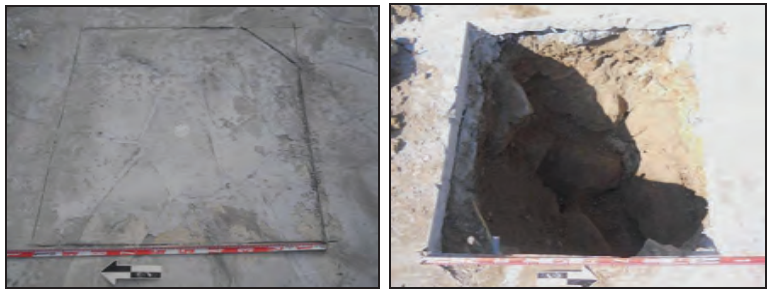


Figure 99. Photo of T-22 prior to excavation (left) and post-excavation (right); view to east (left) and west (right)

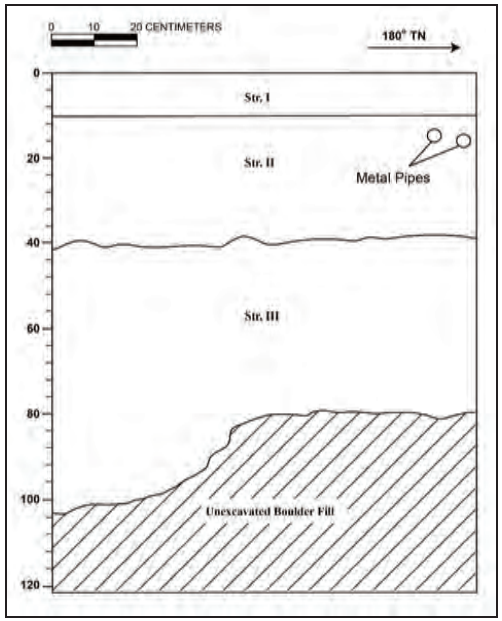


Figure 100. Stratigraphic profile drawing of the east wall of T-22

Table 8. Stratigraphy of T-22

Stratum	Depth (cmbs)*	Description
I	0–10	Concrete pool deck surface
II	10–41	10YR 3/3 (dark brown); mixed cinder, sand, and topsoil fill; weak, fine to very coarse, granular structure; dry, loose consistency; non-plastic; mixed sediments; diffuse, smooth lower boundary; few roots observed; no cultural materials present; fill layer associated with pool construction
III	41–104	5YR 5/2 (reddish gray); mixed sand and topsoil fill; weak, fine to very coarse, granular structure; dry, loose consistency; non-plastic; mixed sediments; abrupt, wavy lower boundary; few roots observed; no cultural materials present; fill layer associated with pool construction

*cmbd=centimeters below datum

5.3.5 SIHP # 50-10-37-12915 (Probable Burial Area—Sand Dune)

FUNCTION:	Probable burial
SITE TYPE:	Sand dune
DIMENSIONS:	Unknown
CONDITION:	Buried/unknown
LIKELY AGE:	Pre-Contact

DESCRIPTION: SIHP # -12915 was previously recorded by Tuggle (1990) as follows:

> The dune area along the coast south of Ke‘eku [sic] Heiau has been noted as a burial area by members of the Kahalu‘u community. No information is currently available on the exact locations of the burials, and it is unknown whether any remain following the construction of the Kona Lagoon Hotel. This area thus is listed as a ‘probable site’, one that would be placed in a Conservation category if it proves to be definite . . .
>
> It is recommended that any earth-moving activity in this vicinity be archaeologically monitored. [Tuggle 1990:65]

During the current AIS, CSH was unable to confirm SIHP # -12915 within the project area, and the Tuggle (1990) description was determined to be accurate. It is likely that this site is present but buried; given the sensitive nature of the reported cultural deposit excavation was not undertaken to confirm its presence. The vicinity was documented using GPS and photographs (see Figure 37 and Figure 101).

Figure 101. Photo showing the vicinity of SIHP # -12915; view to west

5.3.6 SIHP # 50-10-37-12950 (Low-Walled Enclosure—LCA 5966)

FUNCTION:	Habitation
SITE TYPE:	Complex
DIMENSIONS:	N/A
CONDITION:	Destroyed
LIKELY AGE:	Historic; nineteenth century

DESCRIPTION: SIHP # -12950 was previously recorded by Walker and Rosendahl (1989) and Tuggle (1990). Tuggle (1990) described the site as follows:

> This site, defined as a ‘midden area and *‘ili‘ili* scatter’ (Walker and Rosendahl 1989: A-40) is a low-walled enclosure, representing the remains of a *kuleana* parcel. This parcel was awarded to Maheu (also ‘Meheu’), as LCA 5966. It is described in the mid-19th century records as enclosed, with two houses (Native Testimony 1848). The land to the south and *makai* was identified as ‘idle’, the land *mauka* belonging to Kaukoekoe (or Poohina), and the land to the north belonging to the *konohiki* (Native Register and Native Testimony). No *‘ili* name was noted for this parcel, but the LCA *mauka* (5694:1) was located in the *‘ili* of Hokio, which may thus include 5966. Maheu was also awarded a two acre agricultural parcel somewhere *mauka*.
>
> By the time of the Baldwin survey (1909) no house was located on the parcel [see Figure 20], corroborated by the Podmore map of 1925. In both cases, however, an enclosing wall was shown, presumably representing the original *kuleana* walls constructed by Maheu (although not exactly the area ultimately awarded). The walls were still intact when the area was mapped in 1969 (Keauhou Beach plot plan) and again in 1971.
>
> The site was mapped and test excavated (three 1x1m pits) in the 1989 season. The *makai* portion of the site has been heavily damaged by storm surf (the site is located at the inland edge of a shallow lagoon), but fragments of a wall could be seen. Only a portion of the south wall remains, much of it destroyed (or covered) by construction activities of the adjoining Kona Lagoon Hotel. The north and *mauka* walls are in good condition, but appear to have been substantially rebuilt. There are no surface indications of the two houses said to have existed in 1848.
>
> The surface of the interior area is heavily covered with midden, but no traditional artifacts were found except for one fragment of a grinding stone. In addition, large quantities of modern trash are scattered over the surface.
>
> The three excavation pits indicated that the deposits in the area are shallow and highly disturbed. Although there are large quantities of modern trash, there are also remnant undisturbed deposits with 19th century artifacts, as well as some flakes of basalt and volcanic glass that may derive from the pre-Contact period.
>
> Much of the modern material, from the 1950s and 1960s, was deposited from the adjoining parcel where structures existed until about 1970 . . .

> Site 12950 is clearly the location of a 19th century *kuleana* lot. Despite substantial disturbance and modern trash, there are some remnants from the 19th century occupation, including wall sections and deposits.
>
> Additional data recovery is recommended. There is a possibility of locating house foundations from the 19th century, and a clear probability of obtaining a good sample of the 19th century artifactual inventory. Information from this important occupational period is difficult to obtain in general, and certainly so in the remainder of the project area due to extensive disturbance. [Tuggle 1990:35-36]

During the current AIS, CSH was unable to confirm SIHP # -12950 within the project area. No surface remnants or cultural deposits were identified. In an attempt to locate buried structural remnants and/or cultural deposits, two test trenches (T-13 and T-29) were excavated in the known vicinity of SIHP # -12950 (see Section 5.3.6.1 and 5.3.6.2). It was determined that modern developments within the project area (landscaping, construction of a sea wall) have obliterated any remains of this historic property.

5.3.6.1 Test Trench 13 (T-13)

Test Trench 13 (T-13) was excavated by hand on the inland side of a modern sea wall within the western bounds of LCA 5966. A 1.0 m by 1.0 m (1.0 sq m) test unit was placed in this location in an attempt to determine the potential for any buried remnants or cultural deposits related to SIHP # -12950 (see Figure 37). Figure 102 (left frame) shows the T-13 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-13 was excavated to bedrock through one stratigraphic level (see Figure 102 and Figure 103). The stratigraphy observed at this location consisted of a single fill layer (Stratum I) overlying basalt bedrock (Table 9). Out-of-context cultural materials were observed to be arbitrarily distributed throughout Stratum I. Despite lacking context within a defined cultural feature, these materials (consisting of marine shell, blue-colored pottery, and clear green and brown colored glass) were collected and analyzed (see Section 6.1).

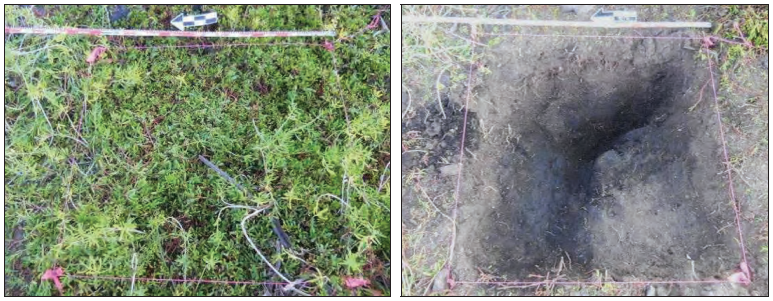


Figure 102. Photo of T-13 prior to excavation (left), and post-excavation (right); view to east

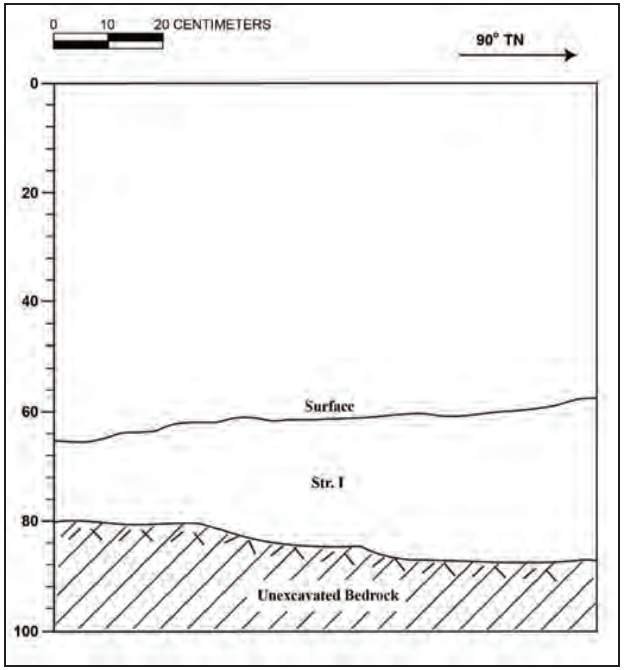


Figure 103. Stratigraphic profile drawing of the north wall of T-13

Table 9. Stratigraphy of T-13

Stratum	Depth (cmbd)	Description
I	57–94	10 YR 4/2 (dark grayish brown); sand and silt fill; weak, medium, granular structure; dry, loose consistency; weak cementation; non-plastic; mixed sediments; abrupt, smooth lower boundary; many roots observed; contains arbitrary distribution of out-of-context cultural materials (marine shell, glass and pottery fragments); contains 20% basalt pebbles and small- to medium-sized cobbles; fill layer associated with landscaping and/or sea wall construction

5.3.6.2 Test Trench 29 (T-29)

Test Trench 13 (T-13) was excavated by hand on the inland side of a modern sea wall within the western bounds of LCA 5966. A 1.0 m by 1.0 m (1.0 sq m) test unit was placed just south of T-13 in an attempt to determine the potential for any buried remnants or cultural deposits related to SIHP # -12950 (see Figure 37). Figure 104 (left frame) shows the T-29 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-29 was excavated to bedrock through two stratigraphic levels (see Figure 104 and Figure 105). The stratigraphy observed at this location consisted of beach sand (Stratum I) and silty loam (Stratum II) overlying basalt bedrock (Table 10). Out-of-context cultural materials were observed to be arbitrarily distributed throughout Stratum I. Despite lacking context within a defined cultural feature, these materials (consisting of fish bone, marine shell midden, and charcoal) were collected and analyzed (see Section 6.1).

Figure 104. Photo of T-29 prior to excavation (left), and post-excavation (right); view to north

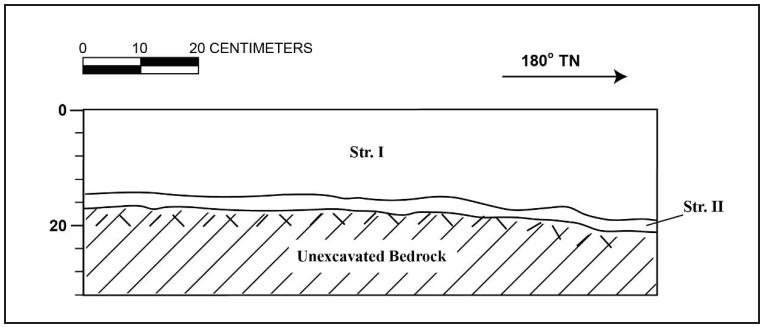


Figure 105. Stratigraphic profile drawing of the east wall of T-29

Table 10. Stratigraphy of T-29

Stratum	Depth (cmbs)	Description
I	0–22	7.5YR 4/3 (brown); medium-grain sand; structureless (single-grain); dry to moist, loose consistency; weak cementation; non-plastic; marine sediment; clear, smooth lower boundary; few fine to coarse roots observed; contains arbitrary distribution of out-of-context cultural materials (fish bone, marine shell midden, and charcoal); layer deposited as either fill or by high seas
II	17–22	10YR 2/1 (black); silty loam; weak, very fine, granular structure; moist, firm consistency; non-plastic; terrigenous sediment; abrupt, smooth lower boundary; few very fine sized roots observed; fill layer associated with landscaping and/or sea wall construction

5.3.7 SIHP # 50-10-37-12951 (Well Complex)

FUNCTION:	Habitation
SITE TYPE:	Complex
NUMBER OF FEATURES:	2
DIMENSIONS:	30.0 m by 5.0 m
CONDITION:	Altered
LIKELY AGE:	Historic; nineteenth century

DESCRIPTION: SIHP # -12951 was previously recorded by Walker and Rosendahl (1989) and Tuggle (1990). Tuggle (1990) described the site as follows:

> This site consists of two wells, 12951-A (439-51) and 12951- B (439-52). These are faced structures that extend to the water table. Both structures have been substantially rebuilt by recent landscaping. These features are not part of *kuleana* lots, but do fall within the area of extensive 19th century wall construction, as shown in the Baldwin map of 1909. Feature 12951-B was noted in 1930 by Reinecke (n.d., Site 29) and described as ‘Fine brackish pool, with very carefully laid steps leading into it.’ This has been rebuilt so that no steps exist now. Reinecke does not mention 12951-A, a site that now has steps leading into it. (It is possible that Reincke’s site 29 is mislocated and could be 12951-A instead of B, but his sketch suggests they are not the same.)
>
> Test pits were placed near each of the wells. The pit near 12951-A immediately encountered large cobble and boulder construction fill, and could not be excavated to any depth. Another pit showed nothing but disturbance and modern material. In the latter case some midden was found on the surface, but this is a recent secondary deposition.
>
> Two test pits (each 1x1m) near 12951-B were quite similar in content. Each had a substantial deposit of modern landscaping fill above a truncated original deposit some 10 to 15 em thick. This deposit contains a few pieces of midden, a few flakes of volcanic glass and basalt, plus two adz fragments. However, this does not appear to be a primary deposit, but rather a secondary deposition in gravels . . .
>
> The two wells could date from the 19th century, but there is no clear evidence in support of this; further, one (and probably both) has undergone substantial modification in recent years. Near 12951-B is a remnant unit with cultural material, but in a secondary deposition.
>
> No further work is recommended for the wells. The deposit with the cultural material is not substantial enough to warrant direct archaeological monitoring during construction; however, provision should be made for the accidental encounter of intact cultural deposits that could exist in the general area. [Tuggle 1990:37]

During the current AIS, CSH confirmed SIHP # -12951 within the project area (see Figure 37). While the Tuggle (1990) description is generally accurate, it was updated to reflect the

present state of the site. SIHP # -12951 was also remapped and photographed. In addition, four sediment cores (C-1A, C-2A, C-2B, and C-2C) were manually extracted from two locations within SIHP # -12951 (C-1 and C-2; see Figure 37). These samples, extracted from the wells at Features A and B, were intended to generate data regarding the construction and use of the former water features and/or any climactic changes indicated within their sediments. The results of the sediment coring are given in Section 5.5 (see also Section 6.2). No water was observed within either of the well features.

Feature A is a roughly ovoid, stone-lined well (Figure 106 and Figure 107). Situated 20 m east of Feature B, it is bound to the south and east by the present parking lot retaining wall and surrounded by landscape vegetation. The interior lining of the well, which reaches a maximum depth of 0.6 m, is constructed with up to two courses of neatly stacked and faced basalt cobbles and boulders. The well surface is flush with the surrounding ground surface. A linear path defined by parallel alignments of basalt cobbles extends northwest from the well. These alignments measure up to 0.4 m deep along the faced interior. An inset *pāhoehoe* slab forms a step or landing at the interface between the lined path and the well. The path and/or slab step are likely components of the stepped entry observed by Tuggle (1990). Overall Feature A measures 5.0 m long (east/west) by 2.0 m (north/south). No artifacts were observed in or around the well. The feature is in fair condition, but has clearly been impacted by modern developments and landscaping.

Figure 106. Photo of SIHP # -12957A, with the modern retaining wall visible in the background; view to east

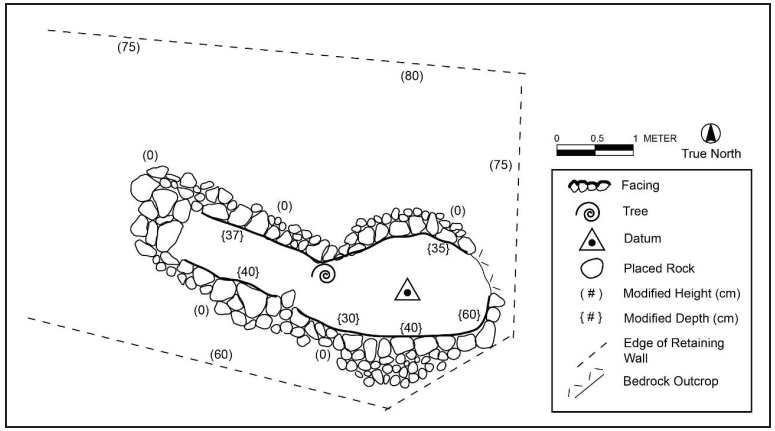


Figure 107. Plan view map of SIHP # -12951A

Feature B is a circular stone-lined well (Figure 108 and Figure 109). It is situated just north of the central tennis courts and approximately 20 m west of Feature A. The area surrounding the feature is landscaped and well maintained. A small, covered concrete patio abuts the feature to the east. Overall Feature B measures 4.5 m long (north/south) by 3.5 m wide (east/west). It is constructed with neatly stacked basalt cobbles and boulders. The interior lining exhibits two to three courses of faced stones, with a maximum depth of 0.8 m. The interior floor is comprised of level soil and organic debris from surrounding vegetation. The constructed lining, which is up to 1.5 m thick aournd the exterior of the well, reaches a height of up to 0.45 m above the surrounding ground surface. The northern portion is more substantially and formally constructed; it is likely the feature once exhibited a similar level of construction along its other sides, but that these materials have since coallapsed and/or been removed for use elsewhere. Feature B is in fair to good condition.

Figure 108. Photo of SIHP # -12957B; view to southeast

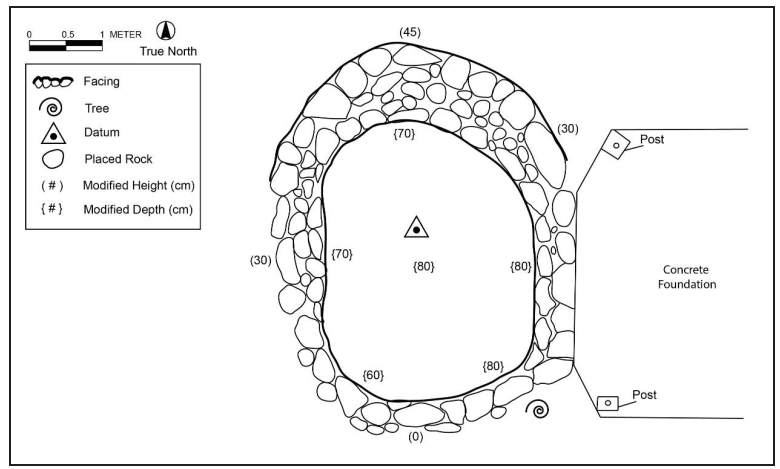


Figure 109. Plan view map of SIHP # -12951B

5.3.8 SIHP # 50-10-37-12953 (Ali‘i Residence—Po‘o Hawai‘i Pond)

FUNCTION:	Habitation
SITE TYPE:	Complex
NUMBER OF FEATURES:	2
DIMENSIONS:	30.0 m by 24.0 m
CONDITION:	Altered
LIKELY AGE:	Unknown (over 50 years)

DESCRIPTION: SIHP # -12953 was previously recorded by Reinecke (1930), Walker and Rosendahl (1989), and Tuggle (1990). The site currently consists of two main features, the ca. 1970s replica of King Kalākaua's Summer Cottage and Po‘o Hawai‘i Pond. Po‘o Hawai‘i has not been restored, though it is proposed for restoration under a preservation plan specific to Mākole‘ā, Kapuanoni, and Po‘o Hawai‘i (Dye and Ayau 2008; see Appendix C).

Tuggle (1990) described the site as follows:

> Po‘o Hawai‘i is a walled pond and an associated area commonly considered an *ali‘i* residential locale. There are no known traditional references to Po‘o Hawai‘i, but the name occurs in the land records of the mid-1800s as an *‘ili* (Native Register and Native Testimony), including not only the site here indicated, but the area of nearby Kapuanoni Heiau as well . . .
>
> The first recorded use of the name Po‘o Hawai‘i to refer to the pond was by Reinecke (n.d.), who also noted that one of the traditional ‘fish-gods' (*ku-ula*) of the area was also called ‘Po‘o Hawaii', presumably based on information from his informant, Kahulumu. This is probably the ku-ula ‘Ka-naio' of Kekahuna (1952).
>
> Associated with Po‘o Hawai‘i . . . was a structure called Mokuahiole. Stokes (n.d.) recorded that although Mokuahiole was ‘on the list of *heiau*, the local information was to the effect that it was Keeaumoku's residence', and in his notes he wrote ‘built by Keeaumoku.' It is probable that this was the temple that was part of the royal house compound that also included Po‘o Hawai‘i. Forbes (n.d.) spelling is ‘Kamoku-uwahiole' on his list of *heiau*.
>
> Kekahuna (1952) notes that the area of Po‘o Hawai‘i and Mokuahiole served as a residence for Kamehameha, Ke‘eaumoku, and Kalakaua . . . The location of his residence is not recorded, but it could have been Po‘o Hawai‘i. (Reinecke--n.d.-notes that a bathing pool offshore was associated with Kamehameha.)
>
> Ke‘eaumoku Papa‘iahiahi, one of Kamehameha's most valued chiefs, almost certainly had one of his main residences here . . .
>
> Kalakaua is said to have torn down Kuakini's stone house at Po‘o Hawai‘i to build a frame structure to serve as a ‘summer house'; a granddaughter of Lana‘i, Kealoha-pau-ole Ka-opua (Kahuina) performed the ceremony before the demolition (Kekahuna and Kelsey (1954) . . .
>
> Kekauluohi, one of Kamehameha's wives, the third Kuhina nui and the mother of Lunalilo, via Kanaina, was brought up at Kahalu‘u and Keauhou (Kamahau 1961: 394), around 1800; she was the granddaughter of Ke‘eaumoku and reared by him, thus probably living at Po‘o Hawai‘i and Mokuahiole when she was in Kahalu‘u.
>
> There is thus substantial evidence that Po‘o Hawai‘i and Mokuahiole served as a major site for *ali‘i* residence in Kahalu‘u during the early post-Contact period until the time of Kalakaua . . .
>
> Pre-Contact *ali‘i* residence of the general area is suggested by the information that the adjacent Kapuanoni was the residence of the early 18th century king Alapai‘i (discussed above).
>
> An LCA parcel that includes the area now called Po‘o Hawai‘i (LCA 6026:2) was awarded to Isaaka Lana‘i. The testimony indicates that the property was received from Kuakini, that it contained five houses, and that it had been enclosed with a stone fence by Lana‘i and ‘missionaries'. Lana‘i did not live here, but in the makai parcel, Kapuanoni. This lot was occupied by ‘Palapala', according to the testimony. Family traditions indicate that Palapala, also called Na-palapala, (ancestor of the present Kana Nahale family) was a foster son of Lana‘i, and appointed a *konohiki* by Lana‘i and Kuakini (Kekahuna and Kelsey 1954) . . .
>
> There were five houses recorded in LCA testimony (presumably one being the stone house of Kuakini), but the first map (Baldwin 1909) shows only two houses. One of these was the frame house of Kalakaua that had replaced the house of Kuakini. The two houses appear on Reinecke's 1930 map (n.d.), but only the Kalakaua house remained when Kekahuna (1952) mapped Po‘o Hawai‘i. That structure was torn down shortly afterward. A reconstruction of the Kalakaua house, now standing, was built in the 1970s. An architectural historian with the Historic Sites Section of the State of Hawaii indicates that, unfortunately; it is not an accurate rendering.
>
> The area is currently landscaped, and the southern section of the Po‘o Hawaii *kuleana* was destroyed when the present hotel was constructed (Keauhou Beach plot plan, 1969). Nonetheless the possibility is high that some of the remains of the ancient royal house foundations still exist . . .
>
> There is a strong possibility that Po‘o Hawai‘i was an *ali‘i* residence of great antiquity. Any intact deposits here would be among the most important in Kahalu‘u, possibly containing a cross-section of the entire history of the region. [Tuggle 1990:59–62]

During the current AIS, CSH relocated SIHP # -12953 within the project area (see Figure 37). The Tuggle (1990) description was determined to be generally accurate. Because the King Kalākaua Summer Cottage is a modern reconstruction (per Tuggle 1990), it was determined that documentation of this feature would not yield useful data. Instead, the present investigation focused on updating the documentation of Po‘o Hawai‘i, which will be impacted by proposed restoration activities. This effort involved completion of a site description, mapping and photography. In the project AISP, CSH had recommended obtaining a sediment core sample from within the pond. During the present fieldwork, Mr. Mahealani Pai advised against this activity given the sensitive nature of the site.

Po‘o Hawai‘i at SIHP # -12953 is a roughly oval-shaped, stone-lined pond (Figure 110 and Figure 111). The pond is anchialine; as such, the water level fluctuates with the changing tides. Various marine vertebrates and invertebrates were observed within the waters of the pond including *āholehole*, *‘ama‘ama*, tilapia, *manini*, *‘ōpae*, and crabs. It is situated in a well-maintained landscaped area bounded by a replica of the King Kalākaua Summer Cottage to the northwest and the KBR to the north. Grassy lawns are present to the west and northwest. Numerous large coconut trees surround the pond. Overall Po‘o Hawai‘i measures 30.0 m long (north/south) by 24.0 m wide (east/west). The sidewalls of the pond have been constructed of neatly stacked and faced basalt cobbles and boulders (Figure 112). The constructed sidewalls generally extend below the water surface, presumably to the base of the pond, with a maximum measured height of 1.9 m. The sidewalls rise up to 0.5 m above the exterior ground surface. The sidewalls slope inward toward their base; at the surface they are generally 0.5 to 1.0 m thick. In a few places the walls cross over outcroppings of bedrock or soil embankments. A culvert is present along the western edge of the pond, extending west to the sea. The portion of the culvert that empties into the ocean is not visible because a seawall has been constructed over it; however water was observed flowing out from under this wall during low tide. An opening in the sidewall is present just north of the culvert. Overall the site is in excellent condition, suggesting its construction has been maintained in modern times.

Figure 110. Photo of SIHP # -12953, showing Po‘o Hawai‘i in the foreground and a replica of King Kalākaua’s Summer Cottage in the background; view to northeast

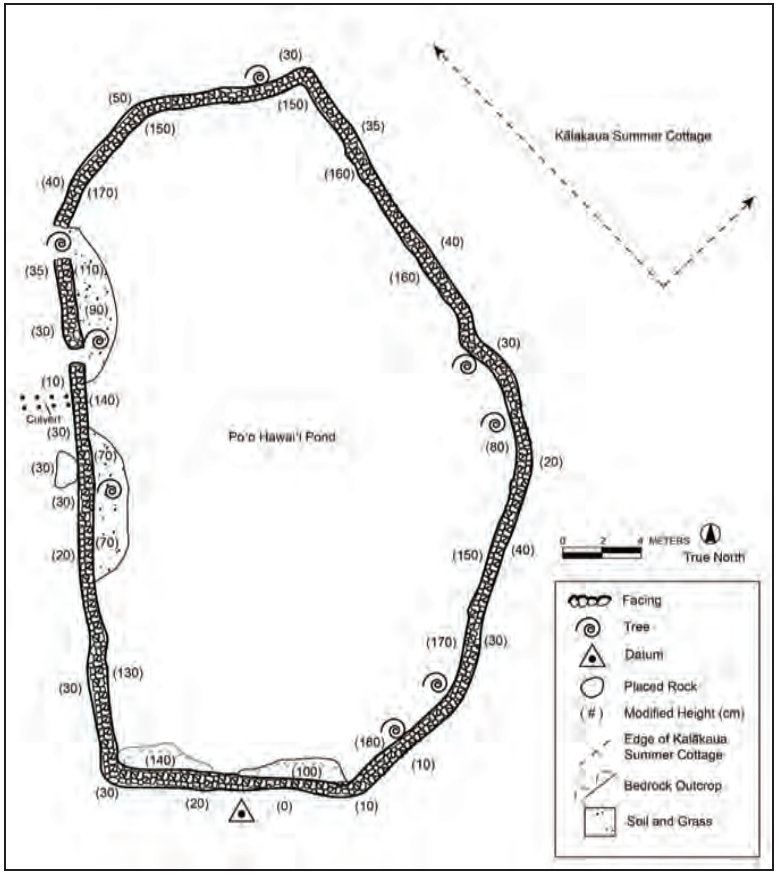


Figure 111. Plan view map of Po‘o Hawai‘i Pond (SIHP # -12953)

Figure 112. Photo showing typical construction along the pond sidewalls; view to southwest

5.3.9 SIHP # 50-10-37-12955 (House Site/Wall—LCA 5632:1)

FUNCTION:	Habitation
SITE TYPE:	Complex
NUMBER OF FEATURES:	2
DIMENSIONS:	40.0 m by 30.0 m
CONDITION:	Altered
LIKELY AGE:	Historic; continuous occupation from early 1800s to mid-1900s

DESCRIPTION: SIHP # -12955 was previously recorded by Emory et al. (1971), Walker and Rosendahl (1989), Tuggle (1990), and Haun and Henry (2004a and b). The site, which represents the remnant of LCA 5632:1, consists of two main features. Feature A is a north-south trending wall of substantial construction, and Feature B is an adjoining enclosure representing the former habitation area. Emory et al. (1971) mistakenly identified Feature A as a portion of the Great Kuakini Wall, which is actually situated somewhat more *mauka*. According to Tuggle (1990:37), “This area was left as a landscaped island when the parking lot for the Kona Lagoon Hotel was constructed” and the large eastern wall may have been reconstructed at that time. The 1990 investigation involved subsurface testing within Feature B:

> The site area was mapped and test excavated (three 1xl m pits) in the 1989 field season. The large *mauka* wall (12955-A) is certainly the wall shown in the 1909 Baldwin map, but it has been rebuilt, probably as a part of the landscaping of the Kona Lagoon Hotel. The northern wall is a remnant of the *kuleana* wall, also shown on the Baldwin map.
>
> The surface of the area has been landscaped, so that there is no evidence of any of the structures identified in earlier maps. The terrace line shown in the 1971 map has also been obscured.
>
> The test unit along the *mauka* wall indicated that the wall is built on bedrock with a shallow adjacent deposit. (The wall needs to be trenched at this point to isolate the rebuilt components.) The test along the lower wall indicated extensive fill, serving to level the area between the terrace face and the *makai* wall; this may have been done as part of the recent landscaping, using part of the cultural deposit as fill . . .
>
> Although there has been some disturbance from modern landscaping, there is a substantial intact deposit remaining in this *kuleana* enclosure, the bulk of it in the terrace of a house site that existed well into the 20th century. Extensive data recovery at this site, along with the documentary information, could well provide the most complete record of late 19th and early 20th century occupation of the project area. Detailed data recovery is recommended if the area is to be affected by any project activities. At the moment the plans are to avoid this area; thus the current recommendation is to place this site into the category of Conditional Preservation. [Tuggle 1990:37-38]

Over a decade later, Haun and Henry described SIHP # -12955 as follows:

> Site 12955 consists of the remnants of a walled house yard associated with Land Commission Award (LCA) 5632, *Apana* I . . . The yard is bounded by wall segments on the north, west, south and east. No remnants of a house or other habitation structures have been reported. LCA 5632 was awarded to Keikihookama during the *Mahele*. [Haun and Henry 2004a:8]

During the current AIS, CSH confirmed SIHP # -12955 within the project area (see Figure 37 and Figure 113). Since the site has undergone some changes since it was recorded by Tuggle (1990) and Haun and Henry (2004a), it was remapped (Figure 114) and photographed and an updated site description was prepared. A test trench (T-4) was excavated within Feature B to identify the potential for intact cultural deposits or buried structural remnants within the former habitation enclosure (see Section 5.3.9.1).

SIHP # -12955 is situated in the southeastern portion of the project area parking lot within an undeveloped “island” amongst asphalted parking lots and driveways (see Figure 37). It is visually apparent that a large amount of cinder fill was imported and spread about in the interior of the site. A handful of trees and shrubs are present along the perimeter of the site, and grasses have spread across the cinder interior surface.

Figure 113. Photo of SIHP # -12955 (LCA 5632:1); view to north

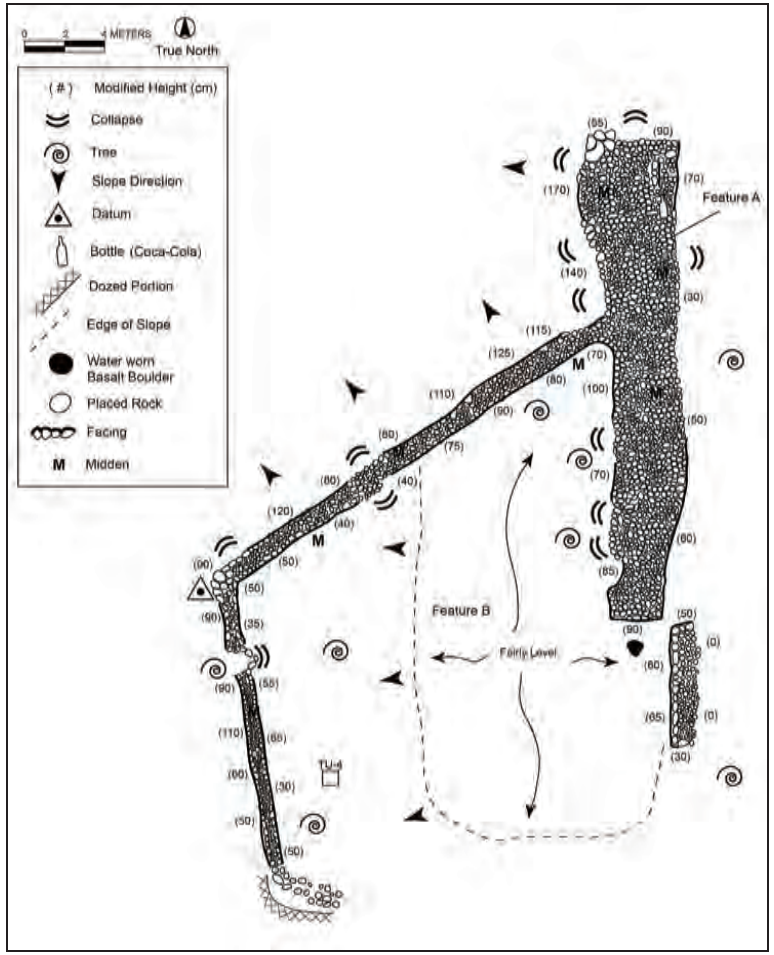


Figure 114. Plan view map of SIHP # -12955

Feature A is a substantial wall remnant forming the inland boundary of the overall site (see Figure 37 and Figure 114). While background research indicates this wall once extended some distance north and south as of the early 1900s (see Figure 20), it has been largely truncated, though the remaining segment has been present since at least 1989 when it was documented by Walker and Ronsendahl (see Figure 32). The wall consists of two sections separated by a 1.0-m-wide gap indicating a potential former entry to the habitation enclosure (Feature B). The sections of the wall separated by the gap are offset and architecturally distinct. Baldwin’s 1909 sketches of walls at Kahaluu (see Figure 20) indicate an irregularity along the otherwise very linear route of wall in this vicinity, of which this isolated southern segment may once have been a part. The more substantial northern segment exhibits a construction of stacked and faced basalt boulder exteriors with a cobble fill (Figure 115). It measures 30.0 long (north/south) by up to 3.0 m thick (east/west) with a maximum height of 1.25 m. The *makai* edge has experienced some collapse. Midden including marine shell, broken glass, and bits of metal was observed scattered along the wall. A Coca-Cola bottle embossed “San Francisco Calif.” on its base was found wedged into the surface of the northern end of this segment. An on-site analysis indicated this bottle likely dates to the 1940s or 1950s. The bottle was deposited back into the wall and covered with rock material. The southern segment is constructed wth a faced alignment of basalt slabs set on edge and filled along its inward edge with smaller cobble materials (Figure 116). It measures 6.1 m long (north/south) by up to 1.0 thick with a maximum height of 0.6 m on the western side, and appears as a terrace with the eastern edge flush with the ground surface. This side of the feature may have been impacted by the driveway construction and somewhat reconstructed to appear as it does at present. Feature A is in fair to good condition, though it has undoubtedly been impacted by past development.

Feature B formerly contained LCA 5632:1, which according to Tuggle (1990) was occupied well into the twentieth century. The feature presently consists of a partially enclosed area formed by walls to the north and west and the Feature A wall to the east. A bulldozed remnant of the southern wall was observed at the southwestern corner of the site. The northern enclosure wall, which is oriented northeast/southwest, measures 22.5 m long by 1.25 m thick with a maximum height of 1.25 m. The western wall segment measures 14.0 m long (north/south) by 1.0 m thick with a maximum height of 1.1 m. Both of these walls exhibit neatly stacked exterior faces with a core-fill of smaller materials. The bulldozed southern wall remnant measures 4.0 m long (northwest/southeast) by 1.25 m thick with a maximum height of 0.15 m. The walls are in fair to good condition with numerous areas of collapse. The interior surface is mostly level, with a downward slope along its western side. No internal features of the house site are currently visible on the surface; such features may lie beneath the cinder fill.

Figure 115. Photo showing the main, northern segment of SIHP # -12955 Feature A; view to northwest

Figure 116. Photo showing the isolated southern segment of SIHP # -12955 Feature A; view to northeast

Figure 117. Photo showing the northern and western core-filled walls of SIHP # -12955 Feature B; view to southwest

5.3.9.1 Test Trench 4 (T-4)

Test Unit 4 (T-4) was excavated by hand within the western bounds of SIHP # -12955 Feature B. A 1.0 m by 1.0 m (1.0 sq m) test unit was placed in this location in an attempt to determine the potential for any buried remnants or cultural deposits related to LCA 5632:1 (see Figure 37 and Figure 114). Figure 118 (left frame) shows the T-4 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-4 was excavated through two stratigraphic levels into a cultural layer (see Figure 118 and Figure 119). The stratigraphy observed at this location consisted of a fill layer (Stratum I) and a disturbed ashy cultural layer (Stratum II) overlying decomposing basalt bedrock (Table 11). The nature of the materials found within Stratum II is very similar in content and provenience to those found during the Tuggle (1990) excavations. A majority of the screened materials were analyzed, including a U.S. dime; corroded alkaline batteries; an intact glass bottle; an aluminum skewer; ceramic, glass, and metal fragments; wooden and glass buttons; marine shell midden; and fish, avian and mammal bones (see Section 6.1). Stratum II also contained waterworn pebbles and corals that were not collected.

Results of excavation at T-4 indicate usage into the later half of the twentieth century, given the presence of the 1965 bottle, alkaline batteries, and aluminum skewer. No clear trash pits or chronological substrata were observed; therefore it is likely Stratum II represents a disturbed cultural layer. The present results may reflect Tuggle’s (1990) findings of extensive fill mixed with part of the site’s cultural deposit along the nearby *makai* wall.

Figure 118. Photo of T-4 prior to excavation (left), and post-excavation (right); view to north

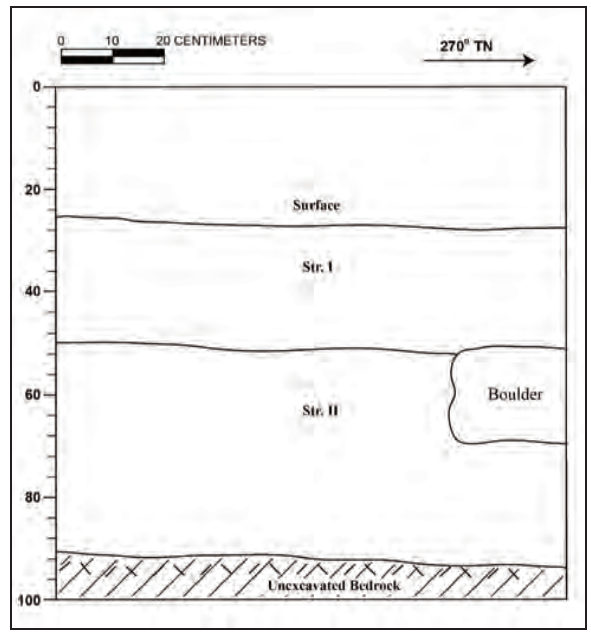


Figure 119. Stratigraphic profile drawing of the south wall of T-4

Table 11. Stratigraphy of T-4

Stratum	Depth (cmbd)	Description
I	27–52	7.5YR 5/6 (strong brown); cinder/topsoil fill; weak, coarse, granular structure; dry, loose consistency; non-plastic; terrigenous sediments; clear, smooth lower boundary; many very fine to fine roots observed; no cultural materials observed; small amount of coral inclusions present
II	52–91	10YR 2/1 (black); silty, ashy loam; weak, very fine to fine, granular structure; dry, loose consistency; weak cementation; non-plastic; terrigenous sediments; clear, wavy lower boundary; very fine to very coarse roots common; possible disturbed cultural layer containing large amounts of midden, modern refuse, and waterworn pebbles and coral

5.3.10 SIHP # 50-10-37-12957 (Low-Walled Enclosure—LCA 5693)

FUNCTION: Habitation
SITE TYPE: Complex
NUMBER OF FEATURES: 3
DIMENSIONS: 30.0 m by 30.0 m
CONDITION: Altered
LIKELY AGE: Historic (mid to late nineteenth century); modern

DESCRIPTION: SIHP # -12957 was previously recorded by Walker and Rosendahl (1989) and Tuggle (1990). The site is presently understood to consist of three main features, of which only one (the *kuleana* enclosure) is over 50 years old. Tuggle (1990) provides historical context for his observations of the site:

> This site is an enclosure (currently landscaped and used as a hotel garden) that is the location of a *kuleana* parcel (LCA 5693). The parcel was awarded to Koolau, and was described as being idle land prior to Koolau’s use of the land as a ‘house lot’ (Native Register and Native Testimony) . . .
>
> The original testimonies for LCA 5693 do not mention an enclosing wall, but the survey of 1852 . . . indicates that walls existed at least on the *makai* and south sides. The testimonies call the property a ‘house lot’, but there is no mention, as there usually is, of an actual house. The 1883 Emerson map does not indicate any house in this locale, while the Baldwin map of 1909 (and Podmore 1925) shows a walled enclosure twice the size of the original parcel, but no house. If a house was ever built on the lot, it was abandoned prior to 1883 . . .
>
> The site was mapped and two test pits (each lxl m) were excavated. The present enclosure is clearly the walled area shown on the 1909 map, and thus was built sometime between 1852 and 1909, although with some rebuilding and landscaping. (A ‘well’ in the center is of recent construction, part of the hotel garden.) A *papamu* has been incorporated as part of the wall foundation in the southeast corner.
>
> Within the enclosure, fragments of midden and pieces of porcelain are present on the surface; testing indicated that this material was recently deposited (perhaps from the construction of the ‘well’).
>
> One test pit in the original *kuleana* area indicated largely recent or disturbed deposits; the lowest level (30 to 40 cm deep, on bedrock) may contain a remnant deposit from the 19th century, but more extensive excavation would be required to determine if significant remains exist.
>
> The test pit on the south side, within the enclosure but outside the original *kuleana*, is much more promising. There is less recent disturbance. The 19th century wall is built on undisturbed beach sand. There is no clear cultural deposit associated with the wall; the deposit may have been removed during landscaping, or may never have been significant, as suggested by the absence for any documentary evidence for a house in this location. Beneath the wall the beach

> sand is about 35cm in thickness (in two depositional units) and contains a fe [sic] pieces of midden and some traditional Hawaiian artifacts, including flakes of volcanic glass and basalt, and a coral abrader. No introduced artifacts were in this deposit, so it may well be pre-Contact or early post-Contact. The sand is deposited on top of a shallow, non-cultural beach gravel, that in turn lies on bedrock.
>
> The sand deposit is not, however, a primary cultural occupation; the amount of cultural material is small, there are only a few flecks of charcoal, and there are no features or living surfaces. In all probability, this is the margin of the original occupational area, (and as a coastal deposit, may well have been a pre-Contact habitation of considerable importance. No testing was done outside the enclosure, so it is uncertain where the main occupation might have been located. The area around the enclosure has been subjected to extensive development, so the probability of such a deposit still existing is limited . . .
>
> The present enclosing walls of 12957 probably date from the mid to late 19th century, but define an area larger than the original *kuleana*. There is no documentary or archaeological evidence that a house ever existed within the enclosure.
>
> A deposit exists below the wall on the south side that is important in suggesting a significant occupation in the vicinity.
>
> The limited historical deposit in the northern section of the enclosure would merit additional data recovery for final verification of the nature of the 19th century occupation. More extensive data recovery in the southern portion of the enclosure is important to provide more information on the intact deposit of that area. [Tuggle 1990:38-40]

During the current AIS, CSH confirmed SIHP # -12957 within the project area (see Figure 37). The Tuggle (1990) description remains largely accurate. Present documentation included mapping (Figure 120), updating the 1990 site description (which involved featurization of the unique structural components), and photography. A shovel test (STP-1) was conducted within Feature B to identify the potential for intact cultural deposits or buried structural remnants within the former habitation enclosure (see Section 5.3.10.1).

SIHP # -12957 is situated within a heavily landscaped area just south of the turnaround at the KBR entrance and north of the *makai* tennis courts. The site consists of three main features. Feature A is the enclosure associated with LCA 5693; Feature B is a stone-lined spring within Feature A; and Feature C is a smaller enclosure abutting the western edge of Feature A.

Feature A is a rectangular enclosure (see Figure 120 and Figure 121). According to Tuggle (1990) this enclosure dates to the mid- to late 1800s, and contains LCA 5693 and adjacent areas. Feature A measures 30.0 m long (north/south) by 26.0 m wide (east/west). Constructed of neatly stacked and faced basalt cobbles and boulders, the enclosure walls range in thickness from 0.9 to 1.25 m and exhibit a maximum height of 0.8 m. Generally the walls are in excellent condition, though the northern wall abutting the hotel driveway is deteriorated. The portions of a *papamū* stone described by Tuggle (1990) were observed incorporated into the wall at the southeastern

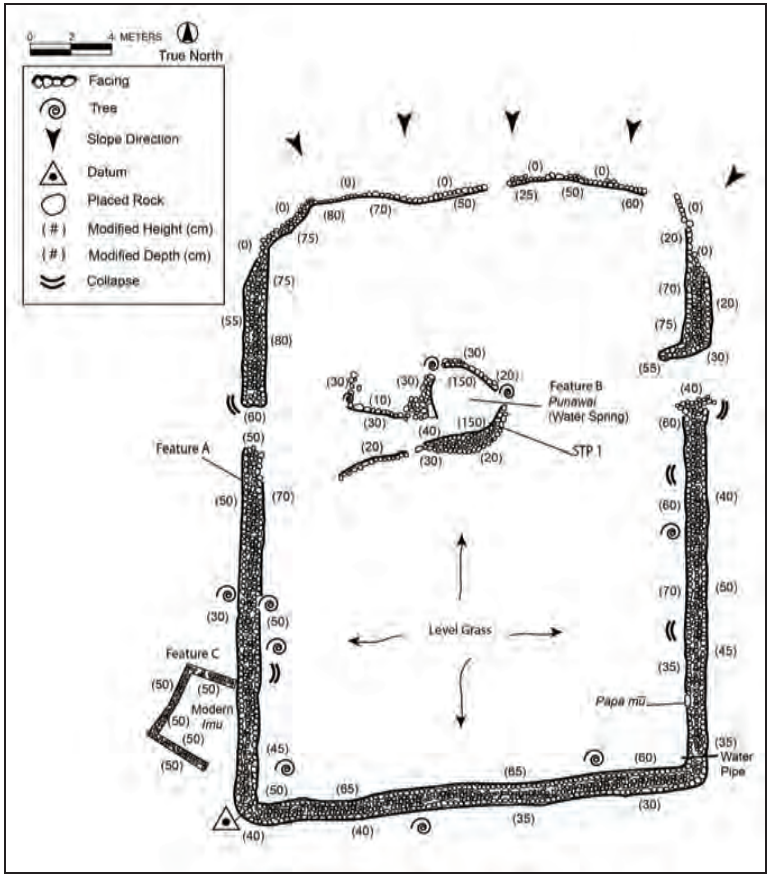


Figure 120. Plan view map of SIHP # -12957

Figure 121. Photo overlooking SIHP # -12957 Feature A, with the KBR visible in the background; view to north

Figure 122. Photo showing portions of a *papamū* incorporated into the construction of SIHP # -12957 Feature A (southeast corner of enclosure); view to east

corner of the enclosure (Figure 122). Two openings, set directly across from one another along the western and eastern walls, provide access to the interior (see Figure 120). The interior is a well-maintained lawn bordered by various ornamental trees and shrubs.

Feature B is a stone-lined natural spring or *punawai* located within the northern, central portion of Feature A (see Figure 120 and Figure 123). The edge of the spring is lined with neatly stacked basalt cobbles and boulders. Overall the feature measures 3.0 m long (east/west) by 3.0 m wide (north/south) with a depth of 1.80 m from the surface of the stone construction to the base of the spring. The stone lining rises between 0.2 and 0.3 m above the exterior ground surface. A pathway beginning just across from the western Feature A entrance leads to steps accessing the water within the spring, though this access point is currently cordoned off. The path is of variable width, defined by alignments of slabs set on their edges. The spring is surrounded by mixed vegetation. Its water level fluctuates with the tide and *‘ōpae‘ula* (endemic small reddish shrimp) were noted in abundance. The feature is in excellent condition.

Feature C is a small enclosure abutting the exterior of the southwestern corner of Feature A (see Figure 120 and Figure 124). This enclosure is oriented slightly offset from Feature A, with an entrance at its southeastern corner. The feature is constructed of neatly stacked and faced basalt cobbles and boulders capped with concrete. It measures overall 4.3 m long (north/south) by 2.6 m wide (east/west), with wall thicknesses of 0.35 m and heights of 0.50 m. The interior of the small enclosure is level rock scattered with organic materials. Burnt waterworn basalt cobbles were observed within the enclosure and along Feature A wall directly to the east. During the AIS fieldwork CSH was informed by Mr. Māhealani Pai that this feature is a modern *imu* (underground oven) constructed by the hotel.

Figure 123. Photo of SIHP # -12957 Feature B; view to east

Figure 124. Photo of SIHP # -12957 Feature C, with Feature A visibe in the background; view to northeast

5.3.10.1 Shovel Test Point 1 (STP-1)

Shovel Test Point 1 (STP-1) was undertaken at SIHP # -12957 Feature B (see Figure 37 and Figure 120) in an attempt to confirm Tuggle’s (1990) interpretation of the feature as modern through the evaluation of any subsurface cultural deposits. A 0.50 m by 0.50 m (0.50 sq m) shovel test was placed along the southern interior edge of the spring (Figure 125). STP-1 was excavated through two stratigraphic levels into decomposing bedrock (Figure 126). The stratigraphy observed at this location consisted of two shallow, natural organic layers (Stratum I and Stratum II) overlying decomposing basalt bedrock (Table 12). Stratum I contained a small basalt waterworn stone, large cowrie shell fragment, and rusted iron chisel or spike. The shell and iron object were collected and analyzed (see Section 6.1.1). It is likely these items were deposited at the site during or after the construction of the well, and subsequently covered by vegetative growth and/or debris. Nothing was observed during the testing to counter Tuggle’s (1990) interpretation of this feature.

Figure 125. Photo of STP-1 at SIHP # -12957 Feature B, post-excavation; view to south

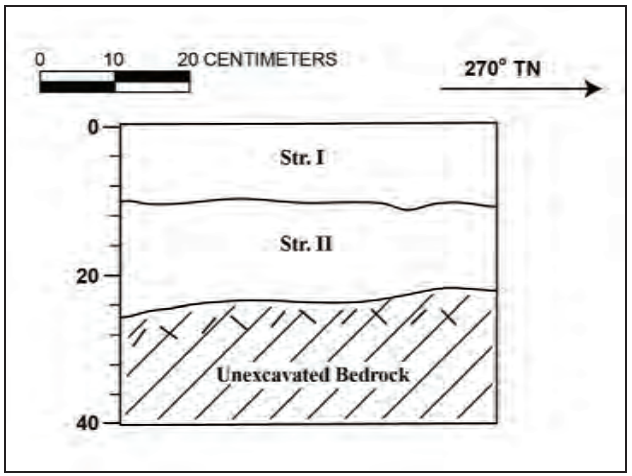


Figure 126. Stratigraphic profile drawing of the south wall of STP-1

Table 12. Stratigraphy of STP-1

Stratum	Depth (cmbs)	Description
I	0–10	10YR 3/3 (dark brown); silty loam; weak, very fine, crumb structure; dry, weakly coherent consistency; non-plastic; terrigenous sediment; clear, smooth lower boundary; many fine to very coarse roots observed; cowrie shell fragment, small basalt waterworn stone, and iron chisel or spike observed; natural organic layer resulting from surrounding vegetation
II	10–26	10YR 2/1 (black); silty loam; weak, fine, crumb structure; dry, weakly coherent consistency; non-plastic; terrigenous sediment; clear, smooth lower boundary; many fine to very coarse roots observed; no cultural materials present; natural organic layer

5.3.11 SIHP # 50-10-37-Ha-D4-34/-01616 (Rectangular Structure)

FUNCTION: Possible burial
SITE TYPE: Platform
DIMENSIONS: 20.0 m by 15.0 m
CONDITION: Destroyed
LIKELY AGE: Unknown (over 50 years)

DESCRIPTION: SIHP # -Ha-D4-34/-01616 was previously recorded by Emory et al. (1971) and Barrera (1971). According to Walker and Rosendahl (1989:24) this site, formerly consisting of a rectangular platform, was destroyed by construction of the Kona Lagoon Hotel. The site was documented by Barrera (1971) as follows:

> This site consists of a small lava bubble over which a platform has been built. The bubble measures approximately 2 by 4 meters; the roof is 60 cm high immediately adjacent to the 80-cm-wide hole in the ceiling. This hole, which provides the only access to the bubble, has been filled in with large (up to 80 cm long) rocks, which act as keystones to retain the smaller (20-cm square) fill-rocks of the platform proper. These latter stones are crudely coursed, indicating a degree of care in construction beyond merely the throwing of fill-stones in haphazardly. The top of the platform is paved with pieces of coral and rock measuring c. 15 by 20 cm.
>
> A 15-cm-deep deposit of moist brown dirt with occasional broken pieces of shell was found immediately beneath the opening of the bubble. Whether this deposit was intentionally placed or whether it was the result of materials sifting down through the platform could not be determined. The sparse materials recovered from excavation of this deposit . . . do not point to extended habitational use of the bubble. Although no skeleton was found, a human phalange was found in the platform fill, suggesting that a corpse had been placed on top of the platform. Within thebubble we found a dog tooth and a fragment of dog long bone. The lack of European items indicates an aboriginal burial. [Barrera 1971:12]

During the current AIS, CSH was unable to confirm SIHP # -Ha-D4-34/-01616 within the project area, which was as expected given the information provided by Walker and Ronsendahl (1989). The vicinity was documented using GPS and photographs (see Figure 37 and Figure 127).

Figure 127. Photo showing the developed vicinity of SIHP # -Ha-D4-34/-01616; view to east

5.3.12 SIHP # 50-10-37-Ha-D4-52 (Keawehala Pond)

FUNCTION:	Bathing pool
SITE TYPE:	Stone-lined pond
DIMENSIONS:	30.0 m by 20.0 m
CONDITION:	Destroyed
LIKELY AGE:	Unknown; likely pre-Contact

DESCRIPTION: SIHP # -Ha-D4-52 was previously recorded by Emory et al. (1971) and Barrera (1971). According to Walker and Rosendahl (1989:24) this site, formerly consisting of a stone-lined brackish pond, was destroyed by the construction of the Kona Lagoon Hotel and is now a level, landscaped area. Consultation undertaken for the current project has indicated the pond was filled with concrete during the hotel construction. In his documentation of the site, Barrera (1971:15-16), cited the Emory et al. (1971) site description:

> ‘This is a stone-lined pond at the limit of the high-tide zone between Ke‘eku and Makole-‘a [two *heiau*]. At the time of the survey it was completely overgrown with *hau* bushes. The pond is described and named on Kekahuna‘s map of the Kahaluu Bay area (1952) . . . [It is] now filled with mud an decomposing vegetation which preclude any measurements of its depth. At the SW end of the pond Kekahuna has on his map an X marking the location of the dwelling place of supernatural twin sisters termed mo‘o (lizard-like monsters).
>
> Recommendations. The clearing of the pond should be done under the supervision of an archaeologist to determine the details of construction (Emory et al., 1971:23 [cited in Barrera 1971]).’
>
> Our investigation after the pond had been cleared revealed that it is roughly oval in shape, and measures c. 20 by 30 meters. The wall, which has a 50-cm-wide break on the W side, varies between 1.3 and 3.5 meters in width, and between 80 and 110 cm in height above the bottom of the pond. Its height above the surrounding ground level is about 45 cm. Near the W side of the pond is a small island, 4.3 by 5.5 meters, that stands 60 cm above the bottom of the pond. Although the pond is interesting there seems to be no need for preserving it. [Barrera 1971:15-16]

During the current AIS, CSH was unable to confirm SIHP # -Ha-D4-52 within the project area, which was as expected given the information provided by Walker and Ronsendahl (1989). The vicinity was documented using GPS and photographs (see Figure 37 and Figure 128).

Figure 128. Photo of the vicinity of the filled and landscaped Keawehala Pond (SIHP # -Ha-D4-52); view to west

5.3.13 SIHP # 50-10-37- Ha-D4-53 (Petroglyphs on *Pāhoehoe*)

FUNCTION:	Petroglyph field
SITE TYPE:	Rock art / communication
DIMENSIONS:	15.0 m by 15.0 m
CONDITION:	Destroyed
LIKELY AGE:	Unknown; likely pre-Contact

DESCRIPTION: SIHP # -Ha-D4-53 was previously recorded by Emory et al. (1971) and Barrera (1971). According to Walker and Rosendahl (1989:24), this site, formerly consisting of a field of petroglyphs on a *pāhoehoe* outcropping, was destroyed by construction of the Kona Lagoon Hotel and is now a landscaped area. Barrera (1971:16) previously described the site as follows:

> This small petroglyph field was plane-table mapped. The following letters are keyed to [Figure 129].
>
> | | |
> |---|---|
> | A | Half of anthropomorphic figure |
> | B | Name, B. N. KAHOOPIA, with the ‘N’ written backwards |
> | C–F | Pecked areas, possibly obliterated petroglyphs |
> | G | Name, David Kaomea |
> | H–L | Pecked areas, possibly obliterated petroglyphs |
> | M | Half of a papamu, or board for playing the game of konane; the other half is obliterated by peck marks |
> | N–Q | Circles |
> | R, S | Ovals |
> | T | Half of an anthropomorphic figure. |
>
> [Barrera 1971:16]

During the current AIS, CSH was unable to confirm SIHP # -Ha-D4-53 within the project area, which was as expected given the information provided by Walker and Ronsendahl (1989). The vicinity was documented using GPS and photographs (see Figure 37 and Figure 130).

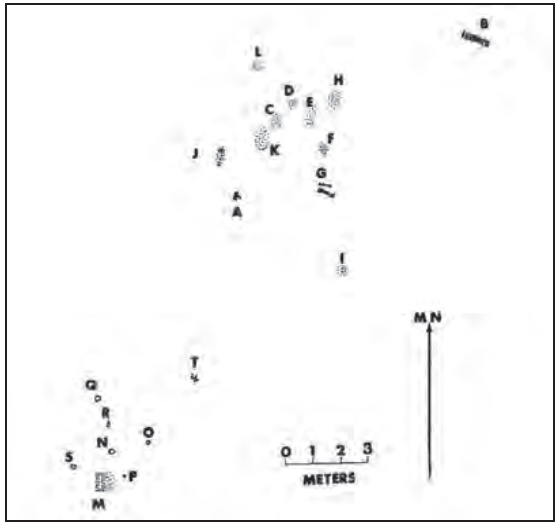


Figure 129. Plane-table map of SIHP Ha-D4-53 (from Barrera et al. 1971:17)

Figure 130. Photo showing the landscaped vicinity of SIHP # -Ha-D4-53; view to east

5.4 Results of Exploratory Test Trenching

Subsurface testing was conducted within the project area to assess the stratigraphy and potential for subsurface historic properties. Three criteria were considered in the selection of test trench locations: testing was proposed for (1) areas subject to project-related ground disturbance; (2) areas thought to have the potential to contain cultural deposits based on background research; and (3) to provide general coverage of the overall project area. Four of the 29 total test trenches were excavated within the context of a historic property (T-4, T-13, T-22, T-29; see Figure 37), in an attempt to further clarify the nature or age of the existing site; the results of these excavations are given within the applicable historic property descriptions in Section 5.3. The remaining 25 test trenches were excavated outside the context of any historic property, and were therefore more exploratory in nature. This section presents the results of this exploratory testing, providing for each test trench a rationale for testing in that particular location, the nature of the testing (i.e., mechanical versus hand excavation and size of unit), the stratigraphy observed, and any cultural materials identified. While the exploratory testing did not identify any new archaeological or cultural features, it did provide valuable information about the nature of the sediments found throughout the project area.

5.4.1 Test Trench 1 (T-1)

Test Trench 1 (T-1) was excavated with mechanical assistance in the far southeastern corner of the project area, where a maintenance building is proposed (see Figure 6 and Figure 37). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 131 (left frame) shows the T-1 area cut out (using a chop saw) prior to excavation. T-1 was excavated to bedrock through three stratigraphic levels (Figure 132). The stratigraphy observed at this location consisted of asphalt (Stratum I), basalt gravel fill (Stratum II), and silty loam (Stratum III) overlying basalt bedrock (Table 13). No cultural materials were observed during the excavation of T-1.

Figure 131. Photo of T-1 prior to excavation (left), and post-excavation (right); view to south

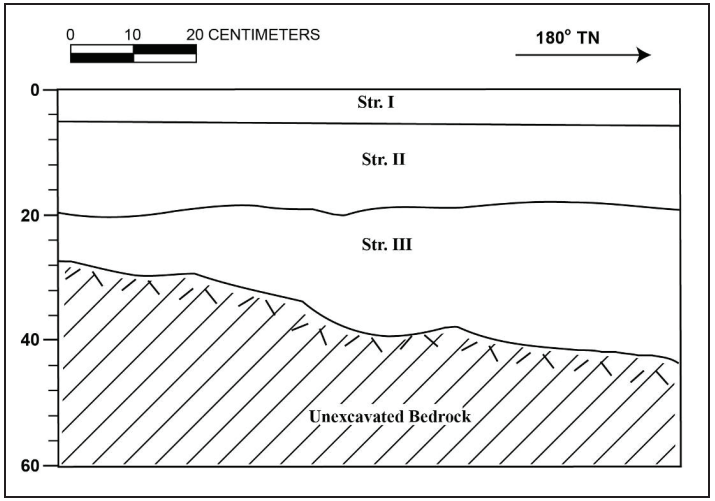


Figure 132. Stratigraphic profile drawing of the east wall of T-1

Table 13. Stratigraphy of T-1

Stratum	Depth (cmbs)	Description
I	0–10	Asphalt parking lot surface
II	10–21	Compacted basalt gravel fill; clear, smooth lower boundary; no cultural materials present
III	21–43	10YR 4/2 (dark grayish brown); silty loam; weak, fine, crumb structure; dry, loose consistency; weak cementation; terrigenous sediments; clear, wavy lower boundary; no roots observed; no cultural materials present; includes 20% basalt gravel and small cobbles

5.4.2 Test Tench 2 (T-2)

Test Unit 2 (T-2) was excavated with mechanical assistance in the southeastern portion of the project area, where a seepage pit is proposed (see Figure 37). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area, including the adjacent habitation at SIHP # -12955 / LCA 5632:1. Figure 133 (left frame) shows the T-2 unit cut out (using a chop saw) prior to excavation. T-2 was excavated to bedrock through two stratigraphic levels (see Figure 133 and Figure 134). The stratigraphy observed at this location consisted of asphalt (Stratum I) and basalt gravel fill (Stratum II) overlying basalt bedrock (Table 14). No cultural materials were observed during the excavation of T-2.

Figure 133. Photo of T-2 prior to excavation (left), and post-excavation (right); view to west

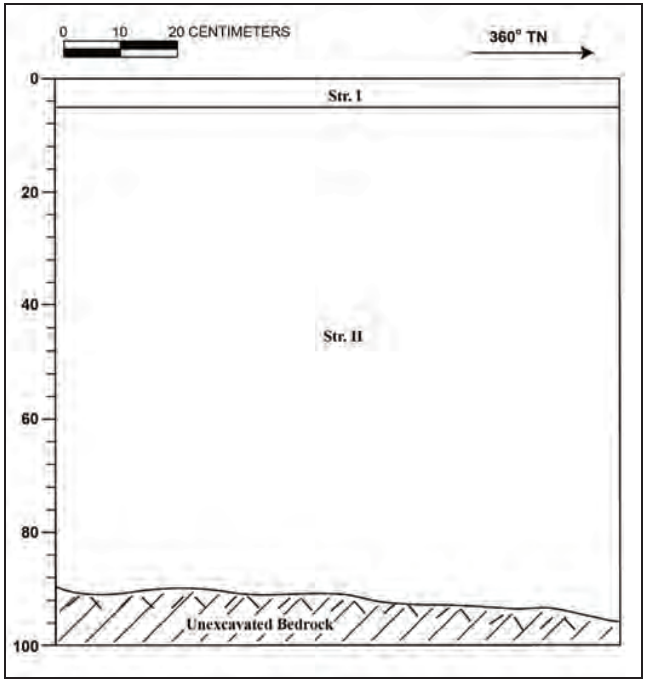


Figure 134. Stratigraphic profile drawing of the west wall of T-2

Table 14. Stratigraphy of T-2

Stratum	Depth (cmbs)	Description
I	0–6	Asphalt parking lot surface
II	6–98	Basalt gravel fill; abrupt, smooth lower boundary; no cultural materials present

5.4.3 Test Trench 3 (T-3)

Test Unit 3 (T-3) was excavated with mechanical assistance at the midpoint of the southern project area boundary in the vicinity of the proposed Hale Ki‘i and Hale Wa‘a (see Figure 6 and Figure 37). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 135 (left frame) shows the T-3 unit cut out (using a chop saw) prior to excavation. T-3 was excavated to bedrock through two stratigraphic levels (see Figure 135 and Figure 136). The stratigraphy observed at this location consisted of asphalt (Stratum I) and basalt gravel fill (Stratum II) overlying basalt bedrock (Table 15). No cultural materials were observed during the excavation of T-3.

Figure 135. Photo of T-3 prior to excavation (left), and post-excavation (right); view to north

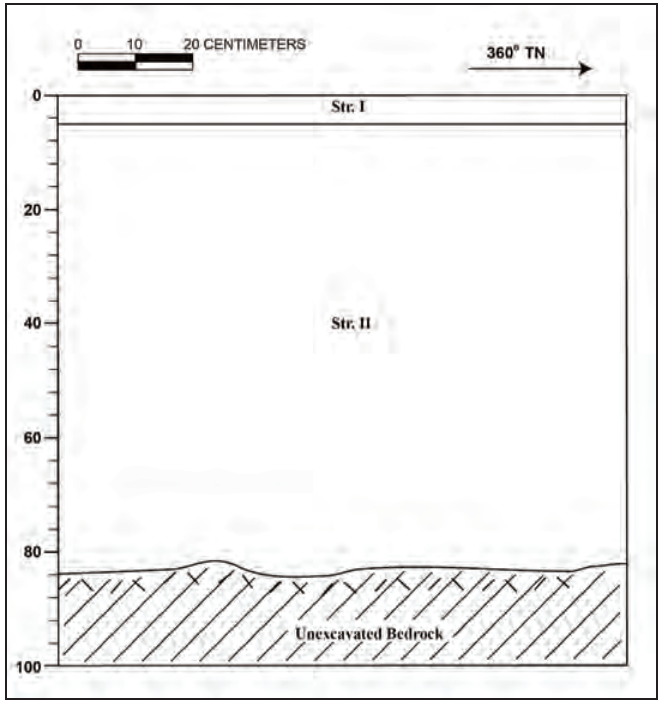


Figure 136. Stratigraphic profile drawing of the west wall of T-3

Table 15. Stratigraphy of T-3

Stratum	Depth (cmbs)	Description
I	7–13	Asphalt parking lot surface
II	13–93	Basalt gravel fill with large cobble inclusions; abrupt, smooth lower boundary; no cultural materials present

5.4.4 Test Trench 5 (T-5)

Test Trench 5 (T-5) was excavated by hand north of SIHP # -03819 (Mākole‘ā Heiau) in the location of the former Kawai‘ōpae Pool as indicated by Kekahuna (1952) (see Figure 14 and Figure 37). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the grassy lawn in an attempt to relocate the pool and determine the potential for any cultural deposits in this location. Figure 137 (left frame) shows the T-5 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-5 was excavated to bedrock through two stratigraphic levels to basalt bedrock (see Figure 137 and Figure 138). The stratigraphy observed at this location consisted of fill layers (Stratum I and Stratum II) overlying basalt bedrock (Table 16). Stratum II was a fill layer consisting of basalt rock material mixed with modern demolition debris including fragmental tempered glass, plastic, and metals. Aside from these debris, no cultural materials were observed during the excavation of T-5.

Figure 137. Photo of T-5 prior to excavation (left), and post-excavation (right); view to north (left) and west (right)

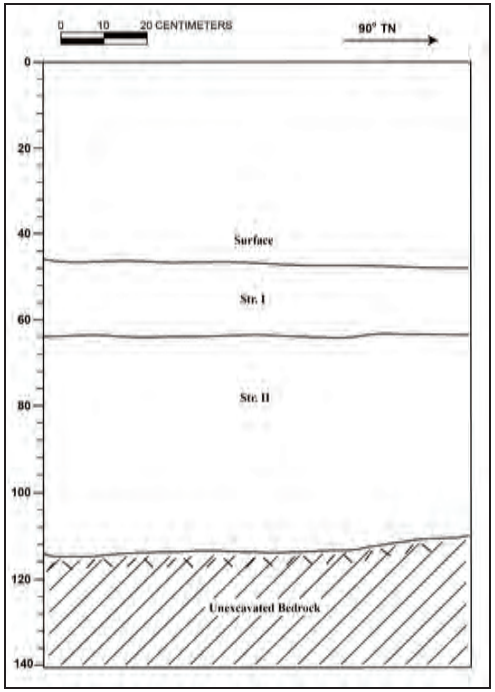


Figure 138. Stratigraphic profile drawing of the north wall of T-5

Table 16. Stratigraphy of T-5

Stratum	Depth (cmbd)	Description
I	48–65	10R 3/4 (dusky red); loamy cinder fill; weak, coarse, subangular blocky structure; moist, very friable consistency; weak cementation; non-plastic; terrigenous sediments; abrupt, smooth lower boundary; fine to medium roots common; no cultural materials present; contains 20% topsoil; landscaping fill layer
II	65–165	2.5 YR 3/1 (dark reddish gray); basalt gravel and cobble fill mixed with hotel demolition debris (i.e., tempered glass, plastic and metal); abrupt, smooth lower boundary

5.4.5 Test Trench 6 (T-6)

Test Trench 6 (T-6) was excavated by hand in the southern portion of the project area, where a comfort station and storage structures are proposed (see Figure 6 and Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the present grassy surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 139 (left frame) shows the T-6 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-6 was excavated to bedrock through two stratigraphic levels (see Figure 139 and Figure 140). The stratigraphy observed at this location consisted of fill layers (Stratum I and Stratum II) overlying basalt bedrock (Table 17). Stratum II was a fill layer consisting of loamy basalt gravel material mixed with modern demolition debris including sections of metal pipe and 1 by 1-inch chunks of concrete and tile. Aside from these debris, no cultural materials were observed during the excavation of T-6.

Figure 139. Photo of T-6 prior to excavation (left), and post-excavation (right); view to north

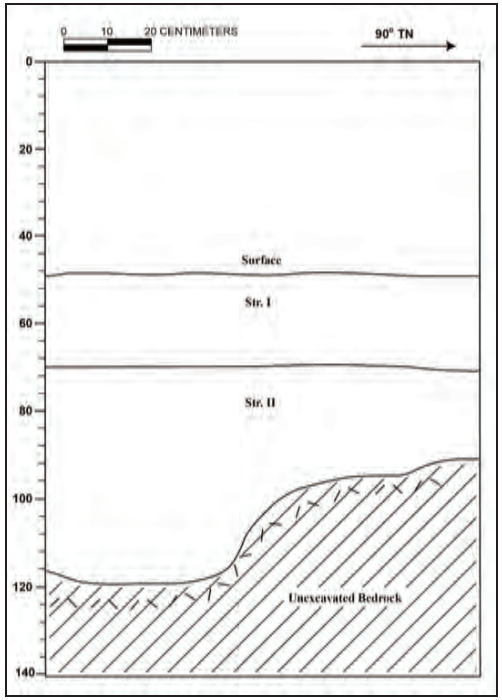


Figure 140. Stratigraphic profile drawing of the north wall of T-6

Table 17. Stratigraphy of T-6

Stratum	Depth (cmbd)	Description
I	50–70	10R 4/4 (weak red); loamy cinder fill; weak, coarse, subangular blocky structure; moist, very friable consistency; weak cementation; non-plastic; terrigenous sediments; abrupt, smooth lower boundary; fine to medium roots common; no cultural materials present; includes 10% topsoil; landscaping fill layer
II	70–115	10 YR 4/2 (dark grayish brown); loamy basalt gravel fill mixed with hotel demolition debris (i.e., metal pipe, 1 by 1-inch chunks of concrete and tile); abrupt, wavy lower boundary

5.4.6 Test Trench 7 (T-7)

Test Trench 7 (T-7) was excavated by hand in the southern portion of the project area near T-6, where a comfort station and storage structures are proposed (see Figure 6 and Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the present grassy surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 141 (left frame) shows the T-7 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-7 was excavated to bedrock through two stratigraphic levels (see Figure 141 and Figure 142). The stratigraphy observed at this location consisted of fill layers (Stratum I and Stratum II) overlying basalt bedrock (Table 18). Stratum II was a fill layer consisting of loamy basalt gravel material mixed with large basalt cobbles and boulders and modern demolition debris including chunks of concrete. Aside from these debris, no cultural materials were observed during the excavation of T-7.

Figure 141. Photo of T-7 prior to excavation (left), and post-excavation (right); view to north

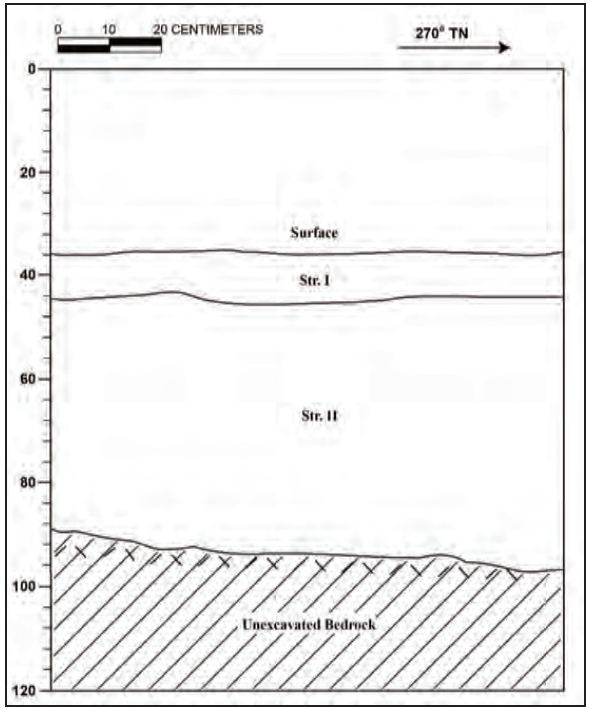


Figure 142. Stratigraphic profile drawing of the south wall of T-7

Table 18. Stratigraphy of T-7

Stratum	Depth (cmbd)	Description
I	38–44	10R 4/4 (weak red); loamy cinder fill; weak, coarse, subangular blocky structure; moist, very friable consistency; weak cementation; non-plastic; terrigenous sediments; abrupt, smooth lower boundary; fine to medium roots common; no cultural materials present; includes 10% topsoil; landscaping fill layer
II	44–97	10 YR 4/4 (dark yellowish brown); loamy basalt gravel fill mixed with hotel demolition debris (i.e., concrete chunks) and large basalt cobbles and boulders; abrupt, wavy lower boundary

5.4.7 Test Trench 8 (T-8)

Test Trench 8 (T-8) was excavated with mechanical assistance in the southeastern portion of the project area, where a seepage pit is proposed (see Figure 37). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 143 (left frame) shows the T-8 unit cut out (using a chop saw) prior to excavation. T-8 was excavated to bedrock through two stratigraphic levels (see Figure 143 and Figure 144). The stratigraphy observed at this location consisted of asphalt (Stratum I) and basalt gravel fill (Stratum II) overlying basalt bedrock (Table 19). No cultural materials were observed during the excavation of T-8.

Figure 143. Photo of T-8 prior to excavation (left), and post-excavation (right); view to east

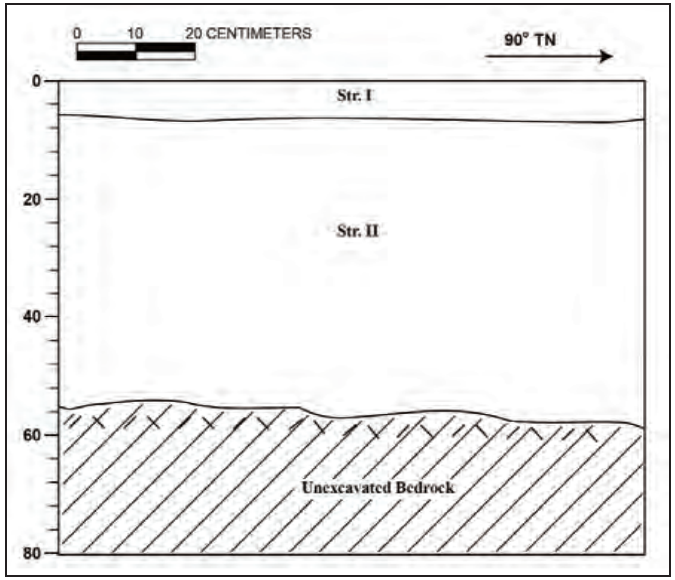


Figure 144. Stratigraphic profile drawing of the north wall of T-8

Table 19. Stratigraphy of T-8

Stratum	Depth (cmbs)	Description
I	0–6	Asphalt parking lot surface
II	6–59	Basalt gravel fill; clear, wavy lower boundary; no cultural materials present

5.4.8 Test Trench 9 (T-9)

Test Trench 9 (T-9) was excavated by hand in the southeastern portion of the project area, where the Hale Ho‘omaha is proposed (see Figure 6 and Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the present grassy surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 145 (left frame) shows the T-9 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-9 was excavated to bedrock through two stratigraphic levels (Figure 145 and Figure 146). The stratigraphy observed at this location consisted of two fill layers (Stratum I and Stratum II) overlying basalt bedrock (Table 20). No cultural materials were observed during the excavation of T-9.

Figure 145. Photo of T-9 prior to excavation (left), and post-excavation (right); view to north

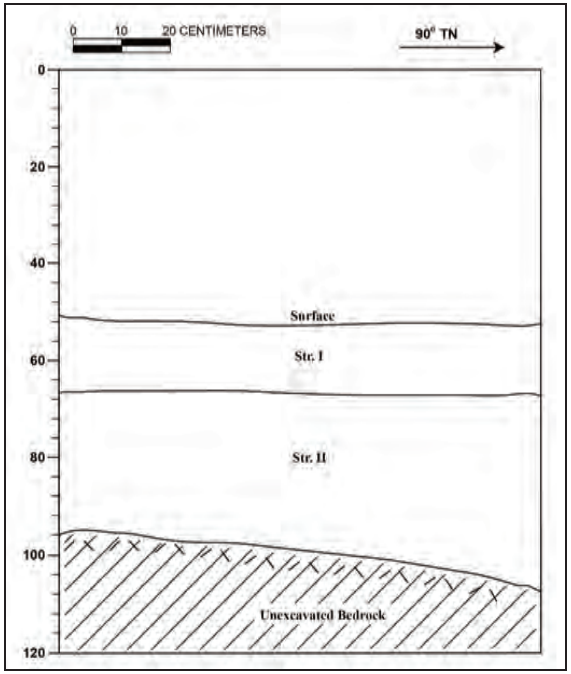


Figure 146. Stratigraphic profile drawing of the north wall of T-9

Table 20. Stratigraphy of T-9

Stratum	Depth (cmbs)	Description
I	52–67	10R 6/4 (pale red); loamy cinder fill; weak, coarse, subangular blocky structure; moist, very friable consistency; weak cementation; non-plastic; terrigenous sediments; abrupt, smooth lower boundary; fine to medium roots common; no cultural materials present; includes 10% topsoil; landscaping fill layer
II	67–102	10 YR 5/2 (grayish brown); loamy basalt gravel fill; clear, smooth lower boundary; no cultural materials present

5.4.9 Test Trench 10 (T-10)

Test Trench 10 (T-10) was excavated by hand in the southern portion of the project area, where a Hale Ho‘omaha structure is proposed (see Figure 6 and Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the present grassy surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 147 (left frame) shows T-10 area marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-10 was excavated to bedrock through two stratigraphic levels (Figure 147 and Figure 148). The stratigraphy observed at this location consisted of two fill layers (Stratum I and Stratum II) overlying basalt bedrock (Table 21). No cultural materials were observed during the excavation of T-10.

Figure 147. Photo of T-10 prior to excavation (left), and post-excavation (right); view to north

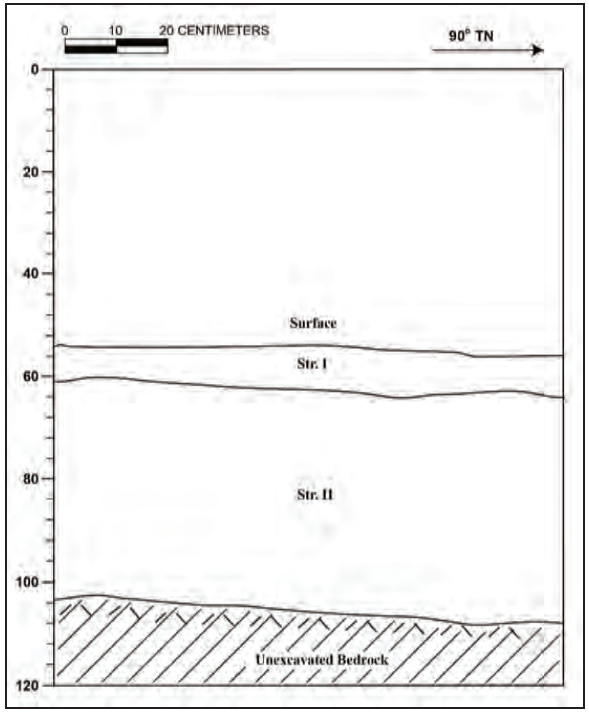


Figure 148. Stratigraphic profile drawing of the north wall of T-10

Table 21. Stratigraphy of T-10

Stratum	Depth (cmbd)	Description
I	52–64	10R 6/4 (pale red); loamy cinder fill; weak, coarse, subangular blocky structure; moist, very friable consistency; weak cementation; non-plastic; terrigenous sediments; abrupt, smooth lower boundary; no roots observed; no cultural materials present; includes 10% topsoil; landscaping fill layer
II	64–108	10 YR 5/2 (grayish brown); loamy basalt gravel fill; clear, smooth lower boundary; no cultural materials present

5.4.10 Test Trench 11 (T-11)

Test Trench 11 (T-11) was excavated with mechanical assistance in the eastern portion of the project area, where an asphalt parking lot is proposed for removal (see Figure 6 and Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 149 (left frame) shows the T-11 unit cut out (using a chop saw) prior to excavation. T-11 was excavated to bedrock through three stratigraphic levels (see Figure 149 and Figure 150). The stratigraphy observed at this location consisted of asphalt (Stratum I) and fill layers (Stratum II and Stratum III) overlying basalt bedrock (Table 22). No cultural materials were observed during the excavation of T-11.

Figure 149. Photo of T-11 prior to excavation (left), and post-excavation (right); view to east

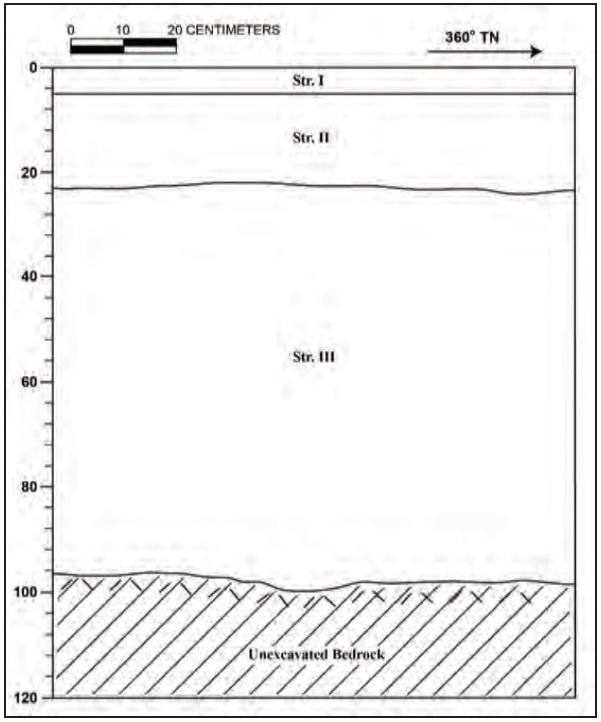


Figure 150. Stratigraphic profile drawing of the west wall of T-11

Table 22. Stratigraphy of T-11

Stratum	Depth (cmbs)	Description
I	0–7	Asphalt parking lot surface
II	7–23	Compacted basalt gravel fill; clear, smooth lower boundary; no cultural material observed
III	23–110	10YR 3/4 (dark yellowish brown); loamy basalt gravel fill mixed with basalt cobbles and boulders and a small amount of coral and small waterworn stones; no cultural materials present

5.4.11 Test Trench 12 (T-12)

Test Trench 12 (T-12) was excavated with mechanical assistance in the eastern portion of the project area, where an asphalt parking lot is proposed for removal (see Figure 6 and Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 151 (left frame) shows the T-12 unit cut out (using a chop saw) prior to excavation. T-12 was excavated to bedrock through three stratigraphic levels (see Figure 151 and Figure 152). The stratigraphy observed at this location consisted of asphalt (Stratum I) and fill layers (Stratum II and Stratum III) overlying basalt bedrock (Table 23). Out-of-context cultural materials were observed to be arbitrarily distributed throughout Stratum II. Despite lacking context within a defined cultural feature, these materials (consisting of marine shell, glass and large mammal bone) were collected and analyzed (see Section 6.1).

Figure 151. Photo of T-12 prior to excavation (left), and post-excavation (right); view to north

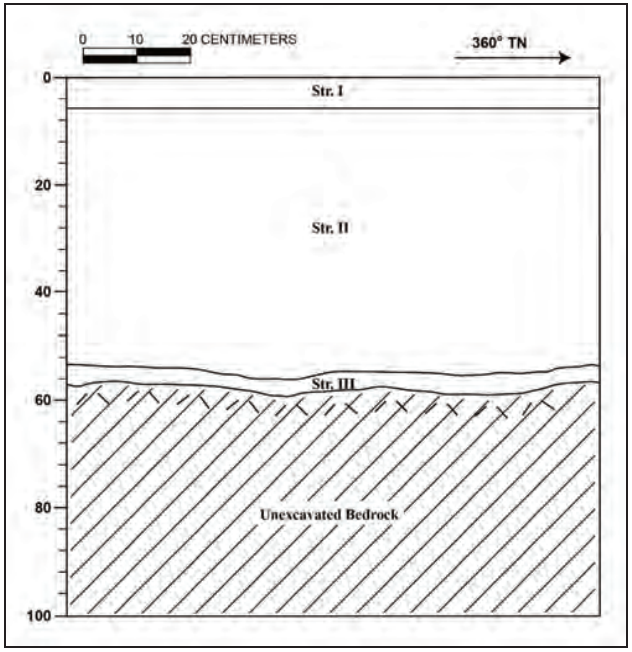


Figure 152. Stratigraphic profile drawing of the north wall of T-12

Table 23. Stratigraphy of T-12

Stratum	Depth (cmbs)	Description
I	0–7	Asphalt parking lot surface
II	7–55	Compacted basalt gravel fill; clear, smooth lower boundary; no cultural material observed
III	55–57	2.5 YR 6/3 (light reddish brown); medium grain sand fill; weak, medium, granular structure; moist, very friable consistency; weak cementation; non-plastic; marine sediments; clear, smooth lower boundary; contains arbitrary distribution of out-of-context cultural materials (i.e., marine shell, glass fragments, and large mammal bone); very thin layer of beach sand fill over bedrock

5.4.12 Test Trench 14 (T-14)

Test Trench 14 (T-14) was excavated with mechanical assistance near the middle of the central tennis court, which is proposed for removal (see Figure 6 and Figure 37). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. LCA 5694 was located in the immediate vicinity, and some believe a post-Contact cemetery was disturbed by developments in this area as well. A GPR survey at this court indicated some potential for subsurface rock features (see Section 5.2.8). Figure 153 (left frame) shows the T-14 unit cut out (using a chop saw) prior to excavation. T-14 was excavated to bedrock through two stratigraphic levels (see Figure 153 and Figure 154). The stratigraphy observed at this location consisted of asphalt (Stratum I) and fill (Stratum II) overlying basalt bedrock (Table 24). No cultural materials were observed during the excavation of T-14.

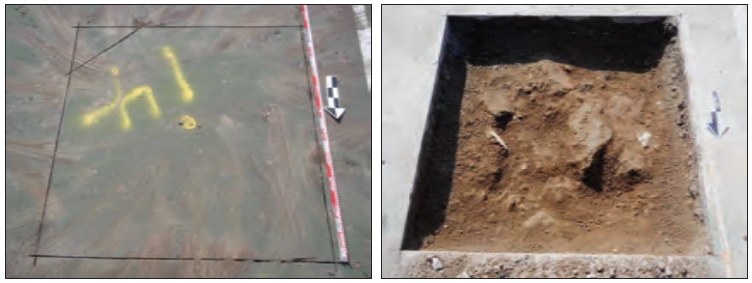


Figure 153. Photo of T-14 prior to excavation (left), and post-excavation (right); view to south

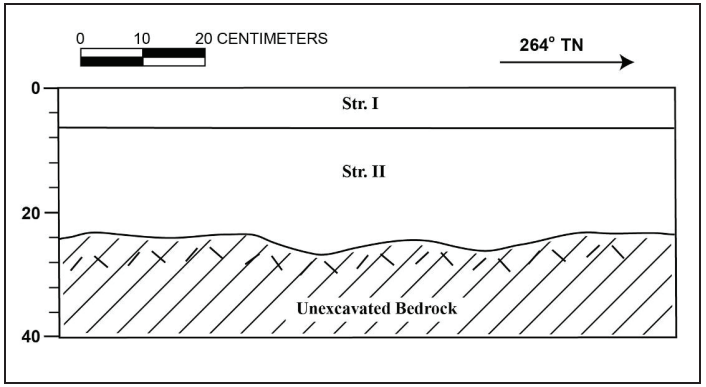


Figure 154. Stratigraphic profile drawing of the west wall of T-14

Table 24. Stratigraphy of T-14

Stratum	Depth (cmbs)	Description
I	0–6	Asphalt tennis court surface
II	6–26	10 YR 3/3 (dark brown); stony silty sand fill; weak, fine to very coarse, granular structure; moist, very friable consistency; weak cementation; non-plastic; mixed sediments; clear, wavy lower boundary; roots common; no cultural materials present; includes 25% basalt gravel and cobbles

5.4.13 Test Trench 15 (T-15)

Test Trench 15 (T-15) was excavated by hand along the eastern edge of the project area to provide general subsurface testing coverage (see Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the grassy surface in this location to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 155 (left frame) shows the T-15 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-15 was excavated to bedrock through one stratigraphic level (see Figure 155 and Figure 156). The stratigraphy observed at this location consisted of fill (Stratum I) overlying basalt bedrock (Table 25). The maintained grassy surface and presence of irrigation pipelines within Stratum I indicate it is a layer of landscaping fill. Out-of-context cultural materials were observed to be arbitrarily distributed throughout Stratum I. Despite lacking context within a defined cultural feature, these materials (consisting of marine shell and cane slag) were collected and analyzed (see Section 6.1).

Figure 155. Photo of T-15 prior to excavation (left), and post-excavation (right); view to north

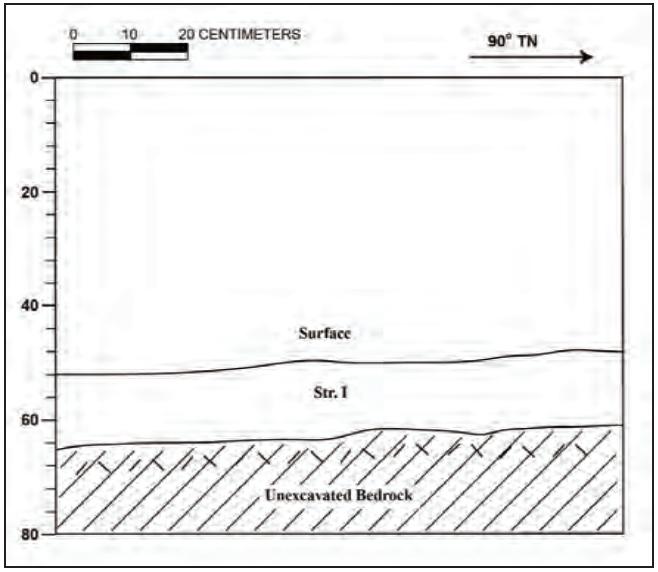


Figure 156. Stratigraphic profile drawing of the north wall of T-15

Table 25. Stratigraphy of T-15

Stratum	Depth (cmbd)	Description
I	47–66	10 YR 3/3 (dark brown); silty loam fill; moderate, medium, crumb structure; moist, friable consistency; weak cementation; non-plastic; mixed sediments; abrupt, smooth lower boundary; roots common; contains arbitrary distribution of out-of-context cultural materials (marine shell, cane slag); silty loam mixed with sand and cinder; landscaping fill layer (irrigation pipelines extend through layer)

5.4.14 Test Trench 16 (T-16)

Test Trench 16 (T-16) was excavated by hand along the eastern edge of the project area near T-15 to provide general subsurface testing coverage (see Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the grassy surface in this location to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 157 (left frame) shows the T-16 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-16 was excavated to bedrock through two stratigraphic levels (see Figure 157 and Figure 158). The stratigraphy observed at this location consisted of landscaping fill layers (Stratum I and Stratum II) overlying basalt bedrock (Table 26). Out-of-context cultural materials were observed to be arbitrarily distributed throughout Stratum I. Despite lacking context within a defined cultural feature, these materials (consisting of marine shell and cane slag) were collected and analyzed (see Section 6.1).

Figure 157. Photo of T-16 prior to excavation (left), and post-excavation (right); view to east

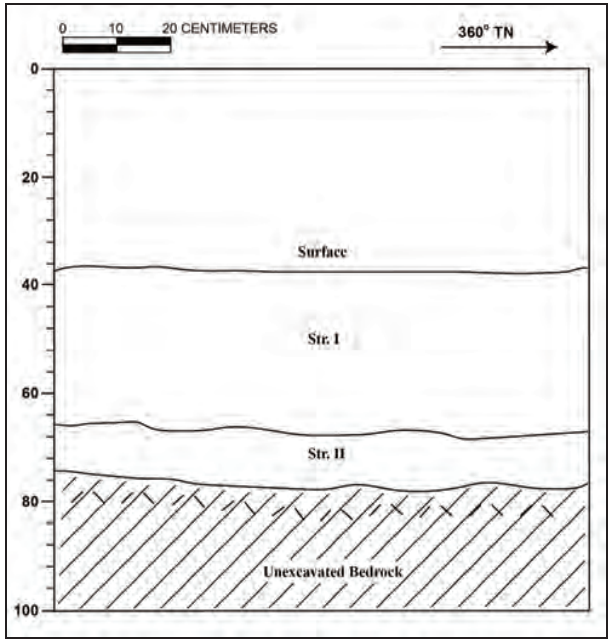


Figure 158. Stratigraphic profile drawing of the west wall of T-16

Table 26. Stratigraphy of T-16

Stratum	Depth (cmbd)	Description
I	37–67	10 YR 2/3 (very dark brown); silty loam fill; moderate, medium, crumb structure; moist, friable consistency; weak cementation; non-plastic; mixed sediments; clear, smooth lower boundary; many fine to very coarse sized roots observed; contains arbitrary distribution of out-of-context cultural materials (marine shell, cane slag); silty loam mixed with sand and cinder; landscaping fill layer
II	67–77	10 YR 2/1 (black); stony beach fill; weak, medium to very coarse, granular structure; moist, very friable consistency; weak cementation; non-plastic; mixed sediments; abrupt, smooth lower boundary; many medium roots observed; no cultural materials present; includes basalt cobbles and small waterworn stones and corals

5.4.15 Test Trench 17 (T-17)

Test Trench 17 (T-17) was excavated with mechanical assistance in an existing parking lot near the proposed Heritage Center, to provide general subsurface testing coverage (see Figure 6 and Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 159 (left frame) shows T-17 area cut out (with a cement chop saw) prior to excavation. T-17 was excavated to bedrock through three stratigraphic levels (see Figure 159 and Figure 160). The stratigraphy observed at this location consisted of asphalt (Stratum I) atop fill and/or disturbed layers (Stratum II Stratum III) overlying basalt bedrock (Table 27). Out-of-context cultural materials were observed to be arbitrarily distributed throughout Stratum III, including cane slag, a rusted iron nail, ceramic and glass fragments, a possible basalt abrader fragment, marine shell, and faunal bone (likely pig). The presence of cane slag mixed in with the other cultural materials at this trench suggests at least some of the sediments were imported. The imported sediments may have been mixed with a disturbed local cultural layer, or been sourced from an outside dump, accounting for the presence of additional cultural materials. Despite lacking context within a defined cultural feature, the cultural materials found at T-17 were collected and analyzed (see Section 6.1).

Figure 159. Photo of T-17 prior to excavation (left), and post-excavation (right); view to north

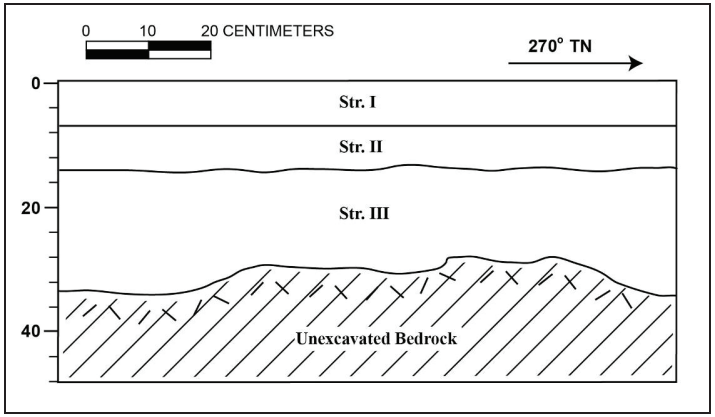


Figure 160. Stratigraphic profile drawing of the south wall of T-17

Table 27. Stratigraphy of T-17

Stratum	Depth (cmbs)	Description
I	0–7	Asphalt parking lot surface
II	7–14	10 YR 3/2 (dark brown); stony silty loam fill; weak, fine, granular structure; moist, friable consistency; weak cementation; non-plastic; terrigenous sediments; diffuse, smooth lower boundary; few coarse roots observed; no cultural materials present; includes 25% basalt cobbles
III	14–36	10YR 2/2 (very dark brown); silty loam; weak, fine, granular structure; moist, very friable consistency; weak cementation; slightly plastic; terrigenous sediments; clear, wavy lower boundary; few roots observed; contains arbitrary distribution of out-of-context cultural materials (i.e., cane slag, a rusted iron nail, ceramic and glass fragments, a possible basalt abrader fragment, marine shell, and faunal bone); fill layer possibly mixed with a disturbed cultural layer

5.4.16 Test Trench 18 (T-18)

Test Trench 18 (T-18) was excavated with mechanical assistance near the middle of the *makai* tennis court, which is proposed for removal (see Figure 6 and Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. A GPR survey at this court indicated a potential for subsurface *pāhoehoe* lava flows with pockets of sediment accumulation that could contain cultural deposits. Figure 161 (left frame) shows the T-18 unit cut out (using a chop saw) prior to excavation. T-18 was excavated to bedrock through two stratigraphic levels (see Figure 161 and Figure 162). The stratigraphy observed at this location consisted of asphalt (Stratum I) and fill (Stratum II) overlying basalt bedrock (Table 28). No cultural materials were observed during the excavation of T-18.

Figure 161. Photo of T-18 prior to excavation (left), and post-excavation (right); view to south (left) and west (right)

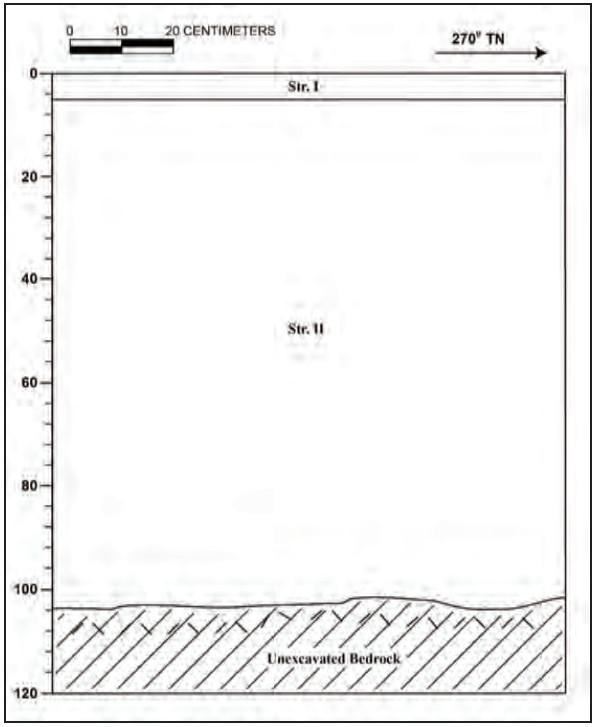


Figure 162. Stratigraphic profile drawing of the west wall of T-18

Table 28. Stratigraphy of T-18

Stratum	Depth (cmbs)	Description
I	0–6	Asphalt tennis court surface
II	6–104	5 YR 5/3 (reddish brown); silty cinder and basalt cobble fill; weak, coarse, subangular blocky structure; dry, loose consistency; weak cementation; non-plastic; terrigenous sediments; clear, smooth lower boundary; few medium to coarse sized roots observed; no cultural materials present

5.4.17 Test Trench 19 (T-19)

Test Trench 19 (T-19) was excavated with mechanical assistance along the KBR driveway turnaround, which is proposed for removal (see Figure 6 and Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 163 (left frame) shows the T-19 unit cut out (using a chop saw) prior to excavation. T-19 was excavated through six stratigraphic levels (see Figure 163 and Figure 164). The stratigraphy observed at this location consisted of asphalt (Stratum I) atop several layers of fill (Stratum II through Stratum VI) (Table 29). Excavation at T-19 was terminated due to physical limitations prior to reaching bedrock. No cultural materials were observed during the excavation of T-19.

Figure 163. Photo of T-19 prior to excavation (left), and post-excavation (right); view to west

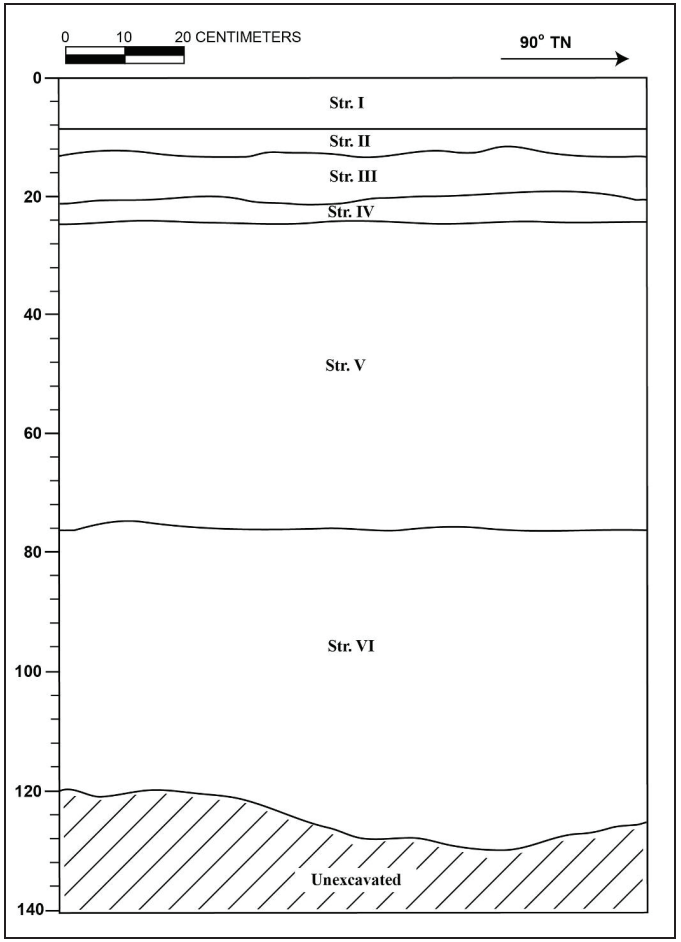


Figure 164. Stratigraphic profile drawing of the north wall of T-19

Table 29. Stratigraphy of T-19

Stratum	Depth (cmbs)	Description
I	0–9	Asphalt driveway surface
II	9–13	10 YR 3/3 (dark brown); gravelly loam fill; weak, fine, crumb structure; dry, loose consistency; weak cementation; non-plastic; terrigenous sediments; clear, smooth lower boundary; few roots observed; no cultural materials present
III	13–21	10YR 5/2 (grayish brown); basalt gravel fill; clear, smooth lower boundary; no cultural materials present
IV	21–23	10YR 4/3 (brown); sandy basalt gravel fill; clear, smooth lower boundary; no cultural materials present
V	23–77	10 YR 5/2 (grayish brown); extremely stony basalt gravel fill; clear, smooth lower boundary; includes 80% basalt cobbles; no cultural materials present
VI	77–127	10YR 4/3 (brown); stony basalt gravel fill; abrupt, wavy lower boundary; no cultural materials observed

5.4.18 Test Trench 20 (T-20)

Test Trench 20 (T-20) was excavated with mechanical assistance in the northern portion of the project area to provide general subsurface testing coverage (see Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed in the existing asphalt surface to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 165 (left frame) shows the T-20 unit cut out (using a chop saw) prior to excavation. T-20 was excavated to bedrock through two stratigraphic levels (see Figure 165 and Figure 166). The stratigraphy observed at this location consisted of asphalt (Stratum I) and gravel fill (Stratum II) overlying basalt bedrock (Table 30). No cultural materials were observed during the excavation of T-20.

Figure 165. Photo of T-20 prior to excavation (left), and post-excavation (right); view to east

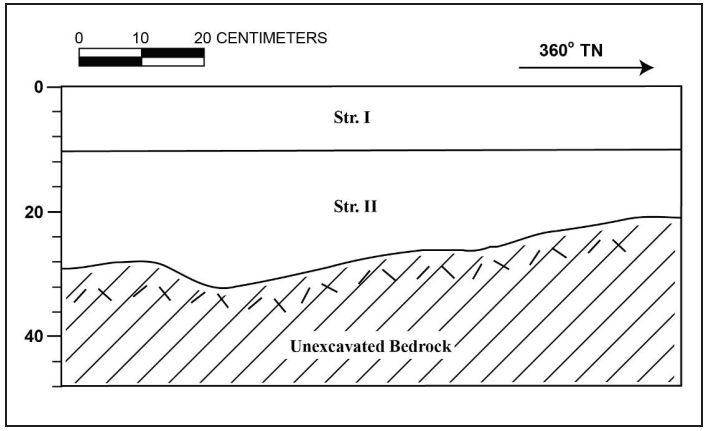


Figure 166. Stratigraphic profile drawing of the west wall of T-20

Table 30. Stratigraphy of T-20

Stratum	Depth (cmbs)	Description
I	0–10	Asphalt parking lot surface
II	10–34	10 YR 4/3 (brown); loamy basalt gravel fill; clear, wavy lower boundary; few roots observed; no cultural materials present; very compacted fill material

5.4.19 Test Trench 21 (T-21)

Test Trench 21 (T-21) was excavated with mechanical assistance in the northern portion of the project area to provide general subsurface testing coverage (see Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed in the existing asphalt surface to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 167 (left frame) shows the T-21 area cut out (with a cement chop saw) prior to excavation. T-21 was excavated to bedrock through three stratigraphic levels (see Figure 167 and Figure 168). The stratigraphy observed at this location consisted of asphalt (Stratum I) atop gravel fill (Stratum II) overlying natural black sand (Stratum III) and basalt bedrock (Table 31). Out-of-context cultural materials were observed to be arbitrarily distributed throughout Stratum II. Despite lacking context within a defined cultural feature, these materials (consisting of cane slag) were collected and analyzed (see Section 6.1).

Figure 167. Photo of T-21 prior to excavation (left), and post-excavation (right); view to south

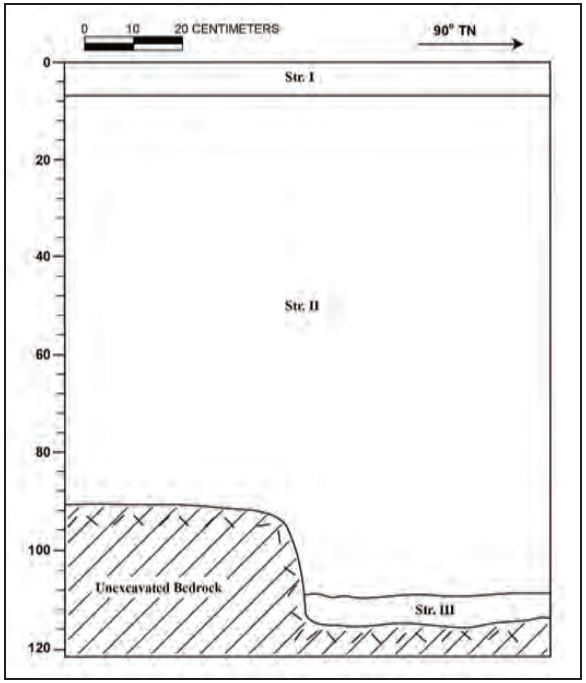


Figure 168. Stratigraphic profile drawing of the west wall of T-21

Table 31. Stratigraphy of T-21

Stratum	Depth (cmbs)	Description
I	0–8	Asphalt parking lot surface
II	8–112	10 YR 5/3 (brown); loamy basalt gravel fill; clear, wavy lower boundary; contains arbitrary distribution of out-of-context cultural materials (cane slag); very compacted fill layer
III	112–117	10YR 2/1 (black); black sand; structureless (single-grain); dry, loose consistency; no cementation; non-plastic; marine sediments; no roots observed; no cultural materials present; natural layer containing white sand mottles

5.4.20 Test Trench 23 (T-23)

Test Trench 23 (T-23) was excavated by hand in a grassy area east of SIHP # -10997 (Kapuanoni Heiau) (see Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed in this location to determine the potential for any buried remnants or cultural deposits related to Kapuanoni Heiau or the former Ali‘i Residence at SIHP # -12953. Figure 169 (left frame) shows the T-23 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-23 was excavated to bedrock through five stratigraphic levels (see Figure 169 and Figure 170). The stratigraphy observed at this location consisted of topsoil (Stratum I) and several fill layers (Stratum II through Stratum IV) atop natural beach sand (Stratum V) and basalt bedrock (Table 32). Out-of-context cultural materials were observed to be arbitrarily distributed throughout Stratum II, including cane slag and marine shell midden. Minimal amounts of faunal bone from a small mammal (possibly a dog or a cat), urchin, and four types of marine shell were observed within Stratum V. No evidence of a trash pit was observed, and the distribution of the materials throughout this layer (up to 30 cm thick) did not clearly indicate a cultural layer. These materials may have been naturally deposited prior to KBR development in the 1960s, as T-23 is located not far from the shoreline. Despite lacking context within a defined cultural feature, the cultural matrerials collected from T-23 were collected and analyzed (see Section 6.1).

Figure 169. Photo of T-23 prior to excavation (left), and post-excavation (right); view to north (left) and west (right)

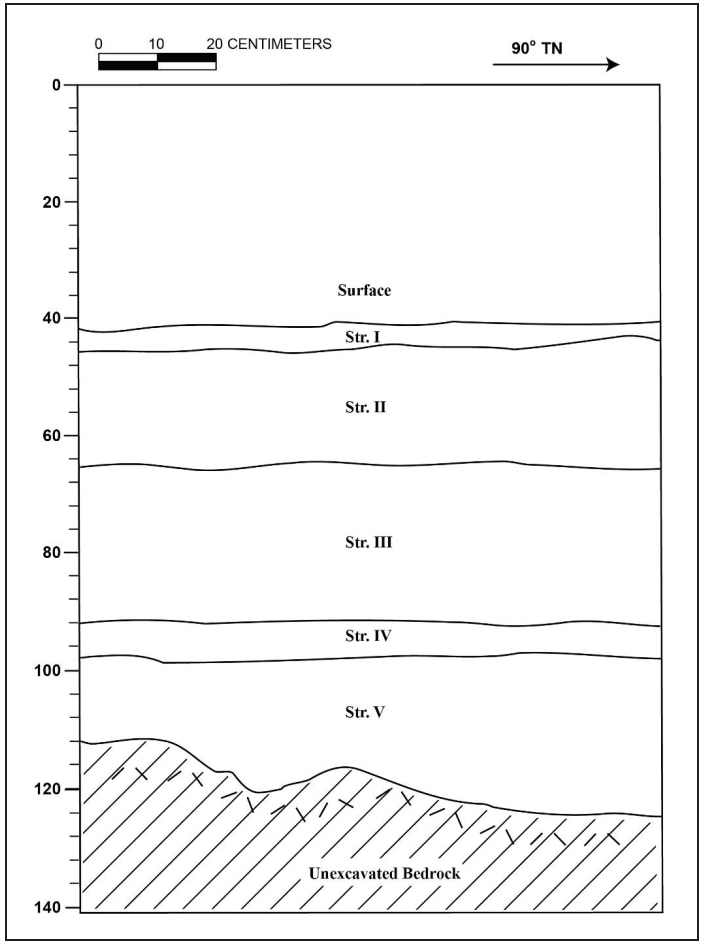


Figure 170. Stratigraphic profile drawing of the north wall of T-23

Table 32. Stratigraphy of T-23

Stratum	Depth (cmbd)	Description
I	41–45	10YR 2/2 (dark brown); loam topsoil; weak, fine, crumb structure; moist, friable consistency; weak cementation; non-plastic; terrigenous sediments; clear, smooth lower boundary; many roots observed; no cultural materials present; organic layer of grass and roots
II	45–65	7.5 YR 3/4 (dark brown); loamy cinder fill; weak, medium to very coarse, subangular blocky structure; dry, loose consistency; weak cementation; non-plastic; terrigenous sediments; abrupt, smooth lower boundary; many roots observed; contains arbitrary distribution of out-of-context cultural materials (i.e., marine shell, cane slag)
III	65–92	10YR 3/2 (very dark grayish brown); very stony loam fill; weak, fine, granular structure; dry, weakly coherent consistency; weak cementation; non-plastic; terrigenous sediments; clear, smooth lower boundary; roots common; includes 60% basalt pebbles and small cobbles; no cultural materials present
IV	92–98	10YR 6/2 (light brown gray); sand fill; structureless (single-grain); moist, loose consistency; no cementation; non-plastic; marine sediments; clear, smooth lower boundary; few roots observed; no cultural materials present
V	98–125	10YR 4/1 (dark gray); gravelly beach sand; structureless (single-grain); moist, loose consistency; no cementation; non-plastic; marine sediments; clear, wavy lower boundary; no roots observed; contains arbitrary distribution of cultural mateirals (i.e., marine shell, urchin, and faunal bone); likely natural beach layer with small waterworn pebble inclusions increasing with depth; does not clearly indicate a cultural layer

5.4.21 Test Trench 24 (T-24)

Test Trench 24 (T-24) was excavated by hand in a grassy area east of SIHP # -10997 (Kapuanoni Heiau) and T-23 (see Figure 37). A 1.0 m by 1.0 m (1.0 sq m) test unit was placed in this location to determine the potential for any buried remnants or cultural deposits related to Kapuanoni Heiau or the former Ali‘i Residence at SIHP # -12953. Figure 171 (left frame) shows the T-24 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-24 was excavated through five stratigraphic levels (see Figure 171 and Figure 172). The stratigraphy observed at this location consisted of topsoil (Stratum I) atop several fill layers (Stratum II through to Stratum V) (Table 33). Out-of-context cultural materials were observed to be arbitrarily distributed throughout Stratum II. Despite lacking context within a defined cultural feature, these materials (consisting of marine shell, a U.S. dime, and cane slag) were collected and analyzed (see Section 6.1). Excavation at T-24 was terminated prior to reaching bedrock due to physical constraints including overall depth and the presence of gas and electrical pipes.

Figure 171. Photo of T-24 prior to excavation (left), and post-excavation (right); view to east

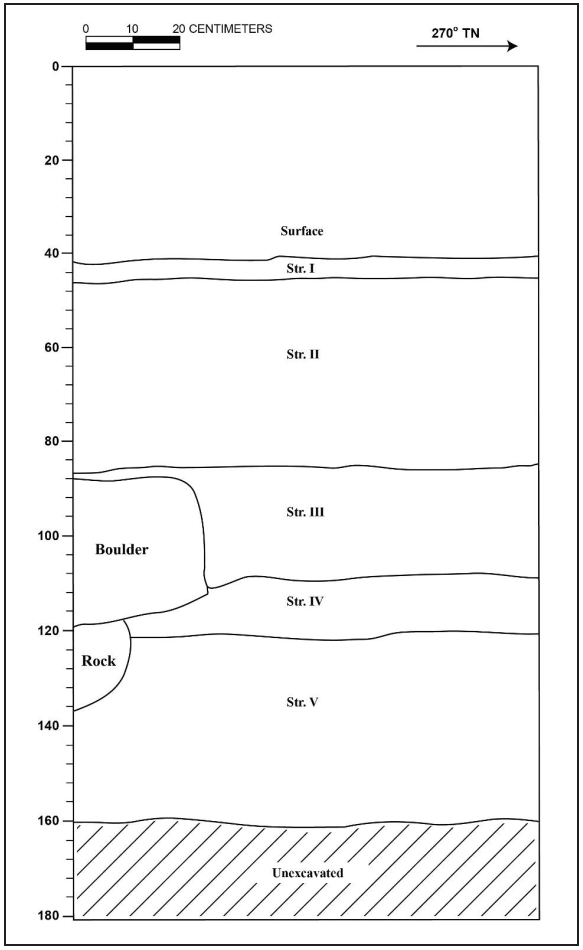


Figure 172. Stratigraphic profile drawing of the south wall of T-24

Table 33. Stratigraphy of T-24

Stratum	Depth (cmbd)	Description
I	41–46	10YR 2/2 (dark brown); topsoil; weak, fine to coarse, crumb structure; moist, friable consistency; weak cementation; non-plastic; terrigenous sediments; clear, smooth lower boundary; many very fine sized roots observed; no cultural materials present; organic layer of grass and roots
II	46–88	7.5 YR 3/4 (dark brown); loam fill; weak, fine, granular structure; dry, weakly coherent consistency; weak cementation; non-plastic; terrigenous sediments; clear, smooth lower boundary; roots common; contains arbitrary distribution of out-of-context cultural materials (i.e., marine shell, cane slag, U.S. dime), as well as both functional and rusting gas and electrical pipes; contains cinder inclusions
III	88–111	10YR 5/2 (grayish brown); sand fill; structureless (single-grain); weak, medium, granular structure; dry, loose consistency; weak cementation; non-plastic; marine sediments; clear, smooth lower boundary; few roots observed; no cultural materials present
IV	111–122	10YR 2/1 (black); sand fill; structureless (single-grain); dry, loose consistency; weak cementation; non-plastic; marine sediments; clear, smooth lower boundary; few roots observed; no cultural materials present
V	122–162	10YR 6/4 (light yellowish brown); sand fill; structureless (single-grain); dry, loose consistency; weak cementation; non-plastic; marine sediments; clear, smooth lower boundary; few roots observed; no cultural materials present

5.4.22 Test Trench 25 (T-25)

Test Trench 25 (T-25) was excavated by hand in the northern portion of the project area, where a seepage pit is proposed (see Figure 37). This location is also in the vicinity of SIHP # 10997 (Kapuanoni Heiau) and SIHP # -12953 (Ali‘i Residence). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the present grassy surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 173 (left frame) shows the T-25 unit marked out (with pink string and pink flagging tape at each corner) prior to excavation. T-25 was excavated to bedrock through three stratigraphic levels (see Figure 173 and Figure 174). The stratigraphy observed at this location consisted of topsoil (Stratum I) atop two fill layers (Stratum II and Stratum III) overlying basalt bedrock (Table 34). No cultural materials were observed during the excavation of T-25.

Figure 173. Photo of T-25 prior to excavation (left), and post-excavation (right); view to north (left) and south (right)

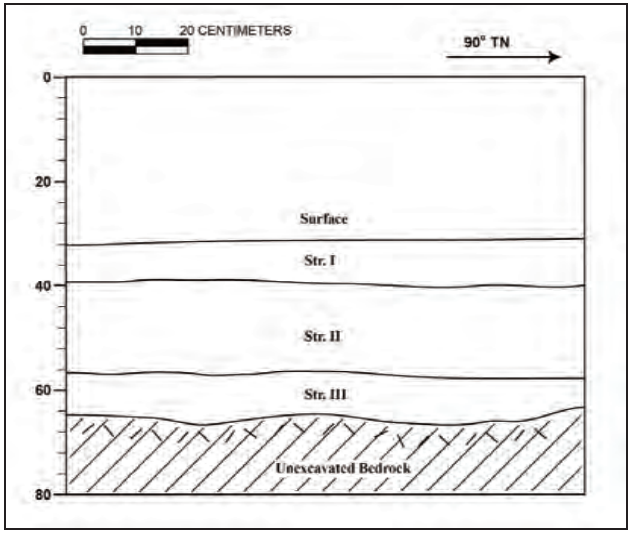


Figure 174. Stratigraphic profile drawing of the north wall of T-25

Table 34. Stratigraphy of T-25

Stratum	Depth (cmbd)	Description
I	33–40	10YR 2/2 (very dark brown); topsoil; weak, fine to coarse, crumb structure; moist, friable consistency; weak cementation; non-plastic; terrigenous sediments; clear, smooth lower boundary; many very fine sized roots observed; no cultural materials present; organic layer of grass and roots
II	40–57	7.5 YR 3/4 (dark brown); loam fill; moderate, fine, granular structure; dry, loose consistency; non-plastic; terrigenous sediments; clear, smooth lower boundary; many coarse to very coarse roots observed; no cultural materials present
III	57–65	10YR 4/2 (dark grayish brown); sand fill; structureless (single-grain); dry, loose consistency; weak cementation; non-plastic; marine sediments; abrupt, wavy lower boundary; few medium roots observed; no cultural materials present

5.4.23 Test Trench 26 (T-26)

Test Trench 26 (T-26) was excavated with mechanical assistance in the northeastern portion of the project area, where a seepage pit is proposed (see Figure 37). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 175 (left frame) shows the T-26 unit cut out (using a chop saw) prior to excavation. T-26 was excavated to bedrock through six stratigraphic levels (see Figure 175 and Figure 176). The stratigraphy observed at this location consisted of asphalt (Stratum I) atop several fill layers (Stratum II through Stratum V) and a possible natural or disturbed cultural layer (Stratum VI) overlying basalt bedrock (Table 35). Two artifacts were observed within Stratum VI, a clear glass fragment and iron cart wheel. These items were collected and analyzed (see Section 6.1.1). The presence of these two items alone does not indicate a trash pit or cultural layer, though it may indicate a disturbed cultural layer at this or a nearby location.

Figure 175. Photo of T-26 prior to excavation (left), and post-excavation (right); view to north (left) and south (right)

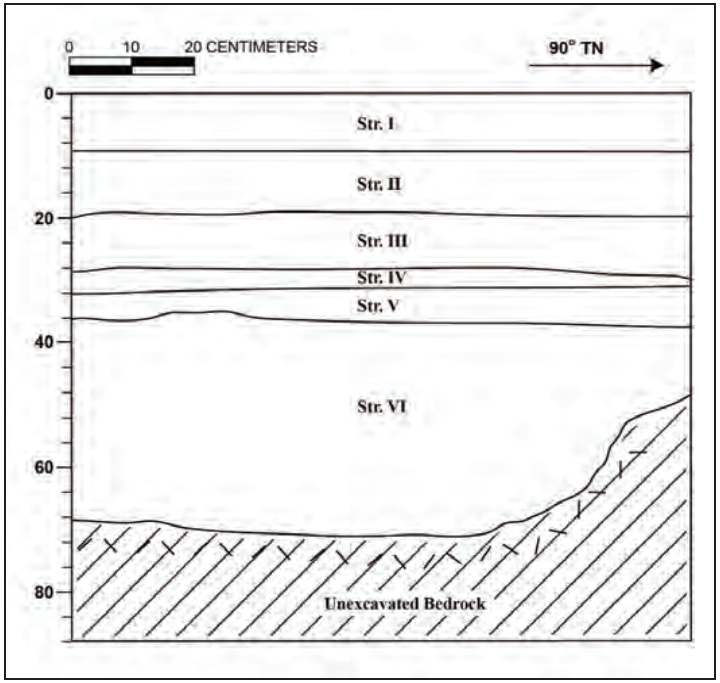


Figure 176. Stratigraphic profile drawing of the north wall of T-26

Table 35. Stratigraphy of T-26

Stratum	Depth (cmbs)	Description
I	0–10	Asphalt parking lot surface
II	10 –20	10 YR 5/3 (brown); loamy basalt gravel fill; clear, smooth lower boundary; no cultural materials present
III	20–30	10 YR 4/3 (brown); loamy basalt gravel fill; clear, smooth lower boundary; few roots observed; no cultural materials present
IV	30–32	10YR 2/1 (black); silty sand fill; weak, fine, granular structure; dry, loose consistency; weak cementation; non-plastic; mixed sediments; clear, smooth lower boundary; roots common; no cultural materials present
V	32–48	10 YR 4/3 (brown); loamy basalt gravel fill; clear, smooth lower boundary; few roots observed; no cultural materials present
VI	48–70	10YR 2/1 (black); very stony silty sand; weak, fine to coarse, granular structure; dry, loose consistency; weak cementation; non-plastic; mixed sediments; clear, wavy lower boundary; few roots observed; iron cart wheel and single clear glass fragment observed; includes 70% basalt cobbles; may represent a disturbed natural or cultural layer

5.4.24 Test Trench 27 (T-27)

Test Trench 27 (T-27) was excavated with mechanical assistance in the central portion of the project area, where a seepage pit is proposed (see Figure 37). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 177 (left frame) shows the T-27 unit cut out (using a chop saw) prior to excavation. T-27 was excavated to bedrock through two stratigraphic levels (see Figure 177 and Figure 178). The stratigraphy observed at this location consisted of asphalt (Stratum I) and gravel fill (Stratum II) overlying basalt bedrock (Table 36). No cultural materials were observed during the excavation of T-27.

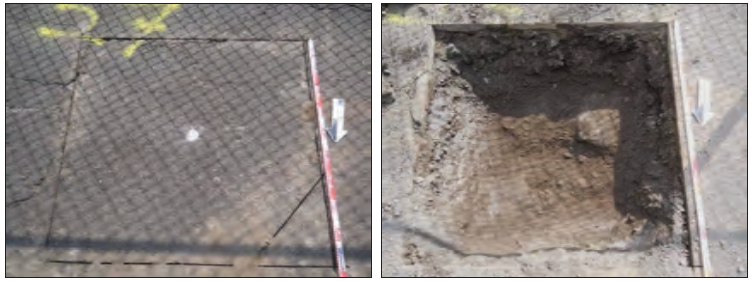


Figure 177. Photo of T-27 prior to excavation (left), and post-excavation (right); view to south

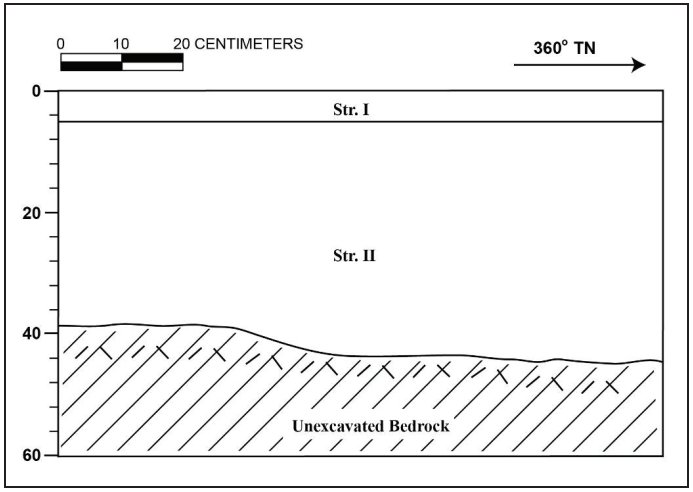


Figure 178. Stratigraphic profile drawing of the west wall of T-27

Table 36. Stratigraphy of T-27

Stratum	Depth (cmbs)	Description
I	0–5	Asphalt parking lot surface
II	5–44	Basalt base coarse fill; abrupt, smooth lower boundary; no cultural materials present

5.4.25 Test Trench 28 (T-28)

Test Trench 28 (T-28) was excavated with mechanical assistance in the southern portion of the project area, where a seepage pit is proposed (see Figure 37). A 1.0 by 1.0 m (1.0 sq m) test unit was placed within the present asphalt surface in an attempt to determine the potential for any buried remnants or cultural deposits related to past land uses in this area. Figure 179 (left frame) shows the T-28 unit cut out (using a chop saw) prior to excavation. T-28 was excavated to bedrock through two stratigraphic levels (see Figure 179 and Figure 180). The stratigraphy observed at this location consisted of asphalt (Stratum I) and gravel fill (Stratum II) overlying basalt bedrock (Table 37). No cultural materials were observed during the excavation of T-28.

Figure 179. Photo of T-28 prior to excavation (left), and post-excavation (right); view to east

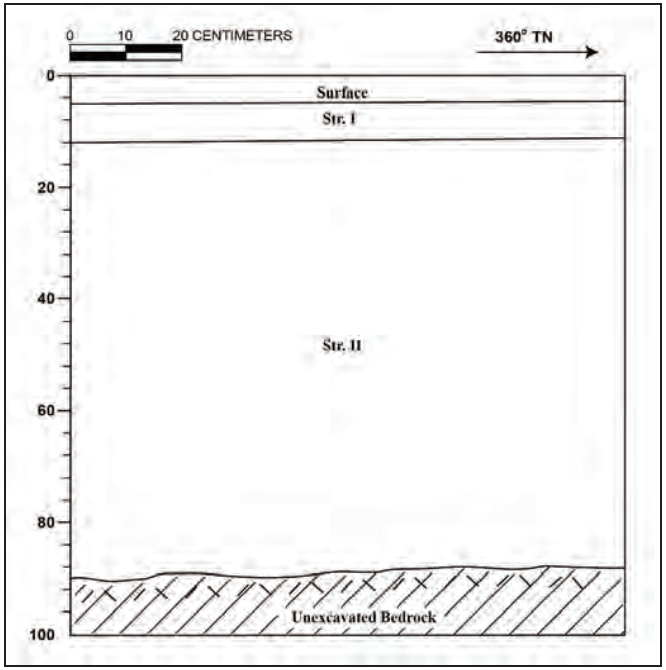


Figure 180. Stratigraphic profile drawing of the west wall of T-28

Table 37. Stratigraphy of T-28

Stratum	Depth (cmbs)	Description
I	0–12	Asphalt parking lot surface
II	12–90	Basalt base course fill; abrupt, smooth lower boundary; no cultural materials present

5.5 Results of Sediment Coring

The manual extraction of four sediment cores (C-1A, C-2A, C-2B, and C-2C) from two locations within the project area (C-1 and C-2) was successfully completed on 31 January 2014 by CSH archaeologist Oli Bautista, B.A. under the direct supervision of Hallet H. Hammatt, Ph.D. (see Figure 37). Once successfully extracted, the four sediment cores were returned to the CSH Waimānalo laboratory to be opened, documented, and sampled.

Once opened, each core sample was measured and the lengths of the sediment cores were compared to the actual core depths (termed depth of penetration) in order to calculate the percentage of core compaction. The actual core depth at C-1A was measured at 35 cm below surface, while the corresponding length of C-1A was 19 cm. The percent of core compaction was then calculated at 45%. The depth of penetration, core length, and percent of compaction for each of the four core samples is presented in Table 38. While the percent of compaction of each core sample was high compared to alternative coring methodologies, the relationship and superposition of strata remained constant.

Documentation of each core sample included the production of a scaled stratigraphic profile map, photographs, and a detailed description of each stratum using standard USDA soil description terminology. Following laboratory documentation, subsamples were collected from approximately 5 cm thick sections of selected strata within C-1A and C-2C. These subsamples were then submitted to PaleoResearch Institute of Golden, Colorado for pollen analysis (see Appendix E) and Beta Analytic Inc. of Miami, Florida for radiocarbon analysis.

Table 38. Sediment Core Sample Information

Core	Depth of Penetration (cm)	Core Length (cm)	Percent of Compaction
C-1A	35	19	45%
C-2A	100	36	64%
C-2B	84	34	59%
C-2C	66	39	40%

5.5.1 Core C-1A

Core C-1A was extracted from the open air well of SIHP # -12951A. Sediment within C-1A consisted of highly organic silty clay (Stratum I) grading into organic silty clay (Stratum II) (Figure 181, Figure 182, and Table 39). The stratigraphy of C-1A respresented the gradual breakdown of organic debris over time within the open air well (SIHP # -12951A). A single subsample (Sample 1A1) was collected from the upper boundary of Stratum II within Core C-1A, halved, and submitted for pollen/starch grain analysis and radiocarbon analysis. Pollen/starch grain analysis showed that the sample was domintated by fern spores and foraminifera, indicative of a wet, possibly brackish water environment (Cummings 2014:2). Coconut and *loulu* palm pollen, cheno-am pollen, and *ilex* pollen were also identified in the subsample. The *ilex* pollen documents the presence and growth of introduced holly or yerba mate. No starch grains were observed. A 2-sigma calibration of the radiocarbon analysis

suggested two possible date ranges, 1680 AD to 1770 AD (29.8%) and 1800 AD to 1940 AD (65.6%), with the post-Contact date range (1800-1940) being the most probable.

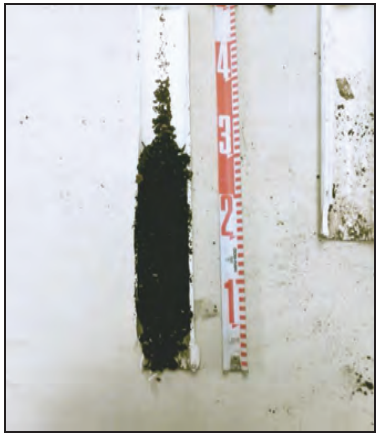


Figure 181. Core C-1A, view from top to base

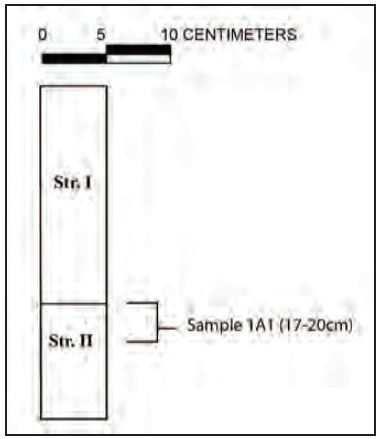


Figure 182. Core C-1A stratigraphic profile showing Sample 1A1

Table 39. Core C-1A Stratigraphy

Stratum	Depth (cm)	Description
I	0–17	10YR 3/3, very dark brown; silty clay; weak, fine, crumb structure; moist, friable consistency; slightly plastic; terrigenous sediments; abrupt, smooth lower boundary; many very fine to fine roots observed; contains high percentage organic material
II	17–26	10YR 2/2, very dark brown; silty clay; weak, fine, blocky structure; moist, friable consistency; slightly plastic; terrigenous sediments; lower boundary not visible; few very fine to fine roots observed; contains high percentage organic material

5.5.2 Core C-2A

Core C-2A was extracted from the open air well of SIHP # -12951B. Sediment within C-2A consisted of highly organic silty clay (Stratum I) grading into organic silty clay (Stratum II) (Figure 183, Figure 184, and Table 40). The stratigraphy of C-2A respresented the gradual breakdown of organic debris over time within the open air well (SIHP # -12951B). No additional analysis was performed on the Core C-2A sediment.

5.5.3 Core C-2B

Core C-2B was extracted from the open air well of SIHP # -12951B. Sediment within C-2B consisted of highly organic silty clay (Stratum I) grading into organic silty clay (Stratum II) (Figure 185, Figure 186, and Table 41). The stratigraphy of C-2B respresented the gradual breakdown of organic debris over time within the open air well (SIHP # -12951B). No additional analysis was performed on the Core C-2B sediment.

5.5.4 Core C-2C

Core C-2C was extracted from the open air well of SIHP # -12951B. Sediment within C-2C consisted of highly organic silty clay (Stratum I) grading into organic silty clay (Stratum II) (Figure 187, Figure 188, and Table 42). The stratigraphy of C-2C respresented the gradual breakdown of organic debris over time within the open air well (SIHP # -12951B). Two subsamples were collected form Core C-2C, one at the upper boundary of Stratum II (Sample 2C1) and one from the middle of Stratum II (Sample 2C2). The subsamples were halved and each submitted for pollen/starch grain analysis and radiocarbon analysis. Pollen/starch grain analysis showed that the samples were domintated by fern spores and foraminifera, indicative of a wet, possibly brackish water environment (Cummings 2014:2). Coconut and *loulu* palm pollen, Rhamnaceae and *Straussia*-type pollen, and *Dodonses* were also identified within the Core C-2C subsamples. No starch grains were observed. A 2-sigma calibration of the radiocarbon analysis suggested the subsample from the upper boundary of Stratum II (Sample 2C1) was modern. The analysis of the sample from the middle of Stratum II (Sample 2C2) suggested two possible date ranges, AD 1680 to 1730 (25.2%) and AD 1800 to 1930 (70.2%), with the post-Contact date range (1800-1930) being the most probable.

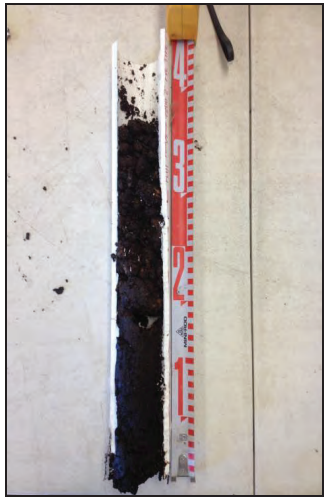


Figure 183. Core C-2A, view from top to base

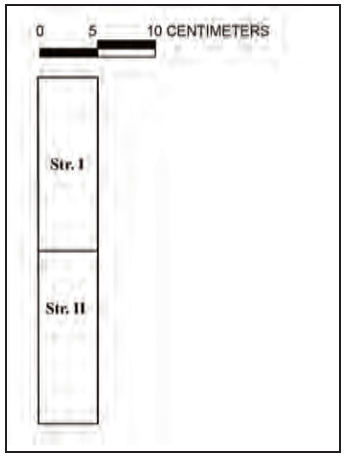


Figure 184. Core C-2A stratigraphic profile

Table 40. Core C-2A Stratigraphy

Stratum	Depth (cm)	Description
I	0–15	10YR 3/3, very dark brown; silty clay; weak, fine, crumb structure; moist, friable consistency; slightly plastic; terrigenous sediments; abrupt, smooth lower boundary; many very fine to fine roots observed; contains high percentage organic material
II	15–30	10YR 2/2, very dark brown; silty clay; weak, fine, blocky structure; moist, friable consistency; slightly plastic; terrigenous sediments; lower boundary not visible; few very fine to fine roots observed; contains high percentage organic material

Figure 185. Core C-2B, view from top to base

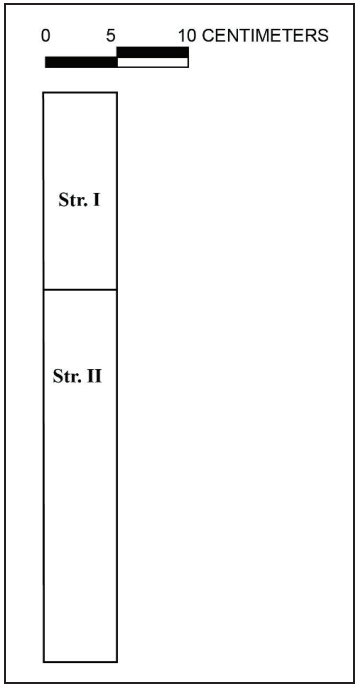


Figure 186. Core C-2B stratigraphic profile

Table 41. Core C-2B Stratigraphy

Stratum	Depth (cm)	Description
I	0–14	10YR 3/3, very dark brown; silty clay; weak, fine, crumb structure; moist, friable consistency; slightly plastic; terrigenous sediments; abrupt, smooth lower boundary; man very fine to fine roots observed; contains high percentage organic material
II	14–40	10YR 2/2, very dark brown; silty clay; weak, fine, blocky structure; moist, friable consistency; slightly plastic; terrigenous sediments; lower boundary not visible; few very fine to fine roots observed; contains high percentage organic material

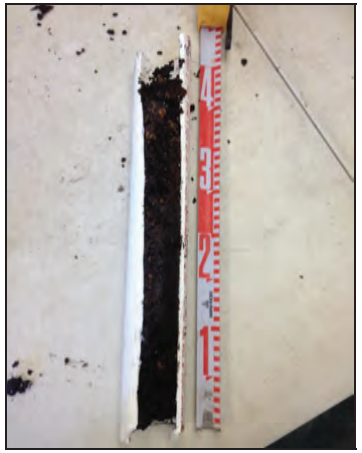


Figure 187. Core C-2C, view from top to base

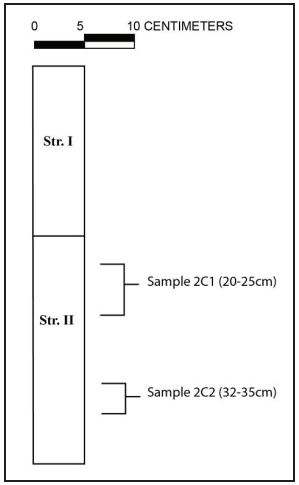


Figure 188. Core C-2C stratigraphic profile showing Sample 2C1 and 2C2

Table 42. Core C-2C Stratigraphy

Stratum	Depth (cm)	Description
I	0–20	10YR 3/3, very dark brown; silty clay; weak, fine, crumb structure; moist, friable consistency; slightly plastic; terrigenous sediments; abrupt, smooth lower boundary; many very fine to fine roots observed; contains high percentage organic material
II	20–40	10YR 2/2, very dark brown; silty clay; weak, fine, blocky structure; moist, friable consistency; slightly plastic; terrigenous sediments; lower boundary not visible; few very fine to fine roots observed; contains high percentage organic material

Section 6 Results of Laboratory Analysis

Collection of artifacts and cultural materials for laboratory analysis was undertaken as part of the archaeological inventory survey investigation. The laboratory analyses of the material collected during this investigation are organized under two main subsections: Section 6.1 presents the analyses of artifacts and other materials collected during the program of subsurface testing; and Section 6.2 presents the analyses of materials collected during the sediment core sampling. No artifacts or other materials were collected from the ground surface either within or outside of the context of a historic property.

6.1 Materials Collected During Subsurface Testing

All collected materials were screened through 1/8-inch mesh and then later washed and sorted in the laboratory as applicable. The artifacts collected during the project are documented in Section 6.1.1. Marine shell midden was sorted down to the species level (Section 6.1.2). Charcoal was collected from one test unit and was separated, weighed, and catalogued; a discussion of the collected charcoal sample is given in Section 6.1.3.

6.1.1 Artifact Analysis

Thirty-five artifacts were collected from the context of a test trench within the project area. These artifacts are presented in Table 43. In several cases, numerous fragments of similar materials have been collectively cataloged as a single artifact. Fragmental items were weighed but not measured. Additionally, relatively large amounts of cane slag (calcium silicate) were observed and collected (Figure 189). The individual pieces of this material were also weighed but not measured. Most of the fragmented materials included glass of various colors and ceramics, though a single piece of a possible basalt abrader (Catalog # 84) was also recovered from T-17. This artifact is a small chunk of medium-grained basalt exhibiting a single worked side that is so flat it almost appears saw cut. Alternatively, this artifact may be a piece of demolition or construction-related debris. The only items encountered during the testing program that were not fragmental were a medicine bottle (from T-4; Figure 190), two small buttons (one white plastic and one wooden, both from T-4; Figure 191), a U.S. dime (from T-24), and several metal items including an aluminum skewer (from T-4), iron nail (from T-17), iron spike (from STP-1; Figure 192), and iron cart wheel (from a possible disturbed cultural layer at T-26; see Figure 192). While the dime in T-24 was too corroded to read the embossed date, its composition of copper and nickel indicates it was minted after 1965.

With the exception of the items collected from T-23 and STP-1, the artifacts encountered during the test trenching were generally located within disturbed natural sediments and/or out-of-context materials mixed into fill sediments. No trash pits or undisturbed cultural layers were encountered.

Twelve of the 35 collected artifacts (34%) came from excavations at T-4 (SIHP # -12955 Feature B). Results of excavation at T-4 indicate continued usage into the later half of the twentieth century, given the presence of the 1965 bottle, alkaline batteries, and aluminum skewer. The ashy layer containing these artifacts also yielded midden (see Section 6.1.2). No

Table 43. Artifact Catalog

Catalog #	SIHP # (50-10-37)	Unit	Context (Stratum; depth)	Description	# of Pieces	Material Type	Dimensions (cm)	Weight (grams)
1	N/A	T-15	I; 47-66 cmbd	Cane slag	9	Calcium silicate	Not measured	35.0
2	N/A	T-16	I; 37-67 cmbs	Cane slag	6	Calcium silicate	Not measured	52.6
4	N/A	T-24	II; 46-88 cmbd	Cane slag	8	Calcium silicate	Not measured	142.3
7	N/A	T-24	II; 46-88 cmbd	Dime (coin)	1	Copper/nickel	0.179 d x 0.01 th	2.1
8	N/A	T-23	II; 45-65 cmbs	Cane slag	3	Calcium silicate	Not measured	43.1
12	N/A	T-4	II; 52-91 cmbd	White button with four holes	1	Glass	1.4 d x 0.3 th	0.8
22	-12950	T-13	I; 57-94 cmbd	Brown glass fragment	1	Bottle glass	Not measured	1.2
23	-12950	T-13	I; 57-94 cmbd	Green glass fragments	3	Bottle glass	Not measured	6.6
24	-12950	T-13	I; 57-94 cmbd	Clear glass fragments	3	Bottle glass	Not measured	4.7
25	-12950	T-13	I; 57-94 cmbd	Ceramic fragment	1	Porcelain	Not measured	3.2
26	N/A	T-21	II; 8-112 cmbs	Cane slag	4	Calcium silicate	Not measured	126.7
32	N/A	T-12	III; 55-57 cmbs	Clear glass fragment	1	Window glass	Not measured	5.4
43	-12955B	T-4	II; 52-91 cmbd	Brown button with two holes	1	Wood	1.4 d x 0.2 th	0.5
44	-12955B	T-4	II; 52-91 cmbd	Ceramic fragments	3	Porcelain	Not measured	9.7
45	-12955B	T-4	II; 52-91 cmbd	Ceramic fragment	1	Stoneware	Not measured	18.8
46	-12955B	T-4	II; 52-91 cmbd	Brown glass	1	Medicine bottle	9.7 l x 3.9 w x 0.2 th	74.4
47	-12955B	T-4	II; 52-91 cmbd	Clear glass fragments	23	Jar glass	Not measured	134.4
48	-12955B	T-4	II; 52-91 cmbd	Olive-green glass fragment	1	Unidentified glass	Not measured	0.6
49	-12955B	T-4	II; 52-91 cmbd	Purple glass fragment	1	Unidentified glass	Not measured	0.3

Catalog #	SIHP # (50-10-37)	Unit	Context (Stratum; depth)	Description	# of Pieces	Material Type	Dimensions (cm)	Weight (grams)
50	-12955B	T-4	II; 52-91 cmbd	Alkaline batteries	2	Various	5.0 l x 2.5 d 5.8 l x 2.0 d	55.5
51	-12955B	T-4	II; 52-91 cmbd	Skewer	1	Aluminum	20.5 l x 1.3 w x 0.03 th	3.3
59	-12955B	T-4	II; 52-91 cmbd	Clear glass fragments	3	Unidentified glass	Not measured	16.5
60	-12955B	T-4	II; 52-91 cmbd	Ceramic fragment	1	Porcelain	Not measured	3.5
63	-12955B	T-4	II; 52-91 cmbd	Metal pieces	2	Iron	Not measured	94.9
64	N/A	T-17	III; 14-36 cmbs	Cane slag	15	Calcium silicate	N/A	40.5
84	N/A	T-17	III; 14-36 cmbs	Lithic; possible abrader fragment	1	Basalt	2.3 l x 1.3 w x 1.9 th	5.2
70	N/A	T-17	III; 14-36 cmbs	Ceramic fragments	31	Stoneware	Not measured	35.8
71	N/A	T-17	III; 14-36 cmbs	Clear glass fragments	7	Unidentified glass	Not measured	14.2
72	N/A	T-17	III; 14-36 cmbs	Brown glass fragments	5	Unidentified glass	Not measured	8.6
73	N/A	T-17	III; 14-36 cmbs	Olive-green glass fragment	1	Unidentified glass	Not measured	1.3
74	N/A	T-17	III; 14-36 cmbs	Nail	1	Rusted iron	5.5 l x 1.7 w x 0.04 th	6.3
75	N/A	T-26	VI; 48-70 cmbs	Clear glass fragment	1	Unidentified glass	Not measured	23.3
76	N/A	T-26	VI; 48-70 cmbs	Cart wheel	1	Iron	20.2 d x 4.0 th	10.0kg>
77	-12957	STP-1	I; 0-10 cmbs	Spike	1	Iron	12.3 l x 2.7 w x 1.8 th	339.2
78	-12957	STP-1	I; 0-10 cmbs	Waterworn	1	Basalt	2.6 l x 2.0 w x 0.9 th	7.8

Figure 189. Photo showing one of the larger pieces of cane slag (calcium silicate) collected from fill sediments within the project area

Figure 190. Photos of medicine bottle (Catatog # 46) from T-4 (left), with a detail of the makers' mark on the base (right)

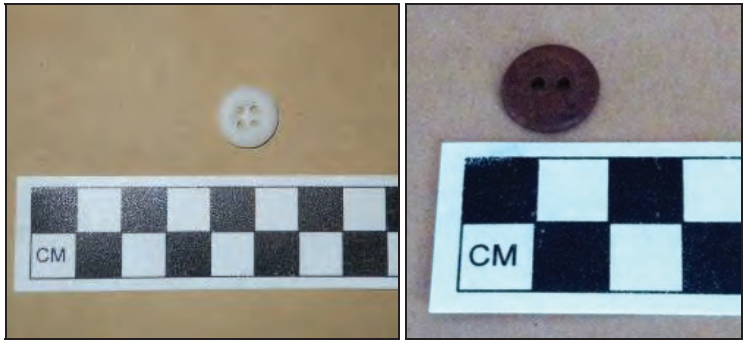


Figure 191. Photos of button artifacts from T-4, showing Catalog # 12 (left) and Catalog # 43 (right)

Figure 192. Photos of examples of iron artifacts, showing Catalog # 76 from T-26 (left) and Catalog # 77 from STP-1 (right)

clear trash pit and no clear chronological substrata were observed; it is likely the layer in which these items were located—overlain by a cinder fill associated with the demolition of the Kona Lagoon Hotel—represents a disturbed cultural layer.

Catalog # 46 is a cylindrical bottle of brown glass found intact in Stratum II at T-4 (SIHP # -12955 Feature B) (see Table 43 and Figure 190). It is machine made and exhibits a continuous threaded lip. The stipled base bears a makers' mark of an anchor superimposed by an uppercase "H." Around the makers' mark are a series of numbers: "86-07" above, "48" below, "3" to the left, and "65" to the right. Lockhart et al. (2013:426, 431, 433) indicate this bottle was manufactured by Anchor Hocking Glass Corp. in Lancaster, Ohio in 1965. The small size of the bottle indicates it likely contained medicine.

A total of 429.5 g of cane slag was collected from T-15, T-16, T-17, T-21, T-23, and T-24 (see Table 43). This material was used as a soil amendment for commercial sugar cane crops. Its substantial presence indicates importation of fill sediments into at least the central and northern portions of the project area (which was never planted commercially with cane). These fill layers were likely imported during or after the construction of KBR in 1968. In addition to cane slag, T-17 contains a fairly high concentration of other artifacts and midden, indicating the imported fill may have been mixed with sediments from a local cultural layer, or contained cultural materials from an outside location (possibly a dump).

6.1.2 Midden

A total of 767.6 g of midden was recovered from nine of the 29 test trenches (Table 44); of these, only four were in the context of an existing or destroyed historic property (SIHP #s -12950, -12955, and -12957). The vast majority of the collected midden was from Stratum II of T-4 at SIHP # -12955 Feature B. T-4 yielded large amounts of both marine shell and non-marine shell midden, concentrated more toward the base of the unit. As discussed in Section 6.1.1, this layer does not appear to represent a formal trash pit but rather a disturbed cultural layer associated with former habitation at that location. The midden found in T-13 and T-29 at SIHP # -12950 is not clearly in association with the habitation feature(s) once present there, as the material was collected from modern fill and/or a layer of naturally deposited sand. At STP-1 (SIHP # -12957 Feature B) a single cowrie shell fragment was observed within the shallow upper organic layer. This shell is interpreted as a modern deposition possibly related to the modern construction of the well or its subsequent use.

The remainder of the test trenches containing midden were excavated outside the context of a historic property. With the exception of T-17, these units (T-12, T-16, T-23, T-24) contain relatively small amounts of midden. The layers containing midden at T-12, T-16, and T-24 are fill layers; this layer at T-12 is interpreted as imported sediments given the presence of cane slag. T-17 contained a much higher volume of midden (over 100 g); as noted in Section 6.1.1, it is unclear what the layer there containing cultural materials represents, as it also included a substantial amount of cane slag. The midden from T-23 comes from two non-contiguous layers (Strata II and V). While the upper layer is a construction-related fill, Stratum V appears to be a natural beach/shoreline layer, containing either naturally deposited midden or scattered materials from a disturbed cultural layer in the vicinity.

Table 44. Midden Catalog

SIHP # (50-10-37)	**-12955B**	**N/A**	**-12950**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**-12950**	**-12957B**
Trench	**T-4**	**T-12**	**T-13**	**T-16**	**T-17**	**T-23**	**T-23**	**T-24**	**T-29**	**STP-1**
Context (Stratum; depth)	**II; 52-91 cmbd**	**III; 55-57 cmbd**	**I; 57-94 cmbd**	**I; 37-67 cmbd**	**III; 14-36 cmbs**	**II; 45-65 cmbd**	**V; 98-125 cmbd**	**II; 46-88 cmbd**	**I; 12 cmbs**	**I; 0-10 cmbs**
Cellana sp. (*‘opihi*, limpet)	15.2	0.1	1.2	--	70.8	0.4	3.8	0.3	5.7	--
Cypraea caputserpentis (*leho*, snakehead cowrie shell)	359.2	3.0	25.9	2.2	37.4	6.7	5.8	2.7	4.5	13.8
Nerita (*pipipi*, marine snail)	17.3	--	1.8	--	0.3	0.6	0.6	--	--	--
Conus (*pūpū*, cone snails)	5.3	--	--	--	--	--	--	--	--	--
Isognomon (*‘ōlepe*, bivalve mollusk)	2.2	0.8	--	--	--	--	0.8	--	--	--
Drupa (species of sea snail, purple drupe)	7.9	--	--	--	0.3	--	--	-	--	--
Patellidae (true limpet)	2.9	--	--	--	--	--	--	--	-	--
Total marine shell midden	410.0 g*	3.9 g	28.9 g	2.2 g	108.8 g	7.7 g	11.0 g	3.0 g	10.2 g	13.8 g
Echinoderm (*Echinoidea*, urchin)	7.4	2.8	--	--	--	--	1.4	--	--	--
Mammal bone	134.6	10.8	--	--	5.0	--	1.2	--	--	--
Fish bone	2.7	--	--	--	--	--	--	--	2.1	--
Fish scale	0.1	--	--	--	--	--	--	--		--
Total non-marine shell midden	144.8 g	13.6 g	--	--	5.0 g	--	2.6 g	--	2.1 g	--
Overall total midden	554.8 g	17.5 g	28.9 g	2.2 g	113.8 g	7.7 g	13.6 g	3.0 g	12.3 g	13.8 g

*g = grams

Marine shell midden accounted for 78% (599.6 g) of the midden recovered from the project area excavations. Most of the shellfish species were likely obtained locally along the coastline and are attributable to nearshore shellfish collection (the small amounts of marine shell midden within imported fill layers are clearly of questionable origin). The presence of marine midden recovered from the project area implies coastal resources were an important source of protein-related food for the residents of Kahalu‘u Ahupua‘a.

Faunal bone accounted for 20% (156.4 grams) of the midden recovered from the project area excavations. This bone material consisted of mostly (non-human) mammal bone, though small amounts of fish bone were also recovered from T-4 and T-29. These remains were also all likely obtained locally, though the midden from T-12 is of questionable origin. The remaining 2% of collected midden comprises urchin collected from T-4, T-12, and T-23, and fish scale from T-4.

6.1.3 Charcoal

Procurement of samples for chronological analysis was one of the goals of the subsurface testing within the project area. A charcoal sample was collected from Stratum I at T-29 (Table 45); however, this charcoal sample was not directly associated with surface or subsurface archaeological features or archaeological remnants. Therefore, additional laboratory analysis for chronological data was considered unnecessary.

Table 45. Charcoal Catalog

Catalog #	SIHP # (50-10-37)	Feature	Trench	Context (stratum; depth)	Weight (grams)	Description
083	-12950	N/A	T-29	I; 12 cmbs	9.5	Charcoal/ash

6.2 Materials Collected from Sediment Core Samples

6.2.1 Pollen/Starch Grain Analysis

Pollen/starch grain analysis was conducted on three samples collected during sediment coring within the project area. Sample 1A1 was collected from Stratum II within Core C-1A extracted from the open air well of SIHP # -12951A. Pollen/starch grain analysis showed that the sample was dominated by fern spores and foraminifera, indicative of a wet, possibly brackish water environment (Cummings 2014:2). Coconut and *loulu* (*Pritchardia* spp.) palm pollen, cheno-am pollen, and *ilex* species pollen were also identified in the subsample. The *ilex* pollen documents the presence and growth of introduced holly or yerba mate. No starch grains were observed. Sample 2C1 was collected from the upper boundary of Stratum II within Core C-2C extracted from the open air well of SIHP # -12951B. Sample 2C2 was collected from the middle of Stratum II within Core C-2C extracted from the open air well of SIHP # -12951B. Pollen/starch grain analysis showed that the samples were dominated by fern spores and foraminifera, indicative of a wet, possibly brackish water environment (Cummings 2014:2). Coconut and *loulu* palm pollen, Rhamnaceae and Straussia-type pollen, and Dodonses were also identified within the Core C-2C subsamples. No starch grains were observed. The complete Cummings (2014) pollen/starch grain analysis report is presented in Appendix E.

Cummings (2014) summarizes the pollen/starch grain analysis as follows:

> The local vegetation community, represented in all three samples, included both grasses and sedges as dominant elements, growing either in relatively wet areas or on local sediments. In addition, alena varied in quantity, being most abundant at the time represented by sample 4B from Core 2 [Sample 2C1]. *Loulu hiwa* grew as part of the coastal vegetation. Shrubby vegetation included *‘aheahea* and *a’ali’i* as the most abundant. The local wetland is represented by Typha pollen recovered in sample 4B from Core 2 [Sample 2C1]. Monolete spores and a few Dicksoniaceae and trilete spores document local growth of ferns and provide further evidence of relatively wet conditions. Recovery of Foraminifera from all three samples indicates the presence of at least brackish water and growth of these organisms in sediments or substrate that was either occasionally inundated or perhaps was inundated at a later time. No starches were observed in the samples. [Cummings 2014:2]

6.2.2 Radiocarbon Analysis

Radiocarbon analysis was conducted on three samples collected during sediment coring within the project area (Table 46). Sample 1A1 was collected from Stratum II within Core C-1A extracted from the open air well of SIHP # -12951A. A 2-sigma calibration of the radiocarbon analysis of Sample 1A1 suggested two possible date ranges, AD 1680 to 1770 (29.8%) and AD 1800 to 1940 (65.6%), with the post-Contact date range (1800-1940) being the most probable (Figure 193). Sample 2C1 was collected from the upper boundary of Stratum II within Core C-2C extracted from the open air well of SIHP # -12951B. A 2-sigma calibration of the radiocarbon analysis of Sample 2C1 suggested the subsample was modern. Sample 2C2 was collected from the middle of Stratum II within Core C-2C extracted from the open air well of

SIHP # -12951B. The analysis of Sample 2C2 suggested two possible date ranges, AD 1680 to 1730 (25.2%) and AD 800 to 1930 (70.2%), with the post-Contact date range (1800-1930) being the most probable (Figure 194).

Table 46. Radiocarbon Dating Analysis (2 Sigma Calibration)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age	2 Sigma Calibration
Beta–374392 SAMPLE 1A1 (organic sediment)	140 +/- 30 BP	-26.7 o/oo	110 +/- 30 BP	AD 1680 to 1770 (29.8%) AD 1800 to 1940 (65.6%)
Beta–374393 SAMPLE 2C1 (organic sediment)	108.0 +/- 0.3 pMC*	-26.1 o/oo	108.3 +/- 0.3 pMC	The reported result indicates an age of post 0 BP and has been reported as a % of the modern reference standard, indicating the material was living about the last 60 years or so (“pMC” = percent modern carbon).
Beta–374394 SAMPLE 2C2 (organic sediment)	100 +/- 30 BP	-26.4 o/oo	80 +/- 30 BP	AD 1680 to 1730 (25.2%) AD 1800 to 1930 (70.2%)

*pMC = percent modern carbon

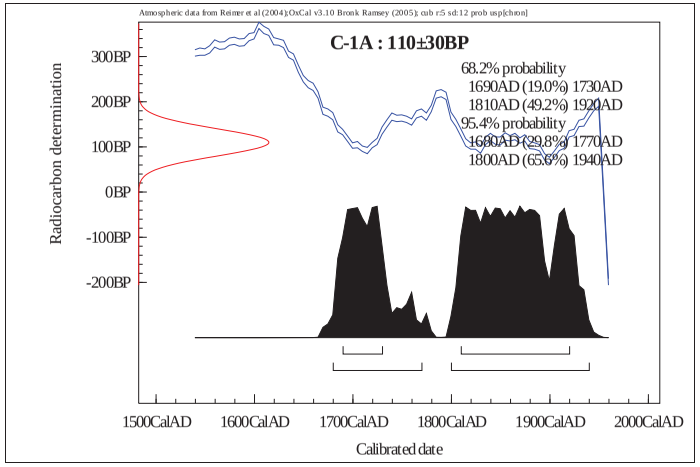


Figure 193. Calibration data and calibration curve for Sample 1A1 collected from Core C-1A

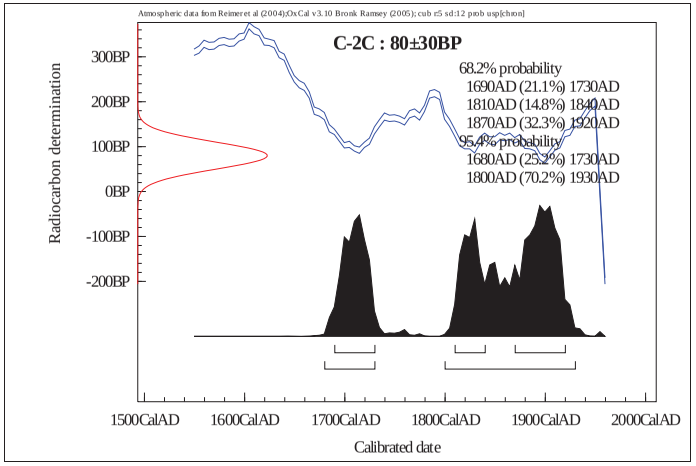


Figure 194. Calibration data and calibration curve for Sample 2C2 collected from Core C-2C

Section 7 Summary and Interpretation

The fieldwork component of the archaeological inventory survey was accomplished intermittently between 22 October 2013 and 25 March 2014 by CSH archaeologists Trevor Yucha, B.S., Fred LaChance, B.A., Johnny Dudoit, B.A., and Olivier Bautista, B.A., under the general supervision of Hallett H. Hammatt, Ph.D. (principal investigator). The fieldwork included pedestrian survey and documentation of surface features; a Ground Penetrating Radar (GPR) Survey; layout, excavation, and documentation of test trenches and a single shovel test; core sampling; and observation of a geotechnical survey.

Eight previously identified historic properties were confirmed during the inventory survey investigation (see Table 6). No new historic properties were encountered. Furthermore, while two previously recorded sites within the project area were known to have been destroyed (SIHP #s -Ha-D4-34/01616 [rectangular structure] and -Ha-D4-53 [Keawehala Pond]) the current survey also did not locate three additional previously recorded sites: SIHP #s -12915 (dune burials), -12950 (low-walled enclosure), and -HaD4-53 (petroglyphs). The latter two sites were likely impacted by developments near the center of the project area. SIHP # -12915 is believed to still be present but buried.

A GPR survey was conducted within the project area prior to subsurface testing in an attempt to define the local stratigraphy and to prospect for buried cultural deposits. Seven discrete locations (Grids 01-07) within the project area were surveyed with GPR prior to the first phase of subsurface testing. The GPR survey typcially indicated a variable *pāhoehoe* substrate in the areas surveyed. While no clear evidence for remnants of Kapuanoni Heiau was identified, the survey noted a set of linear anomalies under the central tennis court bank indicating the possible presence of a post-Contact cemetery believed to be in that location.

Subsurface testing was conducted within the project area to assess the stratigraphy and potential for subsurface historic properties. The testing program was informed by the GPR survey; consultation with the project proponents, SHPD, and area descendants; background research; and anticipated project ground disturbance. Four of the 29 total test trenches were excavated within the context of a previously identified historic property (T-4, T-13, T-22, T-29), in an attempt to further clarify the nature or age of that site. The remaining 25 test trenches were excavated outside the context of any historic property, and were therefore more exploratory in nature. No trash pits or undisturbed cultural layers were encountered. While the exploratory testing did not identify any new archaeological or cultural features, it did provide valuable information about the nature of the sediments found throughout the project area.

The southern portion of the project area has been heavily impacted by the construction and subsequent demolition of the Kona Lagoon Hotel. Some of the test trenches in this area included a fill layer of demolition debris. Throughout this portion of the project area an upper red cinder fill layer was observed, likely indicating a major fill event after the demolition was complete. The construction of the Kona Lagoon Hotel caused the destruction of SIHP #s -Ha-D4-34 and Ha-D4-52. Testing at SIHP # -12955 (LCA 5632:1) identified this cinder fill over a disturbed cultural layer associated with usage of the site that appears to have extended well into the second half of the twentieth century. The present results of testing indicate this site has futher research potential.

More recent developments on the property, particularly the construction of a sea wall and landscaped island near the center of the project area, appear to have destroyed SIHP #s -Ha-D4-53 and -12950. Testing in the former location of SIHP # -12950 indicated fill layers associated with the developments in this area and and a potential for disturbed cultural layers in the vicinity. Testing within the more *mauka* central portion of the project area also indicated widespread disturbance and fill events, and yielded sediments containing cane slag. The sediments were likely sourced from outside the project area, as sugar cane was not grown commercially within the project area.

The northern portion of the project area—including the vicinity of KBR and the landscaped areas to the north—also indicate extensive disturbance and fill, although the sediments are typically deeper. Some of the fill sediments in this area also included significant amounts of cane slag. Evidence of an early, possibly pre-KBR beach layer was observed at some of the test trenches in this area.

The testing program also included the collection of core samples from constructed wells at SIHP # -12955. Radiocarbon and pollen samples from the cores were submitted to Beta Analytic, Inc. and PaleoResearch Institute, respectively, for analysis. While these wells are presently dry, the pollen analyses indicated a wet, possibly brackish water environment, which was to be expected. Radiocarbon analysis of a sample taken from Feature A suggested two possible date ranges, AD 1680 to 1770 (29.8%) and AD 1800 to 1940 (65.6%), with the post-Contact date range (1800-1940) being the most probable. Analysis of a sample from Feature B yielded very similar results with two possible date ranges suggested: AD 1680 to 1730 (25.2%) and AD 1800 to 1930 (70.2%), again with the post-Contact date range (1800-1930) being the most probable. These results indicate that while there is a possibility of pre-Contact usage of SIHP # -12955, the site was well utilized throughout the historic era. A shovel test (STP-1) at nearby SIHP # -12957 Feature B did not yield evidence to counter Tuggle’s (1990) interpretation of this feature as a modern hotel landscaping construction.

The geotechnical survey conducted by Hirata and Associates, Inc. indicated the project area is underlain by layers of porous to dense basalt bedrock, which occasionally appears as a reddish cinder material. Extracted core samples indicated the upper limits of bedrock range from approximately 0.61 to 3.05 m (1.0 to 10.0 ft) below surface in the tested areas. As indicated by CSH’s subsurface testing program, areas with the deepest upper bedrock limits were at the hotel or adjacent to KBR. The shallowest bedrock surfaces were encountered in the central and southern portions of the project area. No cultural materials were observed at any time in the sediments extracted during the geotechinal survey.

In summary, the findings of the current AIS were as anitcpated through current consultation and background research of the project area. This locale has been used continuously from early pre-Contact to modern times for habitation, ceremony, resource procurement, and recreation. Hotel development beginning in the 1960s has significantly altered the landscape and has caused the destruction of some known historic properties, and likely many more features that were never documented. Although the current testing program did not identify any new historic properties, there remains a strong potential for additional subsurface features within the project area, including burials. This very significant area remains an archaeologically and culturally rich location that will continue to educate generations to come.

Section 8 Significance Assessments

The current investigation confirmed the presence of eight historic properties within the project area (SIHP #s -03817, -03818, -03819, -10997, -12951, -12953, -12955, and -12957). These historic properties are all previously identified and evaluated under an investigation approved by SHPD (Walker and Rosendahl 1989); however, as their significance was evaluated at that time using obsolete criteria, they are reevaluated based on the updated findings presented herein.

An additional previously identified historic property was not confirmed but is considered to still be present but buried within the project area (Probable Sand Dune Burial, SIHP # -12915); for this reason, the eligibility of this site for the Hawai‘i Register of Historic Places (HRHP) could not be evaluated.

The eight historic properties confirmed by the current study were evaluated for significance according to the following five broad criteria used by the Hawai‘i State Register of Historic Places (HAR §13-284-6) (Table 47). The criteria are the following:

1. Criterion “a.” Associated with events that have made an important contribution to the broad patterns of our history;
2. Criterion “b.” Associated with the lives of persons important in our past;
3. Criterion “c.” Embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possesses high artistic value;
4. Criterion “d.” Have yielded, or is likely to yield information important for research on prehistory or history;
5. Criterion “e.” Have an important value to the Native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property, or due to associations with traditional beliefs, events or oral history accounts—these associations being important to the group’s history and cultural identity.

All eight historic properties confirmed and documented within the project area are assessed as significant under Criterion “d.” The sites have yielded information important for understanding late pre-Contact to historic land use in the project area.

SIHP #s -03818, -03819, -10997, and -12953 are also recommended significant under Criterion “b” for their associations with the lives of persons of importance in the past. Background research indicates these sites are commonly associated with some of the most well-known *ali‘i* in Hawaiian history (see Section 3.3 and 3.4). SIHP # -03818 (Ke‘ekū Heiau) is associated with Lono-i-ka-makahiki, who resided in the area and by some accounts sacrificed the Maui chief Kamalalawalu there; and with Kamehameha I. SIHP # -03819 (Mākole‘a Heiau) is also associated with Lono-i-ka-makahiki, as is SIHP # -10997 (Kapuanoni Heiau). Oral histories also indicate Kapuanoni was associated with Kalani‘ōpu‘u and was the residence of Alapa‘inui. Finally, SIHP # -12953 is a former *ali‘i* residence associated with such important figures as Ke‘eaumoku, Governor John Adams Kuakini, and the chiefess Kekāuluohi.

Table 47. Historic Property Significance Criteria and Recommended Treatment

SIHP # (50-10-37)	Temporary Site #(s)	Function	Probable Age	Significance Criteria	Recommendations
-03817	50-Ha-D4-2, H-00165-25 (Hāpaiali‘i)	Ceremonial, religious	Pre-Contact; AD 1200s or 1300-1400s	b, c, d, e	Preservation
-03818	50-HA-D4-3, H-00073-4, H-00165-24 (Ke‘ekū + Hale O Papa)	Ceremonial, religious	Pre-Contact; AD 1200-1300s	b, c, d, e	Preservation and repair of Hale O Papa
-03819	50-Ha-D4-5, H-00073-6, H-00165-22 (Mākole‘ā)	Ceremonial, religious	Pre-Contact	b, d, e	Preservation
-10997	H-00073-2, H-00165-41 (Kapuanoni)	Ceremonial, religious	Pre-Contact	b, d, e	Preservation
-12951	PHRI 439-51, PHRI 439-52, H-00769, H-01426	Habitation	Historic; nineteenth century	d	No further work
-12953	PHRI 439-53, H-00165-43, H-00748-11881,	Habitation	Unknown (over 50 years)	b, d	Preservation and restoration
-12955	PHRI 439-55, PHRI 439-56, 50-Ha-D4-47, 50-Ha-D4-49,	Boundary, habitation	Historic; early 1800s to mid-1900s	d	Preservation and restoration
-12957	PHRI 439-57	Habitation	Historic (mid to late 1800s) and modern	d	Avoidance

For their distinctive construction, SIHP #s -03817 and -03818 are recommended significant under Criterion “c.” While these sites have been restored (or in the case of Ke‘ekū Heiau, 90% restored), this work was informed by a combination of archaeological study and background research, and it is believed they are fairly accurate representations of the pre-Contact *heiau*.

Finally, SIHP #s -03817, -03818, -03819, and -10997 are assessed as significant under Criterion “e” for their important value to the Hawaiian people as ceremonial sites.

Section 9 Project Effect and Mitigation Recommendations

9.1 Project Effect

CSH’s project specific effect recommendation is “effect, with agreed upon mitigation measures.” The project has the potential to impact historic properties in the project area. The recommended mitigation measures (see Table 47) will reduce the project’s potential adverse effect on significant historic properties.

9.2 Mitigation Recommendations

It is recommended that of the nine extant historic properties within the project area, six sites be preserved. Furthermore, two sites that will not be affected by the present project are recommended for preservation in the form of avoidance. The remaining historic property is not recommended for further archaeological research.

9.2.1 Historic Properties for Which Sufficient Data Has Been Recovered

No further historic preservation work is recommended for one historic property that was confirmed within the project area. SIHP # -12951 is a nineteenth century well complex that has been impacted by modern developments. Sufficient information regarding the location, function, age, and construction methods of these features have been generated by the current AIS investigation to mitigate any adverse effect caused by proposed development activities (though none is presently anticipated). Furthermore, these wells no longer provide any resources to the community (i.e., water or aquatic flora or fauna).

9.2.2 Preservation

Six historic properties are recommended for preservation under a plan in accordance with HAR §13-277-3. Five historic properties have existing, site-specific preservation plans in place (SIHP #s -03817, -03818 Feature A, -03819, -10997, and -12953). While the repair of Hale O Papa (SIHP # -03818 Feature B) and the restoration of the Keikiho‘okama House Site (SIHP # -12955) are not presently specified as part of the Kahalu‘u Ma Kai project, these future undertakings would likely require eventual preparation of a preservation plan.

CSH therefore recommends development of a single, project area-wide preservation plan to address SIHP #s -03818 Feature B and -12955 and to update the existing preservation plans, which were developed prior to restoration work that has already occurred. Aside from addressing buffer zones and protective measures for all historic properties recommended for preservation within the project area, this preservation plan would include detailed maps of the restored *heiau* sites. In consultation with KS it is proposed that this mapping would be completed as part of school year 2014-2015 *‘āina*-based education activities.

Additonally, preservation by avoidance is recommended for two historic properties: SIHP #s -12915 and -12957. Project plans presently do not indicate ground disturbing activities at these sites. No ground disturbing activities should be undertaken at any time within the backshore sand dune area at SIHP # -12915. It is recommended that after storms or other events of high seas, the

vicinity be inspected by KS staff for any exposed remains. If at any time human remains are exposed in this area, development of a burial treatment plan will be required in accordance with HRS §6E-43 and HAR §13-300. Following the recommendations of Walker and Rosendahl (1989), if in the future any projects are proposed with potential to impact SIHP # -12957, it is recommended the site first be subjected to a program of data recovery. If required, this work should proceed in accordance with a data recovery plan pursuant to HAR §13-278.

9.2.3 Archaeological Monitoring

Due to the potential for additional surface and subsurface historic properties, including human burials, it is recommended that development (including the KBR demolition) within the project area be attended by an archaeological monitoring program. The monitoring program will begin with the production of an archaeological monitoring plan for the review and approval of SHPD prior to the beginning of construction. Field monitoring should be carried out in accordance with the plan. An archaeological monitoring report should be submitted for review and approval by SHPD following the completion of all monitoring activities related to project development.

9.3 Disposition of Materials

Materials collected during the current archaeological inventory survey will remain temporarily curated at the CSH storage facility in Pāhoa, Hawai‘i. CSH will make arrangements with the landowner regarding the disposition of this material. Should the landowner request archiving of material, an archive location will be determined in consultation with SHPD.

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Draft

Archaeological Inventory Survey for the Kahaluʻu Ma Kai Project, Kahaluʻu Ahupuaʻa, North Kona District, Island of Hawaiʻi, TMKs: [3] 7-8-013:002, 013, 042, and 043

Volume II: Appendices

Prepared for
Helber Hastert & Fee, Planners, Inc.
and
Kamehameha Schools (KS)

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Appendix A Land Commission Awards (LCAs)

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Document Delivery

Mahele Database Documents
Number: 05632

Claim Number:	**05632**		
Claimant:	**Keikihookama**		
Other claimant:			
Other name:			
Island:	**Hawaii**		
District:	**Kona, North**		
Ahupuaa:	**Kahaluu**		
Ili:	**Makolea, Lehuakona, Pakii 1, Ulumoe**		
Apana:	**11**	Awarded:	**1**
Loi:	**0**	FR:	
Plus:		NR:	**391v8**
Mala Taro:	0	FT:	
Kula:	0	NT:	**618v4**
House lot:	**1**	RP:	**4439**
Kihapai/Pakanu:	20	Number of Royal Patents:	**1**
Salt lands:	0	Koele/Poalima:	**No**
Wauke:	**0**	Loko:	**No**
Olona:	0	Lokoia:	**No**
Noni:	**0**	Fishing Rights:	**No**
Hala:	0	Sea/Shore/Dunes:	**No**
Sweet Potatoes:	0	Auwai/Ditch:	**No**
Irish Potatoes:	0	Other Edifice:	**No**
Bananas:	**0**	Spring/Well:	**No**
Breadfruit:	**0**	Pigpen:	**No**
Coconut:	0	Road/Path:	**Yes**
Coffee:	0	Burial/Graveyard:	**No**
Oranges:	0	Wall/Fence:	**No**
Bitter Melon/Gourd:	0	Stream/Muliwai/River:	**No**

Sugar Cane:	0	Pali:	**No**
Tobacco:	0	Disease:	**No**
Koa/Kou Trees:	0	Claimant Died:	**No**
Other Plants:	0	Other Trees:	0
Other Mammals:	**No**	Miscellaneous:	

No. 5632, Keikihookama, Kahaluu, January 26, 1848
N.R. 391v8

Greetings to the Land Commissioners: I hereby tell of my house lot and my land: My lot is, combining the two long sides, 402 feet, and combining the two wide sides, 276 feet. The circumference is 678 feet. My land has 20 kihapai in it, however it is not a very large ili. The name is Makolea.
KEIKIHOOKAMA

N.T. 618v4
No. 5632, Keikihookama, February 13, 1849

Kamani, sworn, He has seen in Makolea ili of Kahaluu ahupuaa, 11 sections.

Section 1.
Mauka, Konohiki
Ka"u, Ulumoe land
Makai, Naahu's land
Kohala, Makakiloia land
2 kihapais have been cultivated.

Section 2:
Mauka by Naahu's land
Ka`u by Ulumoe land
Makai by Naahu's land
Kohala by Makakiloia land.
4 cultivated kihapais.

Section 3:
Mauka by Naahu's land
Ka`u by Ulumoe land
Makai by Kamaui's land
Kohala by Makakiloia land.
1 cultivated section.

Section 4:
Mauka by Kamaui's land
Ka`u by Ulumoe land
Makai by Naahu's land
Kohala by Makakiloia land.
1 cultivated section.

Section 5 - In the ili land of Lehuakona.
All konohiki boundaries, 1 cultivated section.

Section 6:

Mauka, Kau, Makai by Konohiki
Kohala by Pakii land.

Section 7 - In the ili land of Pakii 1.
Mauka by Kamaui's land
Ka`u by Lehuakona land
Makai by Kamaui's land
Kohala by Pakii 2 land.
1 cultivated kihapai.

Section 8 - In Ulumoe.
Mauka by konohiki
Ka`u by Pakii 2 land
Makai by konohiki
Kohala by Makolea land.
1 cultivated section.

Section 9:
Mauka by Napio's land
Ka`u by Pahii 2 land
Makai by Naahu's land
Kohala by Makolea land.
1 cultivated section.

Section 10:
Mauka by Paakai's land
Ka`u by Pakii land
Makai by Paakai's land
Kohala by Makolea land.
1 cultivated kihapai.

Section 11:
Mauka by Government road
Ka`u, Makai, and Kohala by konohiki.
No fence, 1 house for Keikihookama.

This is a bequest land from Keikihookama's father at the time of Kamehameha I, to the present, no one has objected to him.

Malaihi, sworn, Both he and Kamani have known in the same way.

[Award 5632; R.P. 4439; Kahaluu N. Kona; 2 ap.; 3.86 Acs; microfiche copy at archives also missing Section 1 of N.T. for this claim]

Number: 05693

Claim Number:	**05693**
Claimant:	**Koolau**
Other claimant:	
Other name:	

Island:	**Hawaii**		
District:	**Kona, North**		
Ahupuaa:	**Kahaluu**		
Ili:			
Apana:	**1**	Awarded:	**1**
Loi:		FR:	
Plus:		NR:	**397v8**
Mala Taro:		FT:	
Kula:		NT:	**632v4**
House lot:	**1**	RP:	
Kihapai/Pakanu:		Number of Royal Patents:	
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**No**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**Yes**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**No**
Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**
Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:		Other Trees:	
Other Mammals:	**No**	Miscellaneous:	**2 houses**

No. 5693, Koolau, Kahaluu, Hawaii, January 10, 1848
N.R. 397v8

Greetings to the Land Commissioners: I have a claim for a lot which is 8 fathoms on the east and west and 11 fathoms on the north and south.
KOOLAU

N.T. 632v4
No. 5693, Koolau, 15 February 1849

Punohu, sworn, he has seen in Kahaluu ahupuaa of Hawaii, a house lot.

[It is bounded]:

Mauka and all around by Konohiki
Lot has been enclosed, 2 houses for Koolau and he lives there. It has been an idle land, Koolau has developed it, no one has objected.

Pauni, sworn, both have known alike.

[Award 5693; Kahaluu N. Kona; 1 ap.; .07 Ac.]

Number: 05694

Claim Number:	**05694**		
Claimant:	**Kauakoekoe**		
Other claimant:	Poohina, widow		
Other name:	Kawakoekoe		
Island:	**Hawaii**		
District:	**Kona, North**		
Ahupuaa:	**Kahaluu**		
Ili:	**Hokio**		
Apana:	**7**	Awarded:	**1**
Loi:		FR:	
Plus:		NR:	**397v8**
Mala Taro:		FT:	
Kula:		NT:	**632v4**
House lot:		RP:	**4345**
Kihapai/Pakanu:	19	Number of Royal Patents:	**1**
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**No**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**No**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**No**
Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**
Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:		Other Trees:	
Other Mammals:	**No**	Miscellaneous:	**Awarded 2 apana, Kawakoekoe & Koolau**

had lived there; 12 scattered kihapai

No. 5694, Kauakoekoe
N.R. 397v8

Here is this claim to you for a house lot, as follows: on the east, 17 fathoms, on the west, 20 fathoms, on the north, 15 fathoms, on the south, 16 fathoms. Here is a claim for land in the ili of Hokio, Ahupua`a of Kahaluu. My right to it was from Kalikuaiwa and from Lanai. I am the occupant of the land.
KAUAKOEKOE

N.T. 632-633v4
No. 5694, Kawakaekoe (deceased), /Poohina, wife of above/, 15 February 1849

Pawai, sworn, he has seen in Hokio ili land of Kahaluu ahupuaa, 12 seattered kihapais.

Section 1:Mauka, Imakoloa's land
Kau by Kihikihi's land
Makai and Kohala by Imakaloa's land.
4 cultivated kihapais.

Section 2:
Mauka by Ipunui's land
Ka`u by Kihikihi's land
Makai by Opunui's land
Kohala by Hohio 2 land.
3 cultivated kihapais.

Section 3:
Mauka by Opunui's land
Ka`u by Hokio 4 land
Makai by Opunui's land
Kohala by Hokio 2 land.
5 partially cultivated kihapais.

Section 4:
Mauka by Opunui's land
Ka`u by Hokio 4 land
Makai by Imakaloa's land
Kohala by Hokio 2 land.
2 cultivated kihapais.

Section 5:
Mauka by Pawai's land
Ka`u by Hokio 4 land
Makai by Pawai's land
Kohala by Hokio 2 land.
4 partially cultivated kihapais.

Section 6:
Mauka by konohiki
Ka`u by Hokio 4 land
Makai by Helekamahina land
Kohala by Hokio 2 land.
1 partially cultivated section.

Section 7 - House lot.
Mauka by idle land
Ka`u by Koolau's land
Kohala by konohiki.
Makai by Maheu's land.

Kawakaekoe and Koolau had built an enclosure and had lived there. The land had been acquired at the time of Kalaikuaiwa. Kawakoekoe has died and his wife, Poohina, is living there, no one has objected.

Imakaloa, sworn, Both he and Pawai have known in the same way.

[Award 5694; R.P. 4345; Kahaluu N. Kona; 2 ap.; 2.68 Acs]

Mahele Database Documents
Number: 05915

Claim Number:	**05915**		
Claimant:	**Pawai**		
Other claimant:			
Other name:			
Island:	**Hawaii**		
District:	**Kona, North**		
Ahupuaa:	**Kahaluu**		
Ili:	**Hapaialii**		
Apana:	**1**	Awarded:	**1**
Loi:		FR:	
Plus:		NR:	**404v8**
Mala Taro:		FT:	
Kula:		NT:	**633v4**
House lot:	**1**	RP:	**4336**
Kihapai/Pakanu:		Number of Royal Patents:	**1**
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**No**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**Yes**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**No**

Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**
Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:		Other Trees:	
Other Mammals:	**No**	Miscellaneous:	**2 houses**

No. 5915, Pawai, Kahaluu, Kona, Hawaii, January 13, 1848
N.R. 404v8

Hear ye, Wm. L. Lee and your fellow workers: I have a claim for quiet title for two house lots. One is 113 fathoms in circumference and the other is 90 fathoms in circumference. Those are my claims, which I received from Kaihumua. The witness is Kapalaau. These house lot claims of mine are in the land of M. Kekuanaoa in Kahaluu.

N.T. 633v4
No. 5915, Pawai, February 15, 1849

Imakaloa, sworn, He has seen in the ili land of Hapaialii of Kahaluu ahupuaa of Hawaii, a house lot of which the boundaries are:
Mauka by idle land
Ka`u by Apiki's lot
Makai and Kohala by idle land.

Lot has been enclosed by Pawai, he has two houses in which he is occupying. The land had been for Pawai's father he had bequested it to Pawai upon his (Pawai) death. No one has objected.

Punohu, sworn, Both he and Imakaloa have known in the same way.

Pawai, sworn, He has been in error in his claim for the Kihapais. Therefore he is rejecting this claim on this 15th day of February 1849.

[Award 5915; R.P. 4336; Kahaluu Kona; 1 ap.; .22 Ac.]

Mahele Database Documents
Number: 05966

Claim Number:	**05966**		
Claimant:	**Maheu**		
Other claimant:			
Other name:			
Island:	**Hawaii**		
District:	**Kona, North**		
Ahupuaa:	**Kahaluu**		
Ili:			
Apana:	**1**	Awarded:	**1**
Loi:		FR:	
Plus:		NR:	**405v8**
Mala Taro:		FT:	
Kula:		NT:	**631v4**
House lot:	**1**	RP:	**4359**
Kihapai/Pakanu:		Number of Royal Patents:	**1**
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**No**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**Yes**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**No**

Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**
Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:		Other Trees:	
Other Mammals:	**No**	Miscellaneous:	**Claims 1, is awarded 2 apana; 2 houses**

No. 5966, Maheu
N.R. 405v8

Here is this /claim/ to you all, for a house lot. It is 15 fathoms on the west and east, and 12 fathoms on the north and south.
MAHEU

N.T. 631v4
No. 5966, Maheu, 15 February 1849

Pawai, sworn, he has seen in the ahupuaa of Kahaluu, a house lot and the boundaries are:

Mauka by Poohina's lot
Kau and Makai by idle land
Kohala by konohiki.
Maheu has enclosed the lot, he has 2 houses in which he now occupies, no one has objected.

Punohu, sworn, both have known alike.

[Award 5966; R.P. 4359; Kahaluu, Kona; 2 ap.; 2.05 Acs]

Mahele Database Documents
Number: 06026

Claim Number:	**06026**		
Claimant:	**Lanai, Ikaaka**		
Other claimant:			
Other name:	Isaac, Isaiaka		
Island:	**Hawaii**		
District:	**Kona, North, Kau**		
Ahupuaa:	**Kahaluu, Honokohau iki, Kapua, Pakini nui**		
Ili:	**Poohawaii, Hanapouli, Waioha**		
Apana:	**2**	Awarded:	**1**
Loi:	**0**	FR:	
Plus:		NR:	**407v8**
Mala Taro:	0	FT:	
Kula:	0	NT:	**633v4**
House lot:	**2**	RP:	**6787**
Kihapai/Pakanu:	0	Number of Royal Patents:	**1**
Salt lands:	0	Koele/Poalima:	**No**
Wauke:	**0**	Loko:	**No**
Olona:	0	Lokoia:	**No**
Noni:	**0**	Fishing Rights:	**No**
Hala:	0	Sea/Shore/Dunes:	**Yes**
Sweet Potatoes:	0	Auwai/Ditch:	**No**
Irish Potatoes:	0	Other Edifice:	**No**
Bananas:	**0**	Spring/Well:	**No**
Breadfruit:	**0**	Pigpen:	**No**
Coconut:	0	Road/Path:	**Yes**
Coffee:	0	Burial/Graveyard:	**No**
Oranges:	0	Wall/Fence:	**Yes**
Bitter Melon/Gourd:	0	Stream/Muliwai/River:	**No**

Mahele Database Documents
Number: 06027

Claim Number:	**06027**		
Claimant:	**Kapiimi, wahine**		
Other claimant:			
Other name:			
Island:	**Hawaii**		
District:	**Kona, North**		
Ahupuaa:	**Kahaluu**		
Ili:			
Apana:	**1**	Awarded:	**1**
Loi:		FR:	
Plus:		NR:	**407v8**
Mala Taro:		FT:	
Kula:		NT:	**633v4**
House lot:	**1**	RP:	
Kihapai/Pakanu:		Number of Royal Patents:	
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**No**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**Yes**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**No**

Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**
Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:		Other Trees:	
Other Mammals:	**No**	Miscellaneous:	**1 house**

No. 6027, Kapiimi
N.R. 407-408v8

Here is this house lot claim, made to you: on the east, 17, on the west, 17, on the north, 10. on the south, 10, /at/ Kamaui, ahupua`a of Kahaluu.

Here also, to you, the Land Commissioners, is a lot claim as follows: on the east, 15, on the west, 15, on the south, 10, on the north, 10.
KAPIIMI

N.T. 634v4
No. 6027, Kapiiui (Female), February 15, 1849

Pawai, sworn, He has seen in the ahupuaa of Kahaluu a house lot, the boundaries are:

Mauka, Ka`u and Makai by konohiki
Kohala by Apiki's lot.

Kapiiui has enclosed the lot, 1 house is for him and he lives there. It had been idle land, but he lives there, no one has objected.

Punohu, sworn, Both he and Pawai have known in the same way.

[Award 6027; Kahaluu N. Kona; 1 ap.; .09 Ac.]

Appendix B SHPD Correspondence

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

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

April 22, 2014

Hallett H. Hammatt, Ph.D.
Cultural Surveys Hawaii
PO Box 1114
Kailua, Hawaii 96734

LOG NO: 2014.0910
DOC NO: 1404MV22

Dear Dr. Hammatt:

SUBJECT: **National Historic Preservation Act Section 106 and HRS Chapter 6E-42 Review - Revised Archaeological Inventory Survey Plan for the Kahalu'u Manowai Project Kahalu'u Ahupua'a, North Kona District, Island of Hawai'i TMK: (3) 7-8-013:013, :042 & :043**

Thank you for submitting the revised draft plan titled *Archaeological Inventory Survey Plan for the Kahalu'u Manowai Project Kahalu'u Ahupua'a, North Kona District, Island of Hawai'i TMK: (3) 7-8-013:013, :042 & :043* (M. Wheeler, S. Wilkinson, A. Mitchell and H. Hammatt), February 2014. This plan was received by our office on February 20, 2014. According to the plan, Kamehameha Schools intends to demolish the existing facilities on the subject parcel, which include the Keauhou Beach Resort and remnants of the Kona Lagoon Hotel, and construct new cultural education facilities. The plan indicates that the proposed action will likely require a permit from the US Army Corps of Engineers, which establishes this project as a federal undertaking subject to Section 106 of the National Historic Preservation Act. This 22.73 acre project area in Kahalu'u is an extremely culturally significant location. In addition to being located within the Kahaluu Historic District (SIHP 50-10-37-4150), there are 4 previously identified heiau within this project area as well as multiple residences and fishponds associated with the lives of persons important in Hawaii's history. Much of this history has been covered over by previous resort development in the project area. The AISP proposes to investigate this location through a combination of a 100% pedestrian survey, ground penetrating radar (GPR), 28 subsurface test trenches, and 2 core samples at the locations of current and former fishponds.

The changes that were made to this plan are the result of the SHPD review of a previous draft (LOG NO: 2013.5164, DOC NO: 1209MV29). We believe that the changes made to this AISP have adequately addressed our concerns. The consultation section has been expanded and the results of the consultation have been incorporated into the proposed methodology for the survey. This report meets the requirements of HAR 13-284-5(c) 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. We look forward to the opportunity to review the archaeological inventory survey report upon completion of the field work described in this plan.

Please contact Mike Vitousek at (808) 652-1510 or Michael.Vitousek@Hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,

Mike Vitousek

Michael Vitousek,
Lead Archaeologist Hawaii Island Section
Historic Preservation Division

Appendix C Existing Preservation Plans

H-02166
(3) 7-8-013

T. S. Dye & Colleagues, Archaeologists, Inc.
785 Bishop St., Suite 315, Honolulu, Hawai'i 96813

A Preservation Plan for Ke‘ekū and Hāpaiali‘i Heiau, Kahalu‘u, Kona, Hawai‘i

Thomas S. Dye, Ph.D. Edward Halealoha Ayau

September 3, 2007

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Abstract

In accordance with Hawaiian tradition, Bishop Holdings Corporation and Kamehameha Investment Corporation, modern representatives of the Kamehameha dynasty, will restore Ke‘ekū and Hāpaiali‘i Heiau at Kahalu‘u, Kona, Hawai‘i in consultation with local families with ties to the *heiau* and with appropriate Hawaiian

cultural organizations. This plan sets out steps that will be carried out to document the existing condition of the *heiau* platforms, determine the layout of the platforms before they were battered by the sea and altered in recent times, restore the platforms, and construct timber and thatch structures on the platforms. Restoration of the platforms is scheduled to begin in the summer of 2007 to take advantage of calm seas typical of the season. The goal of the restoration will be to return the two *heiau* to appropriate cultural use. A burial treatment plan is provided to describe the inadvertent discovery of human remains at Hāpaiali‘i Heiau and to prepare for future inadvertent discoveries of human skeletal remains.

1 Ke‘ekū and Hāpaiali‘i Heiau

ahupua‘a

Ke‘ekū *heiau* is located on the former grounds of the Kona Lagoon Hotel, while Hāpaiali‘i *heiau* is located on the southern grounds of the Outrigger Keauhou Beach Resort in Kahalu‘u *ahupua‘a* of the Kona district on Hawai‘i Island. The parcels are indicated on tax maps as TMK:7–8–13:002 and TMK:7–8–13:43, respectively. Both *heiau* are built seaward of the high water line, so that pools of water surround them on three sides at high tide. They are in a state of disrepair after a period of more than 200 years during which they have received only minimal maintenance. During this time, the fences, structures, and images have all been removed or have decayed so that no trace remains. Most of the stone work of both *heiau* remains, but it has been damaged on occasion by high seas [1] and by visitors who climbed over walls or rearranged stones to create camp sites.

luakini

kāula wahine

Ke‘ekū is one of two *heiau luakini* known for Kahalu‘u *ahupua‘a*, the other being ‘Ōhi‘amukumuku, which was located about 400 m away to the northeast. The first mention of Ke‘ekū *heiau* is in relation to Kalaunui‘ōhua, who is believed to have ruled over the island at the end of the fifteenth century [2:188]. Kalaunui‘ōhua sacrificed the *kāula wahine*, Wa‘ahia, at Ke‘ekū, for which he received war powers from the god, Kānenuiakea [7:126–129, 300–302]. In 1906, John F. G. Stokes of Bishop Museum was told by Malanui, grandson of a keeper of Kapuanoni *heiau*, that Ke‘ekū was built[1] by Lonoikamakahiki [9:77], a grandson of ’Umi, who is believed to have ruled in the mid seventeenth century [2:225–239]. Lonoikamakahiki is said to have sacrificed Kamalālāwalu at Ke‘ekū after that Maui ruler was killed in battle on "the grassy plain of Puakō" [3:60].

In contrast, relatively little is known of the traditional history of Hāpaiali‘i *heiau*. In 1906, Stokes learned from Malanui that

kahuna

> this *heiau* was built by Ma‘a, a *kahuna* of Maui, who left for Kaua‘i later. It was said to be much older than Ke‘ekū Heiau. The period of Ma‘a was said to be later than that of Pa‘ao. The *heiau* was for prayers only. [9:73]

Archaeological study of the two *heiau* was begun in 1906 when Stokes had Ke‘ekū cleared of vegetation and mapped it and Hāpaiali‘i [9:73, 74]. Stokes described Hāpaiali‘i as

> a high platform *heiau* with vertical walls. The retaining walls on the north, west, and [south] are built of very large blocks of stone, squared by nature.

[1]Stokes was concerned with the origin of the *heiau*. Perhaps a better interpretation of Malanui's information is that Ke‘ekū was dedicated by Lonoikamakahiki, likely after it was restored (see p. 3).

> The eastern retaining wall is composed of smaller blocks. The platform surface is rather roughly paved. [9:71]

He described Ke'ekū as

> an imposing, heavy-walled enclosure surrounded on the west, north, and east by the sea at high tide. On the west and north, the walls reach a height of 10 and 11 feet, respectively, measured from the outside. From the inside, the four walls range in height from 6 to 6.5 feet, the same as the outside of the east and south walls. [9:75]

He also noted the *huapa'ū* and the platform for the *hale pahu* at the north end of the *heiau* and indicated the former locations of three *hale* named *hale ka'ili'ili*, *hale mana*, and *hale wai ea* along the west end, as pointed out by an informant. Stokes also noted the construction technique used in the walls of the *heiau* exposed to the attack of the sea. These walls were built as a series of faces with a heavy batter. The strong backward slope of these walls would have broken the force of waves and the successive faces would ensure that the wall would only fail piecemeal, rather than all at once.

huapa'ū
hale pahu
hale
hale mana
hale wai ea

The two *heiau* were mapped again in 1952 by Henry E. P. Kekahuna, who included historical notes with information not found in Stokes [9]. In particular, Kekahuna elaborates on the sacrifice of Kamalālāwalu at Ke'ekū, notes that the umbilical cord of Lonoikamakahiki, son of Keawenuia'umi, was cut there, and describes Hāpaiali'i as an "ancient house foundation." His map also shows the interior features of both *heiau* somewhat differently than Stokes does. Cordy [1] describes damage done to Hāpaiali'i by storm waves in 1986.

2 Background to the Restoration Plan

The goal of restoring Ke'ekū and Hāpaiali'i *heiau* is to put them to appropriate cultural use. The work is being planned and funded by Bishop Holdings Corporation, a for-profit subsidiary of Kamehameha Schools, the legacy of the Kamehameha dynasty.

It was the practice of *ali'i* in traditional times to restore *heiau* within their domains from time to time. As Malo notes, this restoration could involve the stone work of the *heiau*, as well as its fences, the timber and thatch structures built within it, and its images.

ali'i

> E ninau aku no ke alii i kana kahuna pule no ke kukulu ana i ka Luakini, ina i manao ke kahuna pule o ka Luakini kahiko no ka heiau, a o ka hale nae, a me ka pa laau ke ahana hou ia, a o ka pa pohaku kahiko no ka pa, a o ke kii kahiko no ke kii, ina i ae mai ke alii, alaila, huikala ia, ua heiau la a noa, i hiki i kanaka ke hele aku e pa laau hou, a me ke aho i na hale i loulu hou a i uki hou a paa. [7:82]
>
> The ali'i asked his kahuna pule about the building of the luakini, and if the kahuna pule thought the older luakini was needed, then the heiau, hale and pā lā'au were to be redone, the old stone tiers made into new ones; the old ki'i made into new ones, and the ali'i agreed. Then this heiau had to be purified and made noa, so a person could go re-fence, re-thatch the hale with Loulu and Uki until the roofs were secure. [7:241]

Sequences of building and rebuilding have been found in archaeological investigations of several *heiau* foundations, indicating that the practice described by Malo had a long history in the islands [4: 5].

The decision of the *ali'i* trust to restore the two *heiau* in the traditional manner was made in consultation with several Hawaiian organizations and local individuals. The Kamehameha Investment Corporation's Cultural Advisory Committee, composed of *kūpuna* from the area, has been consulted from the initial planning stages more than three years ago. More recently, Bishop Holdings Corporation employed Mahealani Pai, a cultural resource specialist with ties to families in Kahalu'u, who took a leading role in the planning and research. As a result, the Edith Kanaka'ole Foundation, a cultural-based organization established by the offspring of the late Luka and Edith Kanaka'ole, was brought in to assist with the project. Other organizations that have been consulted during planning include the Kona Hawaiian Civic Club, the Office of Hawaiian Affairs, the Royal Order of Kamehameha I, and the Daughters of Hawai'i. All of these organizations support the plan to restore the *heiau*.

māhele

In addition, members of families with ties to *māhele* awards in Kahalu'u, have been sought out and contacted. Among these are members of the Kahulamū family, who have been involved most directly through the participation of family *'āpio* in a project where high school students from Kealakehe and Ehunuikaimalino Schools made a plane table map of Kapuanoni *heiau*. Mitchell Fujisaka, a descendant of Kahulamū, who as a young man helped Kekahuna map Hāpaiali'i and Ke'ekū, was also consulted. All of these people support the plan to restore the *heiau*.

The restoration is being carried out on the grounds of an established resort and not in the context of a construction project. Consequently, no short-term measures to protect the *heiau* are planned. Instead, temporary barriers and signs will be set up as appropriate to alert resort visitors to the restoration work and any dangers it might present.

3 Restoration Plan

This plan is designed to satisfy the requirements of *Rules Governing Requirements for Archaeological Site Preservation and Development*, §13–277.

Restoration will be carried out in steps designed to ensure that the restored *heiau* conform as closely as possible to the structures built in traditional Hawaiian times. Where possible, traditional materials and techniques will be used in the restoration. Modern materials and techniques will be used when these might strengthen the structures, especially against wave attack, and when traditional materials are not available. In each case where modern materials are used, every effort will be made to minimize any effect they might have on the traditional appearance of the structures.

Mapping The initial step in restoration is preparation of 1:100 scale plane table maps showing the plans and cross-sections of the two *heiau*. These maps will document the condition of the *heiau* prior to reconstruction and will serve as one basis for setting out the plans of the restored structures.

Map comparison The 1:100 plane table maps of the *heiau* will be compared with the 1906 Stokes maps and the 1952 Kekahuna maps to determine which portions of each structure are intact and which parts have changed over the last century. This

step will identify areas where information at the ground surface is not sufficient to establish the original lines of the *heiau*.

Excavation Limited archaeological excavations will be carried out in areas where the original lines of the *heiau* are not firmly established. The primary purpose of the excavations will be to expose buried foundation stones and other features, as appropriate.

Foundation layout Based on the results of the previous steps, the plans and elevations of the various architectural components will be laid out in the field as a guide for the stone masons.

Stone work Stone work will be carried out by masons under the supervision of a licensed contractor with expertise in the construction of traditional Hawaiian dry stone masonry. An archaeologist will participate in this work to record evidence for earlier structures that might exist within the walls and platforms of the two *heiau*.

Structures Currently, timber and thatch structures and *ki'i* are planned for Ke'ekū *heiau*, but not for Hāpaiali'i *heiau*, unless investigations indicate that structures are appropriate for this *heiau*, too. The locations and sizes of the structures and *ki'i* will be determined by the results of archaeological mapping and excavations.

Cultural use Both of the *heiau* will be used for cultural purposes determined to be appropriate by Bishop Holdings Corporation in consultation with the Hawaiian organizations listed above.

4 Long-term Preservation Measures

The *heiau* are located on the grounds of the resort and will be maintained in a manner consistent with their setting. They will be kept clear of vegetation, which will be removed by hand, litter will be removed promptly, and they will receive periodic maintenance, as appropriate. In particular, damage done to the structures by high seas will be repaired as it occurs by a qualified mason with expertise in restoring traditional Hawaiian stone work. Typically, such a mason would be a licensed contractor, but it might also be the case that an appropriate mason will be employed by the resort or landowner in one capacity or another.

The *heiau* will be accessible to anyone who visits coastal Kahalu'u. It is anticipated that they will see regular cultural use and that they will be points of interest for visitors to the resort. To the extent possible, access to the structures themselves will be controlled through education. Visitor access to the interiors of both *heiau* will be generally prohibited in respect of their religious functions, cultural traditions and sensitivity, protection and visitor safety. Visitors will be able to view the restored *heiau* and have appreciation and respect for their cultural and physical integrity from a distance and with the aid of interpretive signs and a map. These signs will be placed approximately 8 m from the *heiau* and will physically mark the permanent buffer zones (fig. 1). Interpretive signs will be developed and installed after they have been reviewed and approved by the State Historic Preservation Division (SHPD). Due to the location of the *heiau* in a public area, SHPD staff will be able to monitor the condition and use at any time. Access to the interior of the *heiau* will granted to SHPD staff by appointment with Bishop Holdings Corporation or its successors.

Figure 1. Location of 8 m buffer zone boundary around Ke'ekū and Hāpaiali'i *heiau*. Signs will be erected at appropriate spots along the boundary. Note that *heiau* names are indicated on the figure without *kahakō*.

A A Burial Treatment Plan Serving as the Burial Site Component of a Preservation Plan for Ke'ekū and Hāpaiali'i Heiau, Kahalu'u, Kona, Hawai'i

A.1 Introduction

Section 13-300-2 of Title 13, Subtitle 13, Chapter 300, *Rules of Practice and Procedure Relating to Burial Sites and Human Remains* defines a burial treatment plan to mean a plan that meets all necessary requirements as set forth in this chapter and which proposes treatment of burial sites, including preservation in place or relocation, submitted to the department or council, whichever is appropriate, for a determination. The primary contractor responsible for restoration of Ke'ekū and Hāpaiali'i Heiau is Fields Masonry,

which is led by Master Mason Billy Fields. This burial treatment plan is arranged in two parts with the first addressing the inadvertent discovery of human skeletal remains that occurred on August 6, 2007 and the second providing the steps to be followed in the event of future inadvertent discoveries at the project site.

A.2 Inadvertent Discovery at Hāpaiali'i Heiau

A.2.1 Human Remains Discovered on August 6, 2007

On August 6, 2007, human skeletal remains were inadvertently discovered in the back dirt of excavations for the footing of the south wall of Hāpaiali'i Heiau (fig. 2) by Cultural Resource Specialist Edward Halealoha Ayau of Fields Masonry. The location of the discovery is approximately 8 m *makai* of the southeast corner of the *heiau*. Initially it was inconclusive whether the bone fragments were human. Ayau immediately requested Dr. Thomas Dye who was on site to help confirm whether the bones were human and to recover any additional remains. The subsequent discovery of human teeth and other bones helped confirm that the remains were in fact human. At that point Ayau and Dye contacted the landowner representative Cultural Resource Specialist Mahealani Pai and informed him of the discovery. Pai immediately contacted the SHPD to report the inadvertent discovery of human skeletal remains of a single skeleton from a burial site presumably over 50 years old as required by Hawai'i Revised Statutes (HRS) section 6E-43.6 and Hawai'i Administrative Rules (HAR) section 13-300-40. Subsequently, Ayau and Dye identified the original burial pit at a spot immediately beneath the south wall where the long bones were observed in situ. Based on the burial pit location beneath the *heiau* wall, the human skeletal remains were determined to be more than 50 years old. Because the burial site is older than the south wall of Hāpaiali'i Heiau which was constructed in traditional times, the ethnicity of the remains was determined to be Native Hawaiian. The original burial pit was located within the range of tidal fluctuation and was underwater at high tide. The in situ bones were fragile and in relatively poor condition due to the action of the water. The bones found in the back dirt were almost all fragmentary. The bones or *iwi kūpuna* were apparently disturbed during removal of a tree stump and by backhoe excavation of the south wall footing on Friday, August 3, 2007, but were not identified at that time. Heavy rains on Friday afternoon and over the weekend exposed bone fragments on the back dirt pile, leading to their discovery on Monday when restoration work resumed. The *iwi kūpuna* in the back dirt were found immediately adjacent to the original burial pit and were determined not to be distributed more than approximately 2 m away. The back dirt sediment was searched systematically for human remains by passing it through 0.25 in. and 0.125 in. mesh screen as appropriate and collecting bones from the screen. Aside from teeth, a phalanx and one vertebra, all the bones were collected as fragments. This work was carried out by Ayau and Dye over a period of two days on August 6 and 7, 2007. The in situ *iwi kūpuna* were not investigated and no inventory of them was made. Thus, it is not possible to be certain that all of the human skeletal remains were recovered. However, a substantial amount of sediment without *iwi kūpuna* was screened from the back dirt pile to either side of the burial pit and we are reasonably confident that all of the disturbed fragments were recovered. In order to maximize the possibility that additional *iwi kūpuna*, if present,

will be found, the cultural resource specialist and on site archaeologist shall monitor work in the immediate area. In addition, the mason crew was shown how to identify *iwi kūpuna* and instructed to be on the lookout for fragments during restoration activities in the vicinity. The recovered *iwi kūpuna* were wrapped in plain muslin cloth, placed on the original burial pit, the site covered completely with sand, bordered by large stones and capped.

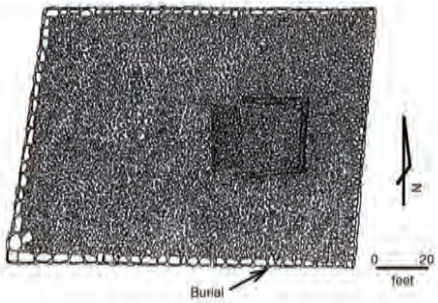

Figure 2. Location of inadvertently discovered human remains. Base map adapted from Stokes (1906, fig. 23).

A.2.2 Reasonably Believed to be Native Hawaiian

An evaluation of the ethnicity of the human skeletal remains inadvertently discovered at the south wall of Hāpaiali'i Heiau was conducted pursuant to HAR §13-300-31(g). In terms of history and tradition associated with the *heiau*, the Preservation Plan provides that in 1906, Anthropologist John Stokes of the Bishop Museum learned from a Hawaiian named Malanui that

> this heiau [Hāpaiali'i] was built by Maia, a kahuna of Maui, who left for Kauai later. It was said to be much older than Ke'eku Heiau. The period of Maia was said to be later than that of Piaao. The heiau was for prayers only.

In addition, Hāpaiali'i Heiau was mapped in 1952 by Henry E.P. Kekahuna who described the *heiau* as an ancient house foundation. Moreover, consultation with families

with ties to *māhele* awards in Kahalu'u and Hāpaiali'i Heiau itself, including descendants of Kahulamū, was conducted by Cultural Resource Specialist Mahealani Pai. These discussions indicated that the remains were believed to be those of an ancestral Native Hawaiian. The result of an evaluation of histories, traditions associated with Hāpaiali'i Heiau and genealogies of families associated with the site indicates it is reasonable to believe that the *iwi kūpuna* are Native Hawaiian.

Furthermore, although HAR 13-300-31(g)(1) provides that, "[w]here oral or written evidence establishes ethnicity by a reasonable belief, the evaluation ends," archaeological evidence gathered during the course of the recovery of the *iwi kūpuna* also supports a determination of Native Hawaiian ethnicity. As stated in section A above,

> Ayau and Dye identified the original burial pit at a spot immediately beneath the south wall where the long bones were observed in situ. Based on the burial pit location beneath the *heiau* wall, the human skeletal remains were determined to be more than 50 years old. Because the burial site is older than the south wall of Hāpaiali'i Heiau which was constructed in traditional times, the ethnicity of the remains was determined to be Native Hawaiian.

Based upon an evaluation of oral, written and archaeological evidence, SHPD should determine by a reasonable belief that the human skeletal remains inadvertently discovered at the south wall of Hāpaiali'i Heiau are Native Hawaiian.

A.2.3 Consultation with Hawaiian Organizations, Individuals

Consultation regarding the inadvertent discovery with Native Hawaiian organizations and families with ties to *māhele* awards in Kahalu'u and Hāpaiali'i Heiau including descendants of Kahulamūwas conducted by Cultural Resource Specialist Mahealani Pai. The consultations resulted in the following: 1. the belief that the *iwi kūpuna* are those of an ancestral Native Hawaiian; 2. the *iwi kūpuna* should be left in place where buried originally and protected from disturbance; and 3. the *heiau* restoration work should continue.

A.2.4 Interim Curation of *Iwi Kūpuna*

The original location of the burial site is directly under the south wall of the *heiau*, approximately 8 m *makai* of the southeastern corner. The landowner recommends to SHPD that the interim curation for these *iwi kūpuna* be the original burial site pending a final determination by SHPD to preserve in place or relocate. As stated in section A above, "[t]he recovered *iwi kūpuna* were wrapped in plain muslin cloth, placed on the original burial pit, the site covered completely with sand, bordered by large stones and capped."

A.2.5 Short Term and Long Term Protection Measures

Short term measures to immediately protect the burial site in place included the following. After proper cultural protocols were conducted, Master Mason Billy Fields and his men built a temporary but secure stone vault around the original burial site. Next, they

incorporated the burial vault into the south wall of the *heiau*. Thereafter, restoration of the south wall was completed. In addition, Cultural Resource Specialist Mahealani Pai notified hotel security to increase efforts to keep tourists and other individuals away from Hāpaiali'i Heiau especially when restoration work was not occurring. Pai himself would conduct periodic security checks in the early morning hours to assure that the burial site was secure and free from any disturbance.Once a final determination has been made by SHPD on the ethnicity of the human skeletal remains and whether to preserve in place or relocate, the following actions shall be taken. If the decision is to preserve in place, the long term measures to properly manage and protect the burial site shall include final reburial preparations conducted by Cultural Resource Specialists Edward Halealoha Ayau and Mahealani Pai and the interim curation vault made permanent by Master Mason Billy Fields and his crew through final south wall reconstruction measures. Buffer zones and landscaping shall be discussed and determined once the *heiau* restoration work is completed as Hāpaiali'i Heiau is surrounded on the north, west, and south sides by the ocean at high tide.In addition, the identification of lineal and/or cultural descendants and access to the burial site are issues that shall be addressed in the near future and as part of the *kuleana* of the landowner, the Native Hawaiian organizations being consulted as part of the *heiau* restoration efforts, and families who have ties to Kahalu'u and Hāpaiali'i Heiau. Should the decision be to relocate, further consultations will become necessary.

A.2.6 Recommend SHPD Preserve in Place

Pursuant to HAR §13–300–40(e), the Department of Land and Natural Resources shall determine whether to preserve in place or relocate following consideration and application of the criteria stated in §13–300–36 and in consultation with appropriate council members, the landowner, and any known lineal or cultural descendants. HAR §13–300–36(a) and (b) provide the criteria for evaluating a request to preserve or relocate inadvertently discovered Native Hawaiian skeletal remains,

> (a) Previously identified Native Hawaiian burial sites and inadvertently discovered Native Hawaiian skeletal remains that meet any one of the following criteria shall be given greater consideration for preservation in place by the council and the department respectively:
> (1) When located in areas with a concentration of skeletal remains;
> (2) Pre-contact or historic period burial sites associated with important individuals and events as recommended by the council following consultation with known lineal or cultural descendants, appropriate Hawaiian organizations, knowledgeable individuals, or any other appropriate source of information;
> (3) When located in areas within a context of historic properties, as defined by section 6E-2, HRS;
> (4) Where known lineal descendants request preservation in place; or
> (5) Where the landowner agrees to preservation in place.
> (b) When determining whether to preserve in place or relocate Native Hawaiian burial sites, the councils and the department where appropriate, shall give due consideration to the following:

(1) The cultural appropriateness of the proposal to preserve in place or relocate;
(2) Any possible harm to the Native Hawaiian skeletal remains if the burial site is left in place;
(3) The request of known lineal or cultural descendants to relocate; and
(4) Any reason presented by the applicant to relocate.

Section (a) of HAR 13-300-36 provides that where any one of the following criteria is met, the inadvertently discovered Native Hawaiian skeletal remains shall be given greater consideration for preservation in place by the department. In regards to the Native Hawaiian skeletal remains inadvertently discovered at Hāpaiali'i Heiau, criteria (3) and criteria (5) are satisfied. Criterion 3 provides for the greater consideration for preservation in place of Native Hawaiian skeletal remains located in areas within a context of historic properties. Here, that historic property is Hāpaiali'i Heiau. Criteria 5 provides for greater consideration where the landowner agrees to preservation in place. The landowner Bishop Holdings Corporation has agreed from the outset to preserve these *iwi kūpuna* in their original location. Criterion 2 may be satisfied given that this is a pre-contact burial site associated with important events at Hāpaiali'i Heiau. However, this would require a recommendation by the Hawai'i Island Burial Council following consultations with known descendants, appropriate Native Hawaiian organizations or other appropriate sources of information.

Section (b) of HAR 13-300-36 provides additional considerations by the department with regard to inadvertently discovered Native Hawaiian skeletal remains. Two of those considerations warrant discussion. The first is subsection (1) which addresses the cultural appropriateness of preservation in place or relocation. Because the burial site at issue predates the *heiau* wall construction, it is culturally appropriate to preserve in place, as this position is most consistent with the original wishes of those who buried this person. The second consideration is any possible harm to the *iwi kūpuna* if left in place. This concern is not as straightforward as the first. It has already been pointed out in section A above that,

> The original burial pit was located within the range of tidal fluctuation and was underwater at high tide. The in situ bones were fragile and in relatively poor condition due to the action of the water. The bones found in the back dirt were almost all fragmentary.

Hence, preservation in place will subject the *iwi kūpuna* to some physical harm due to the action of the ocean water. Nonetheless, this is a natural process, one contemplated by the *kūpuna* when burying in the shoreline. The primary goal of protecting Hawaiian burial sites is to guard the natural process of deterioration of the *iwi* no matter how long it takes. It is not to preserve the bones themselves, but rather to preserve the integrity of the *hele loa* or long journey back to becoming part of the *'āina* again with the infusion of the person's *mana* into the land such that spiritual and physical growth results. Hence, in this particular instance, preservation in place would not harm these particular *iwi kūpuna* in the cultural sense. Instead, it would facilitate the long journey home. For all of these reasons, the landowner recommends to SHPD to preserve in place the inadvertently

discovered Native Hawaiian skeletal remains and approve the recommended measures to protect the *iwi kūpuna* and burial site on a short term and long term basis.

A.3 Future Inadvertent Discoveries of Human Skeletal Remains

Excavations conducted throughout the restoration efforts of both Hāpaiali'i and Ke'ekū Heiau shall be monitored by a qualified archaeologist and a cultural resource specialist. In the event what skeletal remains are inadvertently discovered, the following steps shall take place:

(a) All activity in the immediate area of the discovery shall cease and the monitoring archaeologist and cultural resource specialist shall establish a protective boundary around the area.
(b) The monitoring archaeologist and cultural resource specialist shall determine whether the bones are human by observing the presence of determinative bones such as an intact skull, mandible or the presence of human teeth. All efforts shall be undertaken to keep the bones in place and to utilize only minimal and non-intrusive means so as not to further disturb the remains. Clean muslin cloth shall be used to cover the bones in order to minimize exposure.
(c) The monitoring archaeologist and cultural resource specialist shall attempt to determine whether there is a single skeleton or whether there are multiple skeletons present, all the while being careful to keep the bones in place wherever possible and utilizing only minimal and non-intrusive efforts so as not to further disturb the remains.
(d) Where the bones are determined to be human, the monitoring archaeologist and cultural resource specialist shall determine whether the remains originated from a burial site over 50 years old. All efforts shall be undertaken to be careful and respectful when handling the human skeletal remains.
(e) Where it is determined that the burial site is over 50 years old, the monitoring archaeologist and cultural resources specialist shall immediately notify the landowner representative Cultural Resource Specialist Mahealani Pai and inform him that (1) human skeletal remains have been inadvertently discovered; (2) the remains originate from a burial site over 50 years old; (3) there is either a single skeleton or multiple skeletons present; and (4) to immediately notify the SHPD of the inadvertent discovery and await instructions as to proper treatment.
(f) Following notification to SHPD, and with its permission, the monitoring archaeologist and cultural resource specialist shall undertake efforts to determine the ethnicity of the human skeletal remains and to present their findings to SHPD for a final determination.
(g) The monitoring archaeologist and cultural resource specialist shall undertake efforts to recover any disturbed skeletal remains and to maintain preservation in place wherever possible until a final determination is made by the SHPD as to proper treatment.
(h) Cultural Resources Specialist Mahealani Pai shall conduct consultations regarding the inadvertent discovery with Native Hawaiian organizations identified in the Preservation Plan and those families with ties to mahele awards in Kahalu'u and connections to Hāpaiali'i and Ke'ekū Heiau including descendants of Kahulamū

to discuss 1) whether the remains are those of an ancestral Native Hawaiian; and 2) whether the remains should be left in place where buried originally and protected from disturbance or relocated.

(i) Short term protection measures shall be undertaken to immediately protect the human remains and recommendations for in place preservation and long term protection shall be made for SHPD consideration and final determination.

(j) A report shall be prepared by the monitoring archaeologist and cultural resource specialist and submitted to SHPD that summarizes the inadvertent discovery, the steps taken with regard to the interim treatment of the human skeletal remains and shall include recommendations with regard to ethnicity and the proper short term and long term treatment of the remains and burial site(s).

(k) Once SHPD renders a final determination regarding the ethnicity of the human skeletal remains and whether to preserve in place or relocate, the monitoring archaeologist, cultural resource specialist and Fields Masonry shall implement the final treatment measures for the human skeletal remains and burial site(s) including implementation of all long term protective measures.

(l) Any additional consultation shall be undertaken with identified descendants and the interested parties identified above including such issues as access to the burial site(s) and landscaping. Should the SHPD decide to relocate, further consultations will be necessary.

Glossary

Entries for Hawaiian words are excerpted or paraphrased, where possible, from the *Hawaiian Dictionary* [8], or from Lucas [6].

'aha Sennit, cord braided of coconut husk, human hair, intestines of animals. A prayer or service whose efficacy depended on recitation under taboo and without interuption; the priest was said to carry a cord (*'aha*).

ahupua'a Traditional Hawaiian land division usually extending from the uplands to the sea.

ali'i Chief, chiefess, officer, ruler, monarch, peer, head man, noble, aristocrat, king, queen, commander.

hale House, building, station, hall.

hale mana Largest house in a *luakini* temple.

hale pahu A drum house usually located in a *heiau*.

hale wai ea Small house at the entrance of a *heiau* temple, where the ceremonial *'aha* (cord) was stretched. See also *'aha*.

heiau Traditional Hawaiian place of worship.

kahuna Priest, sorcerer, magician, wizard, minister, expert in any profession.

kāula Prophet, seer, magician.

ki'i Image, statue, picture, photograph, drawing, diagram, illustration, likeness, cartoon, idol, doll, petroglyph.

luakini *Heiau* of the ruling chiefs where human sacrifices were offered.

luapa'ū Refuse pit in the *luakini* temple enclosure.

māhele Land division of 1848.

wahine Woman, lady, wife; sister-in-law, female cousin-in-law of a man.

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A Preservation Plan for Mākole'ā and Kapuanoni Heiau and Po'o Hawai'i, Kahalu'u, Kona, Hawai'i

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April 14, 2008

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Abstract

In accordance with Hawaiian tradition, Bishop Holdings Corporation and Kamehameha Investment Corporation, modern representatives of the Kamehameha dynasty, will restore Mākole'ā and Kapuanoni *heiau* and Po'o Hawai'i at Kahalu'u, Kona, Hawai'i in consultation with local families with ties to the *heiau* and Po'o Hawai'i and with appropriate Hawaiian cultural organizations. This plan sets out steps that will be carried out to document the existing condition of the *heiau* platforms, determine the layout of the platforms before they were altered in recent times, restore the platforms, and construct timber and thatch structures on the platforms. The goal of the restoration will be to return the two *heiau* to appropriate cultural use and stabilize and restore Po'o Hawai'i as habitat for native animals. A burial treatment plan is provided to prepare for possible inadvertent discoveries of human skeletal remains.

heiau

1

1 Mākole'ā, Kapuanoni, and Po'o Hawai'i

ahupua'a

Mākole'ā *heiau* is located on the former grounds of the Kona Lagoon Hotel, while Kapuanoni *heiau* is located on the grounds of the Outrigger Keauhou Beach Resort in Kahalu'u *ahupua'a* of the Kona district on Hawai'i Island. The parcels are indicated on tax maps as TMK:7–8–13:002 and TMK:7–8–13:043, respectively. Kapuanoni *heiau* is built seaward of the high water line, so that pools of water surround it on three sides at high tide. Mākole'ā is located about 180 m from the sea. Both *heiau* are in a state of disrepair after a period of more than 200 years during which they have received only minimal maintenance. During this time, the fences, structures, and images have all been removed or have decayed so that no trace remains. Most of the stone work of both *heiau* remains, but Kapuanoni *heiau* has been damaged on occasion by high seas and during a reconstruction effort several decades ago, and components of Mākole'ā *heiau* were destroyed when a road was built along the south side of the structure many years ago.

Mākole'ā *heiau* is thought to be named after a female Kona *ali'i* who ruled in the fifteenth century [13:55] and was consecrated by Lonoikamakahiki [11:80], who ruled in the mid-seventeenth century. Notations on the Kekahuna map [3] indicate that chiefess Mākole'ā dwelt at the *heiau*. Mākole'ā is also the name of an *'ili* of Kahalu'u and of a small bay nearby; it thus appears to be an old and important local name [13:56].

Mākole'ā was mapped by Stokes [11] and by Kekahuna [3]. Both maps show a rectangular enclosure divided lengthwise by an interior wall and a smaller, nearly square enclosure a few meters south. Kekahuna [3] shows a long wall connecting the two enclosures and a "sacred spring" between them, neither of which were present when Stokes was there nearly 50 years earlier. All of these southern features were either damaged or buried by construction and landscaping.

There are several pieces of recorded information about Kapuanoni *heiau*. Thrum [12]:72 claims it was built "in the time of Lono," probably Lonoikamakahiki who ruled in the mid-seventeenth century [2]; Malanui told Stokes [11] that it was built by Kalaniopu'u, who ruled from 1760 to 1782. Although Lono and Kalaniopu'u ruled a century apart, this information is not necessarily contradictory. *Ali'i* frequently rebuilt temples in their domain and the later reference to Kalaniopu'u could refer to this, rather than to construction of the original temple. Tuggle [13]:58 speculates that Kapuanoni was built on the foundation of an older temple, Hanakalauai or Hanakalawai.

Thrum [12]:72 claimed Kapuanoni was an "ancient *pu'uhonua* and *luakini*." Malanui told Stokes [11] that it was for "prayers in general." Kekahuna believed it was a temple to increase food and fish [3], a conclusion supported by Cordy [1]. Kahulamū told Reinecke [10] that it was the residence of Alapa'ī. Records from the *māhele* indicate that Kapuanoni *heiau* was located in the *'ili* of "Poohawaii," which was awarded to Isaaka Lana'i, and that three houses stood there, at least one of which was occupied by Lana'i. Kekahuna and Kelsey [4]:VI identify Lana'i as "the last high priest of the heiau of Ka-pua-noni, in Kaha-lu'u."

The structure was overgrown by *hau* when Stokes visited it in 1906 and he did not clear or map it. The only map of the *heiau* drawn before the structure was modified during construction of the hotel building at what is now the Outrigger Keauhou Beach Resort was drawn by Kekahuna [3]. He shows a structure 151 ft. long and 98.5 ft. wide with seven compartments, the two most northern of which he considered the "*heiau* proper." The

ruins were mapped in 2007 by high school students from Kealakehe and Ehunuikaimalino schools. Their map (fig. 1) is incomplete and inaccurate in some respects, but does show the major features of the structure, including an alignment of large stones that Tuggle [13] believed might represent the foundation of Hanakalauai *heiau*.

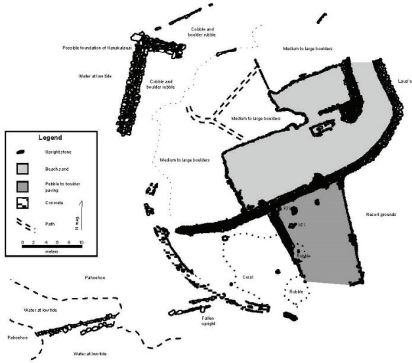

Figure 1. Map of Kapuanoni *heiau* drawn by students of Ehunuikaimalino and Kealakehe schools.

The focal point of Po‘o Hawai‘i is a walled pond around which numerous high *ali‘i* resided in the early historic period up until the time of Kalākaua [4:XIX]. According to Kekahuna [3], these include Kamehameha, Ke‘eaumoku, Kuakini, and Kalākaua. Kuakini was born here or nearby in 1791 and at his death in 1844 his remains were prepared at Po‘o Hawai‘i [13:59]. Kalākaua's frame house was demolished in 1950 [4:XIX], and a reconstruction built in the 1970s, now stands at the site.

Sequences of building and rebuilding have been found in archaeological investigations of several *heiau* foundations, indicating that the practice described by Malo had a long history in the islands [4: 5].

The decision of the *ali‘i* trust to restore the two *heiau* in the traditional manner was made in consultation with several Hawaiian organizations and local individuals. The Kamehameha Investment Corporation's Cultural Advisory Committee, composed of *kūpuna* from the area, has been consulted from the initial planning stages more than three years ago. More recently, Bishop Holdings Corporation employed Mahealani Pai, a cultural resource specialist with ties to families in Kahalu‘u, who took a leading role in the planning and research. As a result, the Edith Kanaka‘ole Foundation, a cultural-based organization established by the offspring of the late Luka and Edith Kanaka‘ole, was brought in to assist with the project. Other organizations that have been consulted during planning include the Kona Hawaiian Civic Club, the Office of Hawaiian Affairs, the Royal Order of Kamehameha I, and the Daughters of Hawai‘i. All of these organizations support the plan to restore the *heiau*.

māhele

In addition, members of families with ties to *māhele* awards in Kahalu‘u, have been sought out and contacted. Among these are members of the Kahulamū family, who have been involved most directly through the participation of family *‘ōpio* in a project where high school students from Kealakehe and Ehunuikaimalino Schools made a plane table map of Kapuanoni *heiau*. Mitchell Fujisaka, a descendant of Kahulamū, who as a young man helped Kekahuna map Hāpaiali‘i and Ke‘ekū, was also consulted. All of these people support the plan to restore the *heiau*.

The restoration is being carried out on the grounds of an established resort and not in the context of a construction project. Consequently, no short-term measures to protect the *heiau* are planned. Instead, temporary barriers and signs will be set up as appropriate to alert resort visitors to the restoration work and any dangers it might present.

3 Restoration Plan

This plan is designed to satisfy the requirements of *Rules Governing Requirements for Archaeological Site Preservation and Development*, §13-277.

Restoration will be carried out in steps designed to ensure that the restored *heiau* conform as closely as possible to the structures built in traditional Hawaiian times. Where possible, traditional materials and techniques will be used in the restoration. Modern materials and techniques will be used when these might strengthen the structures, especially against wave attack, and when traditional materials are not available. In each case where modern materials are used, every effort will be made to minimize any effect they might have on the traditional appearance of the structures.

Mapping The initial step in restoration is preparation of 1:100 scale plane table maps showing the plans and cross-sections of the two *heiau*. These maps will document the condition of the *heiau* prior to reconstruction and will serve as one basis for setting out the plans of the restored structures.

Map comparison The 1:100 plane table maps of the *heiau* will be compared with the 1906 Stokes maps and the 1952 Kekahuna maps to determine which portions of each structure are intact and which parts have changed over the last century. This

step will identify areas where information at the ground surface is not sufficient to establish the original lines of the *heiau*.

Excavation Limited archaeological excavations will be carried out in areas where the original lines of the *heiau* are not firmly established. The primary purpose of the excavations will be to expose buried foundation stones and other features, as appropriate.

Foundation layout Based on the results of the previous steps, the plans and elevations of the various architectural components will be laid out in the field as a guide for the stone masons.

Stone work Stone work will be carried out by masons under the supervision of a licensed contractor with expertise in the construction of traditional Hawaiian dry stone masonry. An archaeologist will participate in this work to record evidence for earlier structures that might exist within the walls and platforms of the two *heiau*.

ki'i

Structures Currently, timber and thatch structures and *ki'i* are planned for Ke'ekū *heiau*, but not for Hāpaiali'i *heiau*, unless investigations indicate that structures are appropriate for this *heiau*, too. The locations and sizes of the structures and *ki'i* will be determined by the results of archaeological mapping and excavations.

Cultural use Both of the *heiau* will be used for cultural purposes determined to be appropriate by Bishop Holdings Corporation in consultation with the Hawaiian organizations listed above.

4 Long-term Preservation Measures

The *heiau* are located on the grounds of the resort and will be maintained in a manner consistent with their setting. They will be kept clear of vegetation, which will be removed by hand, litter will be removed promptly, and they will receive periodic maintenance, as appropriate. In particular, damage done to the structures by high seas will be repaired as it occurs by a qualified mason with expertise in restoring traditional Hawaiian stone work. Typically, such a mason would be a licensed contractor, but it might also be the case that an appropriate mason will be employed by the resort or landowner in one capacity or another.

The *heiau* will be accessible to anyone who visits coastal Kahalu'u. It is anticipated that they will see regular cultural use and that they will be points of interest for visitors to the resort. To the extent possible, access to the structures themselves will be controlled through education. Visitor access to the interiors of both *heiau* will be generally prohibited in respect of their religious functions, cultural traditions and sensitivity, protection and visitor safety. Visitors will be able to view the restored *heiau* and have appreciation and respect for their cultural and physical integrity from a distance and with the aid of interpretive signs and a map. These signs will be placed approximately 8 m from the *heiau* and will physically mark the permanent buffer zones (fig. 1). Interpretive signs will be developed and installed after they have been reviewed and approved by the State Historic Preservation Division (SHPD). Due to the location of the *heiau* in a public area, SHPD staff will be able to monitor the condition and use at any time. Access to the interior of the *heiau* will granted to SHPD staff by appointment with Bishop Holdings Corporation or its successors.

heiau, (ii) collect data from cultural deposits using standard archaeological techniques, as appropriate, and (iii) facilitate the timely identification of inadvertently discovered human remains.

ki'i

Structures Currently, timber and thatch structures and *ki'i* are planned for both *heiau*. The locations and sizes of the structures and *ki'i* will be determined, in part, by the results of archaeological mapping and excavations.

Cultural use Both of the *heiau* will be used for cultural purposes determined to be appropriate by Bishop Holdings Corporation in consultation with the Hawaiian organizations listed above.

Archaeological report A report of archaeological monitoring activities and findings will be submitted to SHPD following completion of the restoration project(s). It is anticipated that relatively little cultural material will be exposed during the restoration and that collections will consist primarily of sediment samples and materials for dating. Collected materials will be stored at the offices of T. S. Dye & Colleagues, Archaeologists, Inc. for analysis and then transferred as appropriate to their owners, Bishop Holdings Corporation and Kamehameha Investment Corporation who will store them at a facility to be determined in Kahalu'u.

Po'o Hawai'i will be restored by removing non-native fishes, clearing vegetation within and on the margins of the pond, and re-building collapsed portions of the walls to their original condition. Steps will be taken to improve the habitat so that native plants and animals repopulate the pond.

4 Long-term Preservation Measures

The *heiau* are located on the grounds of the resort and will be maintained in a manner consistent with their setting. They will be kept clear of vegetation, which will be removed by hand, litter will be removed promptly, and they will receive periodic maintenance, as appropriate. In particular, damage done to the structures by high seas will be repaired as it occurs by a qualified mason with expertise in restoring traditional Hawaiian stone work. Typically, such a mason would be a licensed contractor, but it might also be the case that an appropriate mason will be employed by the resort or landowner in one capacity or another.

The *heiau* will be accessible to anyone who visits coastal Kahalu'u. It is anticipated that they will see regular cultural use and that they will be points of interest for visitors to the resort. To the extent possible, access to the structures themselves will be controlled through education. Visitor access to the interiors of both *heiau* will be generally prohibited in respect of their religious functions, cultural traditions and sensitivity, protection and visitor safety. Visitors will be able to view the restored *heiau* and have appreciation and respect for their cultural and physical integrity from a distance and with the aid of interpretive signs and a map. These signs will be placed approximately 8 m from the *heiau* and will physically mark the permanent buffer zones (fig. 2). Interpretive signs will be developed and installed after they have been reviewed and approved by the State Historic Preservation Division (SHPD). Due to the location of the *heiau* in a public area, SHPD staff will be able to monitor the condition and use at any time. Access to the interior of the *heiau* will granted to SHPD staff by appointment with Bishop Holdings

Corporation or its successors.

Figure 2. Location of 8 m buffer zone boundaries around Mākole'ā and Kapuanoni *heiau*, and the location of Pō'o Hawai'i. Signs will be erected at appropriate spots along the *heiau* buffer boundaries. Note that *heiau* names are indicated on the figure without *kahakō*.

Pō'o Hawai'i has for many years been incorporated into the landscaping of the resort and facilities have been erected close by, well within an 8 m buffer. In this type of closely-managed situation, a physical buffer around Pō'o Hawai'i is not particularly useful. Instead, access to the pond will be restricted by interpretive signs that will be developed and installed after they have been reviewed and approved by SHPD. The signs will ask that visitor respect the pond by staying away from its margins and not entering the water.

5 Inadvertent Discovery Procedures

Section 13–300–2 of Title 13, Subtitle 13, Chapter 300, *Rules of Practice and Procedure Relating to Burial Sites and Human Remains* defines a burial treatment plan to mean a plan that meets all necessary requirements as set forth in this chapter and which proposes treatment of burial sites, including preservation in place or relocation, submitted to the department or council, whichever is appropriate, for a determination. The primary contractor responsible for restoration of Mākole'ā and Kapuanoni *heiau* is Fields Masonry, which is led by Master Mason Billy Fields. This burial treatment plan provides the steps to be followed in the event of inadvertent discoveries of human remains at the project site.

Excavations conducted throughout the restoration efforts of both Mākole'ā and Kapuanoni *heiau* shall be monitored by a qualified archaeologist and a cultural resource specialist. In the event what skeletal remains are inadvertently discovered, the following steps shall take place:

(a) All activity in the immediate area of the discovery shall cease and the monitoring archaeologist and cultural resource specialist shall establish a protective boundary around the area.

(b) The monitoring archaeologist and cultural resource specialist shall determine whether the bones are human by observing the presence of determinative bones such as an intact skull, mandible or the presence of human teeth. All efforts shall be undertaken to keep the bones in place and to utilize only minimal and non-intrusive means so as not to further disturb the remains. Clean muslin cloth shall be used to cover the bones in order to minimize exposure.

(c) The monitoring archaeologist and cultural resource specialist shall attempt to determine whether there is a single skeleton or whether there are multiple skeletons present, all the while being careful to keep the bones in place wherever possible and utilizing only minimal and non-intrusive efforts so as not to further disturb the remains.

(d) Where the bones are determined to be human, the monitoring archaeologist and cultural resource specialist shall determine whether the remains originated from a burial site over 50 years old. All efforts shall be undertaken to be careful and respectful when handling the human skeletal remains.

(e) Where it is determined that the burial site is over 50 years old, the monitoring archaeologist and cultural resources specialist shall immediately notify the landowner representative Cultural Resource Specialist Mahealani Pai and inform him that (1) human skeletal remains have been inadvertently discovered; (2) the remains originate from a burial site over 50 years old; (3) there is either a single skeleton or multiple skeletons present; and (4) to immediately notify the SHPD of the inadvertent discovery and await instructions as to proper treatment.

(f) Following notification to SHPD, and with its permission, the monitoring archaeologist and cultural resource specialist shall undertake efforts to determine the ethnicity of the human skeletal remains and to present their findings to SHPD for a final determination.

(g) The monitoring archaeologist and cultural resource specialist shall undertake efforts to recover any disturbed skeletal remains and to maintain preservation in place

wherever possible until a final determination is made by the SHPD as to proper treatment.

(h) Cultural Resources Specialist Mahealani Pai shall conduct consultations regarding the inadvertent discovery with Native Hawaiian organizations identified in the Preservation Plan and those families with ties to mahele awards in Kahalu'u and connections to Mākole'ā and Kapuanoni *heiau* and Po'o Hawai'i including descendants of Kahulamū to discuss 1) whether the remains are those of an ancestral Native Hawaiian; and 2) whether the remains should be left in place where buried originally and protected from disturbance or relocated.

(i) Short term protection measures shall be undertaken to immediately protect the human remains and recommendations for in place preservation and long term protection shall be made for SHPD consideration and final determination.

(j) A report shall be prepared by the monitoring archaeologist and cultural resource specialist and submitted to SHPD that summarizes the inadvertent discovery, the steps taken with regard to the interim treatment of the human skeletal remains and shall include recommendations with regard to ethnicity and the proper short term and long term treatment of the remains and burial site(s).

(k) Once SHPD renders a final determination regarding the ethnicity of the human skeletal remains and whether to preserve in place or relocate, the monitoring archaeologist, cultural resource specialist and Fields Masonry shall implement the final treatment measures for the human skeletal remains and burial site(s) including implementation of all long term protective measures.

(l) Any additional consultation shall be undertaken with identified descendants and the interested parties identified above including such issues as access to the burial site(s) and landscaping. Should the SHPD decide to relocate, further consultations will be necessary.

Glossary

Entries for Hawaiian words are excerpted or paraphrased, where possible, from the *Hawaiian Dictionary* [9], or from Lucas [7].

ahupua'a Traditional Hawaiian land division usually extending from the uplands to the sea.

ali'i Chief, chiefess, officer, ruler, monarch, peer, head man, noble, aristocrat, king, queen, commander.

heiau Traditional Hawaiian place of worship.

ki'i Image, statue, picture, photograph, drawing, diagram, illustration, likeness, cartoon, idol, doll, petroglyph.

māhele Land division of 1848.

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Appendix D Observations of Geotechnical Survey by Hirata and Associates, Inc.

At the request of KYA Design Group and Kamehameha School (KS), CSH accomplished archaeological observations of the geotechnical survey conducted for the project by Hirata and Associates, Inc. The fieldwork component of the archaeological observations was accomplished on March 20, 2014 through March 27, 2014 by CSH archaeologist Johnny Dudoit, B.A., under the general supervision of Hallett H. Hammatt, Ph.D. (principal investigator). The fieldwork required approximately six person days to complete. The CSH archaeologist’s role was similar to that of an archaeological monitor. The purpose of the observation work was to provide CSH and the client with valuable data regarding the project area sediments, which could provide context to the other findings of the AIS fieldwork. Furthermore, if any cultural deposits were located, CSH would document and provide analysis of these materials within the present report.

The fieldwork consisted of on-site observation of geotechnical boring (drilling) and subsequent core sample extraction or percolation tests. The geotechnical survey involved completion of 11 bore tests (B1 through B11) for the collection of core samples and six percolation tests (P1 through P6) (Figure D-1). The bore tests were undertaken in both paved and grassy/unpaved areas within the project area. The percolation tests all occurred in areas with existing asphalt surfaces.

The geotechnical bore tests were drilled to depths ranging between 2.74 m (9.0 ft) to 5.79 m (19.0 ft) with a consistent diameter of 0.10 m (4.0 in). Figure D-2 shows the drill rig working at B-8, while Figure D-3 shows the subsequent coring at that location. Figure D-4 shows an example of a completed bore. Once the cores were collected, they were extracted and the contents were examined on site. When the contents were released all of the sediments overlying bedrock mixed, so that the individual layers could not be clearly observed and documented. However, the sedimentary materials were examined for cultural materials, and none were observed. The bedrock portions of the core samples were photographed, sometimes in two or three unique sections depending on the overall length of the sample. Included herein are photos of each bedrock sample (or the photo of the uppermost section of the sample where it was subdivided), with the depth range of that portion of the sample (Figure D-7 to Figure D-16).

The geotechnical survey indicates that the project area is underlain by porous to dense basalt bedrock. Occasionally the bedrock appears as a reddish cinder material (see for example Figure D-13). The extracted cores indicate the upper limits of bedrock ranging from approximately 0.61 to (3.05 m 1.0 to 10.0 ft) below surface. Areas with the deepest upper bedrock limits were at the hotel (B-2 and B-3). The shallowest bedrock surfaces were encountered in the central and southern portions of the project area (B-4, B-5, B-6 and B-9).

Since the percolation tests utilized the same drill rig, they exhibited a similar diameter. The percolation tests were drilled to a consistent depth of 0.91 m (3.0 ft). Upon completion of drilling, a section of pipeline was inserted into the hole and filled with water, to observe the resulting drainage (Figure D-17 to Figure D-23). No cultural materials were observed in the extracted sediments.

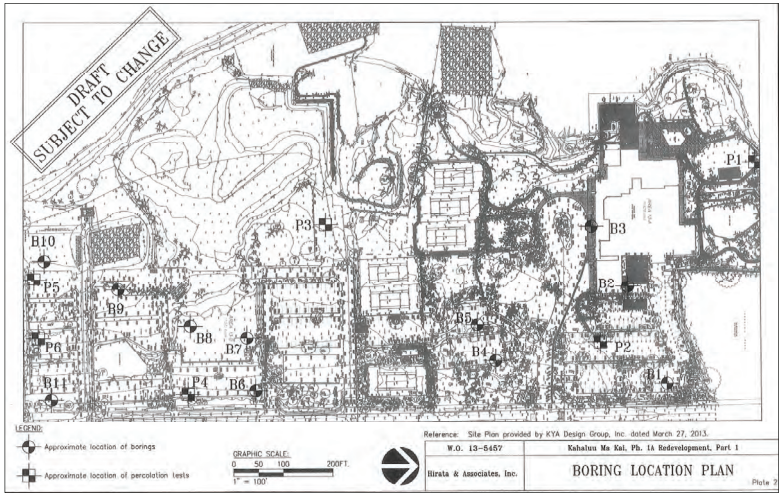

Figure D-1. Geotechnical Boring and Percolation Testing Location Plan (Courtesy of the Client)

Figure D-2. Photo showing the drill rig working at B-8; view to southwest

Figure D-3. Photo showing core sampling at B-8; view to southwest

Figure D-4. Photo showing an example of a completed geotechnical bore test (B-7), measuring 0.10 m (4.0 in) in diameter; view to west

Figure D-5. Photo showing an example of a completed percolation test (P-2), measuring 0.10 m (4.0 in) in diameter; note the inserted pipe section; view to south

Figure D-6. Photo of bedrock portion of core sample from geotechnical bore test B-1; collected between 1.22 and 2.74 m (4.0 and 9.0 ft) below surface

Figure D-7. Photo of bedrock portion (upper section) of core sample from geotechnical bore test B-2, collected between 2.74 and 5.79 m (9.0 and 14.0 ft) below surface

Figure D-8. Photo of bedrock portion of core sample (upper section) from geotechnical bore test B-3, collected between 3.05 and 4.57 m (10.0 and 15.0 ft) below surface

Figure D-9. Photo of bedrock portion of core sample (upper section) from geotechnical bore test B-4, collected between 0.61 and 2.13 m (2.0 and 7.0 ft) below surface

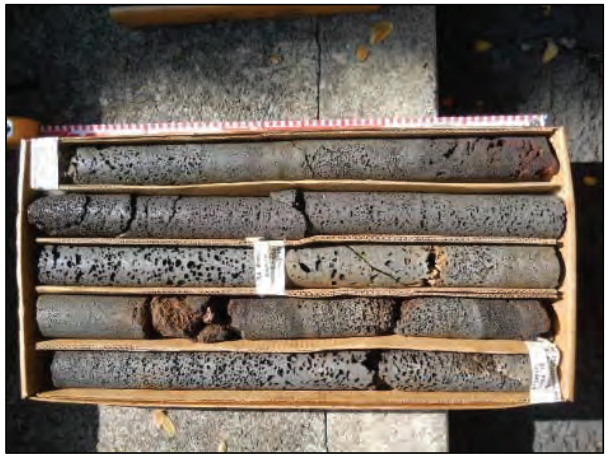

Figure D-10. Photo of bedrock portion of core sample (upper section) from geotechnical bore test B-5, collected between 0.30 and 1.83 m (1.0 and 6.0 ft) below surface

Figure D-11. Photo of bedrock portion of core sample (upper section) from geotechnical bore test B-6, collected between 0.61 and 2.13 m (2.0 and 7.0 ft) below surface

Figure D-12. Photo of bedrock portion of core sample (upper section) from geotechnical bore test B-7, collected between 1.52 and 4.57 m (5.0 to 10.0 ft) below surface

Figure D-13. Photo of bedrock portion of core sample (upper section) from geotechnical bore test B-8, collected between 1.52 and 4.57 (5.0 to 10.0 ft) m below surface

Figure D-14. Photo of bedrock portion of core sample (upper section) from geotechnical bore test B-9, collected between 0.30 and 1.82 m (3.0 and 6.0 ft) below surface

Figure D-15. Photo of bedrock portion of core sample (upper section) from geotechnical bore test B-10, collected between 1.22 and 4.27 m (4.0 and 9.0 ft) below surface

Figure D-16. Photo of bedrock portion of core sample (upper section) from geotechnical bore test B-11, collected between 0.91 and 2.44 m (3.0 and 8.0 ft) below surface

Figure D-17. Photo of completed percolation test P-1; view to east

Figure D-18. Photo of completed percolation test P-2; view to south

Figure D-19. Photo of completed percolation test P-3; view to south

Figure D-20. Photo of completed percolation test P-4; view to east

Figure D-21. Photo of completed percolation test P-5; view to the south

Figure D-22. Photo of completed percolation test P-6; view to east

Appendix E Pollen/Starch Grain Analysis

POLLEN AND STARCH GRAIN ANALYSIS ON SAMPLES FROM KAHALUU AHUPUA'A, HAWAI'I ISLAND

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PaleoResearch Institute Technical Report 14-028

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INTRODUCTION

As part of the excavation of the project area in Kahaluu Ahupua'a, sediment cores were extracted from open air water wells of unknown age. Three segments were sampled at various depths (between 17 and 35 cm) from two different cores and submitted for pollen and starch analysis. The sediment in the samples is composed of organic-rich loam with large seed pods and some detritus material visible (Trevor Yucha, personal communication, March 3, 2014).

METHODS

Pollen

Due to the highly organic nature of these samples, our normal chemical extraction technique was modified. Approximately 0.625 cubic centimeters (cc) of organic-rich sediment was selected for each sample, which received a small amount of hydrochloric acid (10%) to remove any calcium carbonates present in the soil. Next the samples were screened through 250-micron mesh. The samples were allowed to settle for 2 hours, after which the supernatant was poured off and the samples were transferred to 50-ml tubes. The samples then received a 30 minute treatment in hot hydrofluoric (HF) acid to remove inorganic particles. Next, the samples were acetylated for 10 minutes to remove extraneous, non-pollen organic matter.

A light microscope was used to count pollen at a magnification of 500x. Pollen preservation in these samples varied from good to poor. Comparative reference material collected at the Intermountain Herbarium at Utah State University, the University of Colorado Herbarium, and the Bishop Museum Herbarium was used to identify the pollen to the family, genus, and species level, where possible.

Pollen aggregates were recorded during identification of the pollen. Aggregates are clumps of a single type of pollen and may be interpreted to represent either pollen dispersal over short distances or the introduction of portions of the plant represented into an archaeological setting. The aggregates were included in the pollen counts as single grains, as is customary. The presence of aggregates is noted by an "A" next to the pollen frequency on the percentage pollen diagram. The percentage pollen diagram was produced using Tilia 2.0 and TGView 2.0.2. Total pollen concentrations were calculated in Tilia using the quantity of sample processed in cubic centimeters (cc), the quantity of exotics (spores) added to the sample, the quantity of exotics counted, and the total pollen counted and expressed as pollen per cc of sediment.

"Indeterminate" pollen includes pollen grains that are folded, mutilated, or otherwise distorted beyond recognition. These grains were included in the total pollen count since they are part of the pollen record.

DISCUSSION

The site at Kahaluu Ahupua'a lies directly on the western coast of Hawai'i Island and is surrounded by development. Modern vegetation is composed primarily of non-native species and open lawns (Trevor Yucha, personal communication, March 3 2014). Three samples collected from sediment cores extracted from open air water wells of unknown ages were submitted for pollen and starch analysis (Table 1).

The pollen record from these three samples is dominated by fern spores and foraminifera (Figure 1, Table 2), registering wet conditions that include contact with at least brackish water. Recovery of moderate to moderately large quantities of *Cocos nucifera* and *Pritchardia* pollen record coastal vegetation that includes coconut trees and loulu palms. In addition, Rhamnaceae and *Straussia*-type pollen, noted in the two samples from Core 2, indicate that a member of the buckthorn family and *kopiko kea* also grew in the area. Cheno-am pollen was most abundant in sample 3A, collected from Core 3. Shrubby *'aheahea* grows in relatively dry sediments or sediments near the coast with good drainage. Cheno-am pollen was less abundant in samples from Core 2. *Dodonaea* pollen was observed in both Core 2 samples, but not in the sample from Core 3. *A'ali'i* also grows in relatively dry vegetation communities. Pollen from legumes (Fabaceae) was observed only in sample 4C. *Ilex* pollen was recovered in sample 3A, documenting local growth of introduced or alien holly, or yerba mate. *Myrsine* pollen also was noted in sample 4C, indicating local (or regional) growth of *kōlea*.

Low-growing herbaceous plants that formed part of the local vegetation community are represented by *Boerhavia*-type, Cyperaceae, *Heliotropium*, Asteraceae, and Poaceae pollen, representing *alena*, one or more plants in the sedge family, *hinahina*, a member of the sunflower family, and grasses. *Alena* would have been part of the coastal vegetation community. In addition, recovery of a small quantity of *Typha* pollen in sample 4B represents cattails growing as part of a riparian vegetation community. No starch grains were observed in the core samples.

SUMMARY AND CONCLUSIONS

While there are variations in the pollen record, the overall impression of local vegetation is similar in the two samples from Core 2. The local vegetation community, represented in all three samples, included both grasses and sedges as dominant elements, growing either in relatively wet areas or on local sediments. In addition, *alena* varied in quantity, being most abundant at the time represented by sample 4B from Core 2. *Loulu hiwa* grew as part of the coastal vegetation. Shrubby vegetation included *'aheahea* and *a'ali'i* as the most abundant. The local wetland is represented by *Typha* pollen recovered in sample 4B from Core 2. Monolete spores and a few Dicksoniaceae and trilete spores document local growth of ferns and provide further evidence of relatively wet conditions. Recovery of Foraminifera from all three samples indicates the presence of at least brackish water and growth of these organisms in sediments or substrate that was either occasionally inundated or perhaps was inundated at a later time. No starches were observed in the samples.

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TABLE 1
PROVENIENCE DATA FOR SAMPLES FROM KAHALUU AHUPUA'A, HAWAI'I ISLAND

Sample No.	Unit	Stratum	Depth (cmbs)	Provenience/ Description	Analysis
3A	Core 3	II	17-20	Sample from within sediment core, extracted from open air water wells of unknown age.	Pollen Starch
4B	Core 2	II	20-25	Sample from within sediment core, extracted from open air water wells of unknown age.	Pollen Starch
4C	Core 2	II	32-35	Sample from within sediment core, extracted from open air water wells of unknown age.	Pollen Starch

3

TABLE 2
POLLEN TYPES OBSERVED IN SAMPLES FROM KAHALUU AHUPUA'A, HAWAI'I ISLAND

Scientific Name	Common Name	Nat	Pol	End	Ind
TREES:					
Cocos nucifera	Coconut, *Niu, alolani*		x		
Pritchardia	Loulu palm, *Loulu hiwa*			x	
Rhamnaceae	Buckthorn family	x		x	x
Straussia-type	*Kopiko kea*				x
SHRUBS:					
Cheno-am	*Achyranthes, Chenopodium oahuense, Amaranthus, Charpentiera*, etc.	x		x	
Dodonaea viscosa	*A'ali'i, ('a'ali'i kū makani, 'a'ali'i kū ma kua, kūmakani*)				x
Fabaceae	Legume or pea family	x	x	x	x
Ilex aquifolium and *Ilex paraguariensis*	English or European holly, yerba mate, Paraguay tea	x			
Myrsine	*Kōlea, 'Ōliko, Kōlea lau nui, Kōlea lau li'i*			x	
HERBS:					
Boerhavia	*Alena, anena, nena*	x			x
Cyperaceae	Sedge family	x		x	x
Heliotropium	*Hinahina, hinahina ku kahakai, kipukai, lau po'opo'ohina, nena*, Seaside heliotrope	x			x
High-Spine Asteraceae	Sunflower family; Includes *Bidens*	x		x	x
Poaceae	Grass family	x		x	x
Typha domingensis or *angustata*	Cattail	x			
ALIENS:					
Leucaena	*Kao-haole ('ekoa, lilikoa*)	x			
Indeterminate	Too badly deteriorated to identify				
SPORES:					
Dicksoniaceae	Tree fern family			x	x
Monolete bumpy					

4

TABLE 2 (Continued)

Scientific Name	Common Name	Nat	Pol	End	Ind
Monolete smooth					
Trilete smooth					
OTHER:					
Spirogyra	Algal body representing a filamentous green algae common in freshwater habitats				
Foraminifera	Forams, single-celled protists with shells				
Scolecodont	Worm jaw				
Total Pollen Concentration	Quantity of pollen per cubic centimeter (cc) of sediment				

Plant names and information derived from (Wagner et al. 1990)
Fern (spore) names derived from (Selling 1946)

Nat = Naturalized
Pol = Polynesian introduction
End = Endemic
Ind = Indigenous

Pollen identifications to species were made based on the fact that only one species is reported by (Wagner, et al. 1990). Species identification was not made based on morphologic characteristics observed under the microscope.

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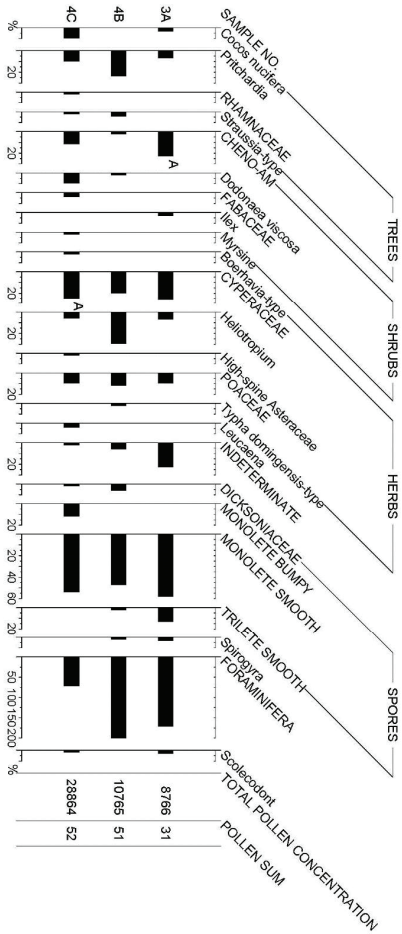

FIGURE 1. POLLEN DIAGRAM FOR KAHALUU AHUPUA'A, HAWAI'I.

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Appendix H

CULTURAL IMPACT ASSESSMENT

FINAL

Cultural Impact Assessment for the Kahaluʻu Ma Kai Project, Kahaluʻu Ahupuaʻa, North Kona District, Hawaiʻi Island TMKs: [3] 7-8-013:002, 013, 042, and 043

Prepared for
Helber Hastert & Fee Planners, Inc. and
Kamehameha Schools (KS)

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Prefatory Remarks on Language and Style

A Note About Hawaiian and Other Non-English Words:

Cultural Surveys Hawaiʻi (CSH) recognizes that the Hawaiian language is an official language of the State of Hawaiʻi, it is important to daily life, and using it is essential to conveying a sense of place and identity. In consideration of a broad range of readers, CSH follows the conventional use of italics to identify and highlight all non-English (i.e., Hawaiian and foreign language) words in this report unless citing from a previous document that does not italicize them. CSH parenthetically translates or defines in the text the non-English words at first mention, and the commonly used non-English words and their translations are also listed in the Appendix A: Glossary for reference.

Abbreviations

APE	Area of Potential Effect
AMSL	Above Mean Sea Level
BC	Boundary Certificate Number
BCT	Boundary Commission Testimony
CSH	Cultural Surveys Hawai‘i
DOH/OEQC	Department of Health/Office of Environmental Quality Control
HAR	Hawai‘i Administrative Rules
HRS	Hawai‘i Revised Statutes
HSRM	Hawai‘i Survey Registered Maps
LCA	Land Commission Award
RM	Registered Map
SIHP	State Inventory of Historic Properties
SHPD	State Historic Preservation Division
TCP	Traditional Cultural Property
TMK	Tax Map Key
UH	University of Hawai‘i
USGS	United States Geological Survey

Management Summary

Reference	Cultural Impact Assessment (CIA) for the Kahalu‘u Ma Kai Project, Kahalu‘u Ahupua‘a, North Kona District, Hawai‘i Island TMKs: [3] 7-8-013:002, 013, 042, and 043 (Magat, Fa‘anunu, and Hammatt 2014)
Date	May 2014
Project Number	CSH (Cultural Surveys Hawai‘i) Job Code: KAHALUU 16
Agencies	State of Hawai‘i Department of Health/Office of Environmental Quality Control (DOH/OEQC)
Project Location	The project area is located on the *makai* (seaward) side of Ali‘i Drive in the *māno wai* (water source or headwaters) of the *ahupua‘a* (traditional land division) of Kahalu‘u
Land Jurisdiction	Private, Kamehameha Schools (KS)
Project Description	The Kahalu‘u Ma Kai Project is a proposed project concerning an educational complex and cultural center in the *ahupua‘a* of Kahalu‘u, North Kona District, on the island of Hawai‘i. The project area consists of 22.73 acres of land along the Keauhou-Kahalu‘u coastline, located on the *makai* side of Ali‘i Drive in the *māno wai* of Kahalu‘u Ahupua‘a, adjacent to and immediately south of Kahalu‘u Bay on Tax Map Key (TMK) parcels: [3]-7-8-013:002, 013, 042, and 043. The former Kona Lagoon Hotel (KLH), demolished in 2004, was located on the project site and the recently closed Keauhou Beach Resort (KBR) still exists on the property. The proposed project includes the demolition of existing facilities (e.g., Keauhou Beach Resort and remnant facilities of the former Kona Lagoon Hotel) and the building of new educational complex and cultural center facility. Demolition of the Keauhou Beach Resort will require adherence to best management practices (BMP) implemented which will include an erosion control plan and will necessitate the creation of staging and stockpiling areas which will be placed entirely on the site’s existing ground surfaces (presently asphalted parking areas). The project APE does not include any area for off-site disposal or use of demolition debris as this is not contemplated as part of the overall demolition plan. However, should the demolition contractor decide to transport materials to an off-site location for storage, this material will be processed and disposed of in an appropriate manner by the demolition contractor, who will also be responsible for ensuring applicable historic preservation review as part of permits required for the use of that site.
Project Acreage	The total project acreage is approximately 22.73 acres
Area of Potential	The APE is defined as the total approximately 22.73 acres. While this

Effect (APE) and Survey Acreage	investigation focuses on the project APE, this study considered the whole *ahupua‘a* of Kahalu‘u.
Document Purpose	The project requires compliance with the State of Hawai‘i environmental review process (Hawai‘i Revised Statutes [HRS] §343), which requires consideration of a proposed project’s effect on cultural practices and resources. Through document research and ongoing cultural consultation efforts, this report provides information pertinent to the assessment of the proposed project’s impacts to cultural practices and resources (per the *Office of Environmental Quality Control’s Guidelines for Assessing Cultural Impacts*), which may include Traditional Cultural Properties (TCP) of ongoing cultural significance that may be eligible for inclusion on the State Register of Historic Places. The document is intended to support the project’s environmental review and may also serve to support the project’s historic preservation review under HRS §6E-42 and Hawai‘i Administrative Rules (HAR) §13–284
Results of Background Research	Background research for this study yielded the following results which are presented in approximate chronological order: 1. The project area, is located on the *makai* (seaward) side of Ali‘i Drive in the *māno wai* (water source or headwaters) of Kahalu‘u Ahupua‘a. Kahalu‘u literally translates to “diving place,” and is one of the most important places in all of the Hawaiian Islands. The project area with its productive fishing grounds, access to the Kona field system and other resources, is home to no less than five *heiau* (place of worship), all of highest spiritual importance, historically and in recent times, to Hawaiians. 2. Archaeological research shows the project area contains numerous culturally and historically significant sites and features including *heiau* (Hāpaiali‘i Heiau, Ke‘ekū Heiau, Mākole‘ā Heiau, Keiki Ho‘okama, Kapuanoni Heiau), Keawehala Pond, petroglyphs, fishponds, freshwater springs, and residential complex associated with *ali‘i* (Po‘o Hawai‘i). 3. Based on radiocarbon dating (Burtchard et al. 1996:54), the earliest settlement in Kona began around AD 900. The earliest settlement most likely was located around Kahalu‘u Bay with its abundant marine resources. 4. The project area is also associated with a number of ruling chiefs who made Kahalu‘u their place of residence, including Lono-i-ka-makahiki, Alapa‘inui, Kalani‘ōpu’u, and Kamehameha (Tuggle 1989:10) as well as a famous and beautiful chiefess by the name of “Makolea” (Reinecke 1930:6).

	5. The project area is associated with specific *mo‘olelo* (oral history) including, but not limited to Pāokamenehune, or the Menehune breakwall created by the *menehune* (legendary race of small people who worked only at night); the famous king sharks Kehau and Laenui, who controlled the lesser sharks to ensure no one was attacked in the waters of Kahulu‘u; Keawehala Pond (Site # Ha-D4-52) as the home of two twin *mo‘o* (lizard) sisters; “Kaao Hooniua Puuwai no Ka-Miki” (“The Heart stirring Story of Ka-Miki”) which tells the story of Ka-Miki, the quick or adept one, and his brother Maka‘iole (“rat or squinting eyes”), who traveled around the island to participate in competitions ca. the thirteenth century when Pili-a-Ka‘aiea was the chief of Kona; “Makolea,” a beautiful chiefess who was the wife of Chief Ke-paka-‘ili-‘ula” and who resided in the *heiau* that bears her name (Kekahuna 1952) and Lono-i-ka-makahiki who was the ruler of Hawai‘i Island during the sixteenth or seventeenth centuries and was involved in several famous battles with the chiefs of Maui (including Kama-lala-walu) who is said to have been put to death on Ke‘ekū Heiau and mourned by his two faithful dogs, whose spirits still guard his body even today (Stokes and Dye 1991).
Results of Community Consultation	A total of 26 people were contacted for the purposes of this CIA; seven people responded and were interviewed for more in-depth contributions. Community consultation indicates: 1. The project area and its environs, from *mauka*-to-*makai* (upland to the sea) has a long history of use by *ali‘i* and *Kānaka Maoli* (Native Hawaiians) for a variety of past and present cultural activities and gathering practices including fishing, *limu* (seaweed) gathering, and spiritual worship. Community participants stress the sacred nature of the place and convey their deep aloha for the project area’s cultural and natural resources. 2. Participants discussed natural and cultural resources including freshwater springs and anchialine ponds teeming with *‘ōpae ‘ula* (small endemic shrimp) which were used as bait; the existence of at least 30 *ku‘una* (place where a net is set in sea) in shallow waters as well as deep water *‘ōpelu ko‘a* (*Decapterus macarellus*, mackerel scad fishing grounds); the consumption and enjoyment of many kinds of fish such as *manini*, *uouo*, *maiko*, *he‘e* (octopus) during a time when fish like parrot fish was so “choke” that it was considered a “junkfish.” They gathered marine resources such as *‘opihi* (limpets), and a large variety of *limu* (seaweed, algae) used for subsistence as well as medicinal purposes and also gathered salt used to dry fish. Community interviewees shared the traditional manner of handling the dead and other burial customs, the protocol and respect accorded to *heiau* in the project area, and gender-based cultural beliefs associated with fishing

	and gathering. They shared place names for cultural and natural resources including Kilohana for a large pond which once existed, place names for each cove along the shoreline such as Imo‘ōhua, where small *manini* or *‘ōhua* would be caught, and told *mo‘olelo* about surfing in the 1950s, and what it was like to grow up in an area with *heiau* of extreme importance. 3. All the community participants expressed their support for the proposed project and the importance of cultural education for the younger generation, with Mrs. Hamm suggesting that all children, not just Hawaiian children, should be able to take advantage of this learning opportunity. 4. They approved the restoration of the *heiau* and stressed the continuing need to teach visitors the right protocol and proper respect in approaching the *heiau*. They called for the use of proper signage to teach the history of the site as well as communicate the need for respecting the area. 5. The majority of the study participants agreed to limiting public access and called for customary fishing rights to be part of the practice of the heritage center. Those living outside the *ahupua‘a* must first ask for permission to fish, and the same should be done for the use of the project area for funeral services. 6.The study participants would like to continue to participate in maintaining the *heiau* and expressed their willingness to be involved in the future operation of the heritage center, emphasizing their aloha for the place and their desire to perpetuate Native Hawaiian culture.
Recommendations	The following recommendations are based on a synthesis of all the information gathered during preparation of this CIA. Faithful attention to these recommendations, and efforts to develop appropriate measures to address these concerns, will help mitigate the adverse impacts of the proposed action on Hawaiian cultural beliefs, practices and resources by the project. 1. In light of statements made by the majority of the participants in this study that there may be burial sites or *iwi kūpuna* (ancestral remains) in the *makai* (seaward) portion of the project area, it is recommended that: a) lineal and cultural descendants will be identified and consulted in accordance with applicable laws; b) personnel involved in development activities in the project area should be informed of the possibility of inadvertent cultural finds, including human remains; c) any development of the *makai* area should be limited and the sand dunes and beach area should be left alone; d) any potential development should be limited to minimally invasive infrastructure; e) should cultural or burial sites be identified during ground disturbance,

	all work should immediately cease, and the appropriate agencies notified pursuant to applicable law. 2. Community members affiliated with the area both genealogically and culturally should be consulted regarding the preservation, restoration, and interpretation of cultural resources including archaeological sites, caves, petroglyphs, trails, possible burials, and other features. 3. As part of active management, visitor/resident education should be provided to encourage proper behavior and protocol to assist in the protection, appreciation, and enjoyment of natural and cultural features.

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Section 1 Introduction

1.1 Project Background

At the request of Helber Hastert & Fee Planners, Inc. and Kamehameha Schools (KS), Cultural Surveys Hawai‘i, Inc. (CSH) has conducted a cultural impact assessment (CIA) for the establishment of the Kahalu‘u Ma Kai project, an educational complex and cultural center in the *ahupua‘a* (land division usually extending from the uplands to the sea) of Kahalu‘u, North Kona District, on the island of Hawai‘i. The project area consists of 22.73 acres of land along the Keauhou-Kahalu‘u coastline. The 22.73-acre project area is located on the *makai* (seaward) side of Ali‘i Drive in the *māno wai* (water source or headwaters) of Kahalu‘u Ahupua‘a, adjacent to and immediately south of Kahalu‘u Bay on Tax Map Key (TMK) parcels: [3]-7-8-013:002, 013, 042, and 043. The former Kona Lagoon Hotel (KLH), demolished in 2004, was located on the project site and the recently closed Keauhou Beach Resort (KBR) still exists on the property. The project area is depicted in Figure 15.

The proposed project includes the demolition of existing facilities (e.g., Keauhou Beach Resort and remnant facilities of the former Kona Lagoon Hotel) and the building of new cultural educational facilities.

Demolition of the Keauhou Beach Resort will require adherence to best management practices (BMP) which include an erosion control plan and will necessitate the creation of staging and stockpiling areas which will be placed entirely on the site’s existing ground surfaces (presently asphalted parking areas). The project APE does not include any area for the off-site disposal or use of demolition debris as this is not contemplated as part of the overall demolition plan. However, should the demolition contractor decide to transport materials to an off-site location for storage, this material will be processed and disposed of in an appropriate manner by the demolition contractor, who will also be responsible for ensuring applicable historic preservation review as part of permits required for the use of that site.

The redevelopment of the site as a natural, cultural, and historical educational complex, referred to Kahalu‘u Ma Kai, is illustrated in Figure 5 and will include the following:

- Outdoor classrooms and interpretation areas
- Cultural *hālau* (school)
- Canoe making and wood carving sheds
- Heritage center for visitors
- Multi-purpose building
- Accessory facilities
- Improved open space and landscaping
- Overnight camping accommodations

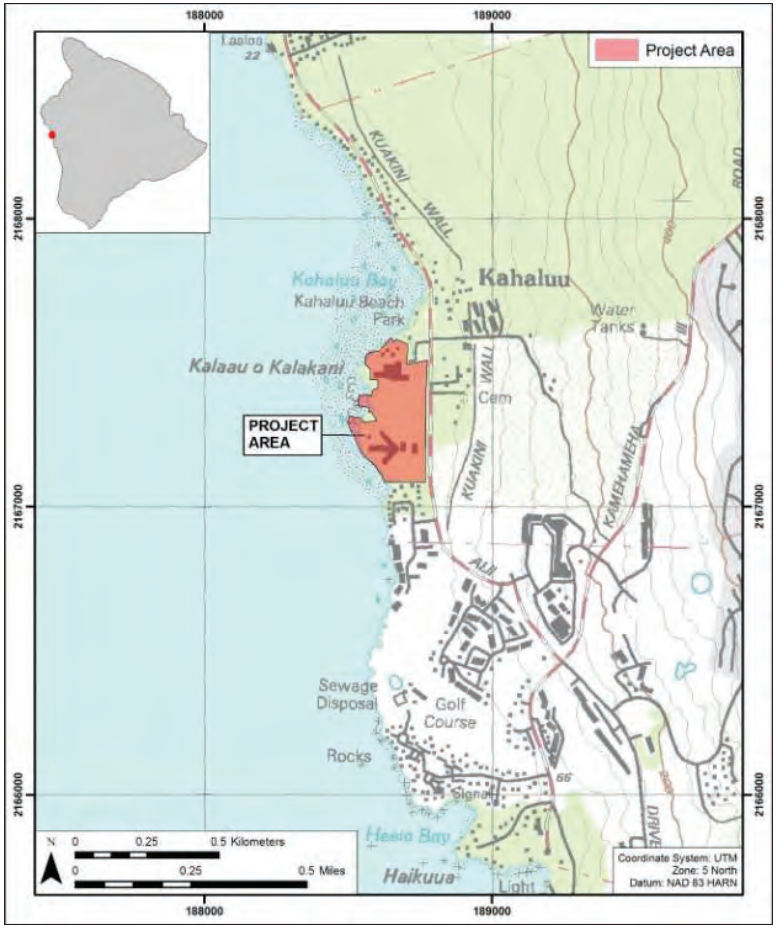

Figure 1. Portion of 1996 USGS topographic map showing the proposed project area

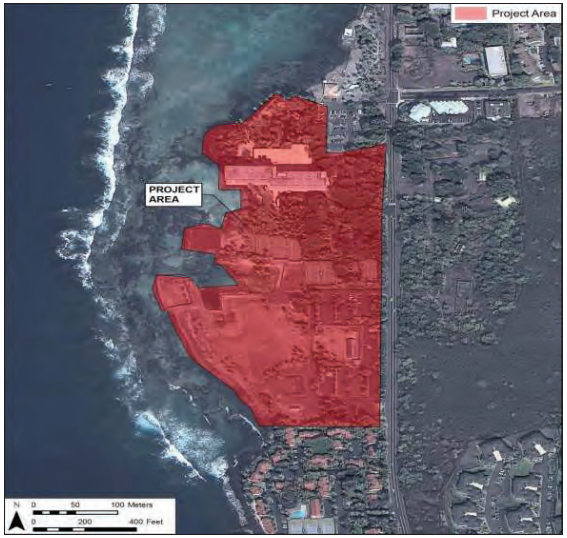

Figure 2. Aerial photograph showing the project area (Google Earth 2010)

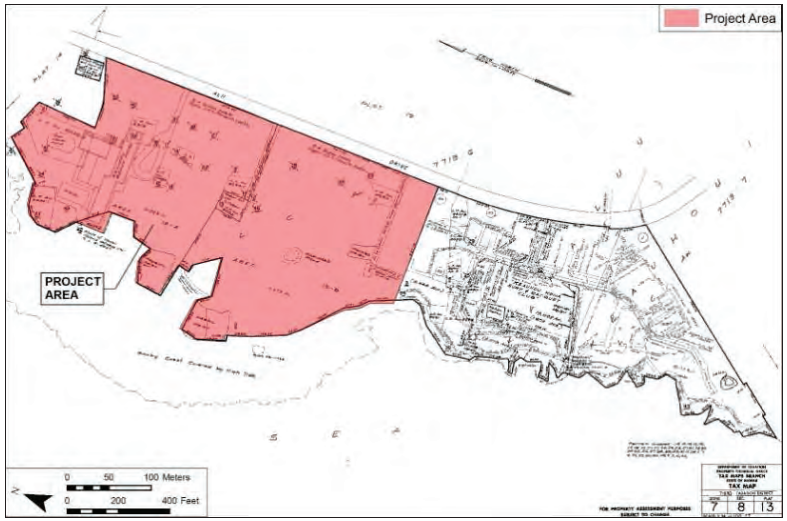

Figure 3. TMK map of the proposed project (Hawai‘i TMK Service 2009)

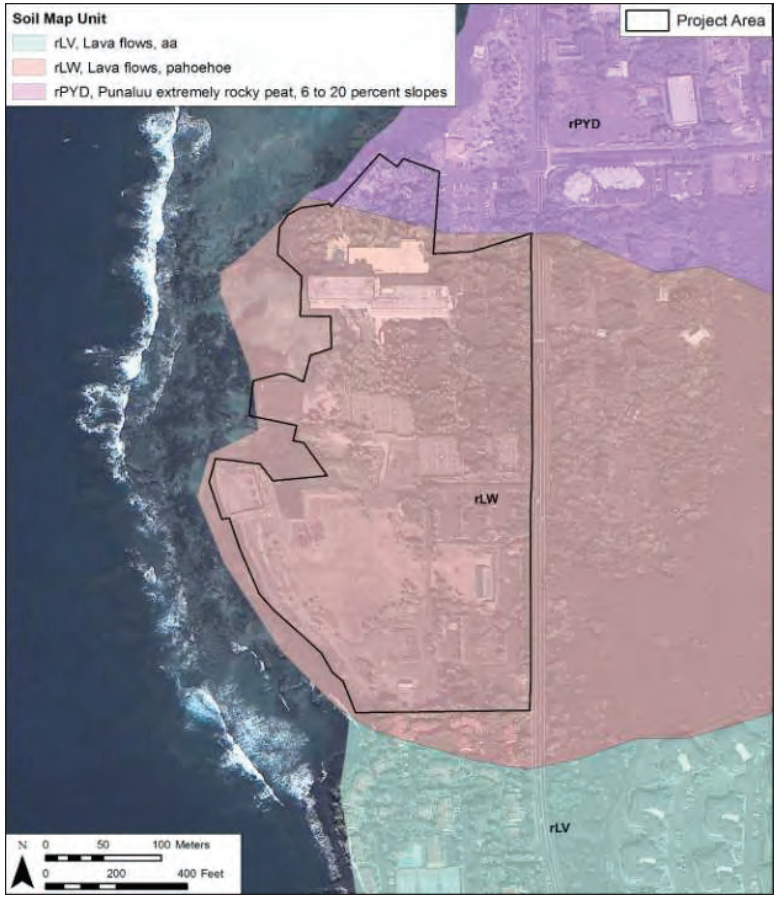

Figure 4. Aerial photograph (Google Earth 2010) overlain with *Soil Survey* data (Sato et al. 1973), showing the land and soil types within the project area

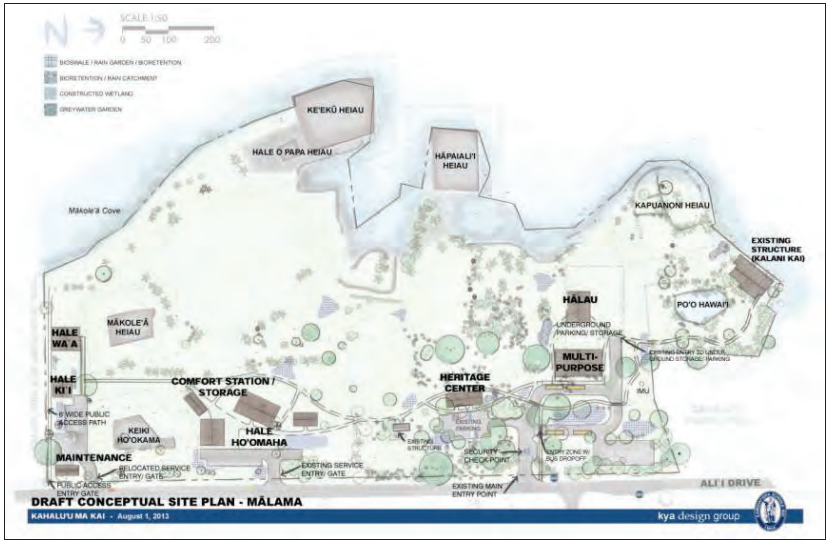

Figure 5. Kahalu‘u Ma Kai redevelopment plans (courtesy of client)

The Kahalu‘u Ma Kai project will support KS programs and users such as the Keauhou-Kahalu‘u Education Group (KKEG). Other KS collaborators that may use the site include government agencies, education institutions, for-profit entities, and non-profit and community-based organizations.

1.2 Document Purpose

The project requires compliance with the State of Hawai‘i environmental review process (Hawai‘i Revised Statutes [HRS] §343), which requires consideration of a proposed project’s effect on cultural practices. CSH is conducting this CIA at the request of Helber Hastert & Fee Planners, Inc. and Kamehameha Schools (KS). Through document research and ongoing cultural consultation efforts this report provides information pertinent to the assessment of the proposed project’s impacts to cultural practices and resources (per the *Office of Environmental Quality Control’s Guidelines for Assessing Cultural Impacts*), which may include Traditional Cultural Properties (TCP) of ongoing cultural significance that may be eligible for inclusion on the State Register of Historic Places, in accordance with Hawai‘i State Historic Preservation Statute (§6E-42) guidelines for significance criteria (Hawai‘i Administrative Rules [HAR] §13–284) under Criterion “e” which states that to be significant an historic property shall:

> Have an important value to the Native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity.

The document is intended to support the project’s environmental review and may also serve to support the project’s historic preservation review under HRS §6E-42 and HAR §13-284.

1.3 Scope of Work

The scope of work for this CIA includes the following:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities, and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation and interviews with knowledgeable parties regarding cultural and natural resources and practices at or near the parcel, present and past uses of the parcel, and/or other practices, uses, or traditions associated with the parcel and environs.
4. Preparation of a report summarizing the results of these research activities and providing recommendations based on findings.

1.4 Natural Environment

The 22.73-acre property is located at sea level on the *makai* side of Ali‘i Drive in the *māno wai* (water source or headwaters) of Kahalu‘u Ahupua‘a. The project area includes large areas extensively altered by the construction of the Keauhou Beach Resort (KBR) and the former Kona Lagoon Hotel. A brackish water pond known as Po‘o Hawai‘i is located just north of the main hotel building that exists on the property and a small brackish water ponded area, resulting from discharge, is located northwest of the project area. Extending from the small brackish ponded area is a shallow intermittent channel which flows into tidal pools. The coastline consists mostly of a flat *pāhoehoe* (smooth, unbroken type of lava) bedrock shelf with very large boulders and numerous shallow tidal pools that extend into the surge zone. A small bay with a rocky sand beach is located on the southern end of the project area. Kahalu‘u Beach Park, a marine protected area and a well known tourist attraction, is located immediately adjacent to and north of the project area. Vegetation consists mainly of landscaping plants—exotic ornamentals with scattered native trees and shrubs—including manicured grass lawns.

The project area is almost entirely underlain by *pāhoehoe* lava flows (rLW), with a small portion to the north covered by soils of the Punalu‘u Series (rPYD), Punalu‘u extremely rocky peat, 6 to 20% slopes (Figure 4). The mean annual temperature within the project area is approximately 75 degrees Fahrenheit, and rainfall ranges between 30 to 40 inches per year (Juvik and Juvik 1998:57).

1.5 Built Environment

1.5.1 Built Environment

The project area is situated in the Kahalu‘u Historic District (State Inventory of Historic Properties [SIHP # 50-10-37-04150, also on the National Register of Historic Places [NRHP]). The study area is bounded by Kahalu‘u Beach Park to the north, the Keauhou Kona Surf and Racquet Club to the south, Ali‘i Drive to the east, and the Pacific Ocean to the west. Presently the northern portion of the project area includes the KBR, which ceased operation in October 2012, and related development (e.g., driveways, parking lots, tennis courts, swimming pool, comfort stations, pump station). Additionally, the project area contains pre-Contact and historic structures that represent archaeological sites, or historic properties. Five *heiau* (pre-Christian places of high worship) are present. Three of the *heiau* have recently undergone restoration work: Hāpaiali‘i Heiau, located south of Kahalu‘u Beach Park; Ke‘ekū Heiau, situated 150 ft southwest of Hāpaiali‘i Heiau; and Mākole‘ā Heiau southeast of Ke‘ekū Heiau. Hāpaiali‘i Heiau is located on the same tidal flat as Ke‘ekū Heiau and is encircled by the breakwater at high tide. East of Ke‘ekū Heiau, rock walls have been constructed to prevent seawater from flooding into the vicinity of the former Keawehala Pond at high tide.

Section 2 Methods

2.1 Overview

The following section summarizes the methods used to garner information on the traditional history, written history, archaeology, and contemporary Native Hawaiian practices and resources of the project area and the larger Kahalu‘u Ahupua‘a for this CIA.

2.2 Archival Research

Historical documents, maps, and existing archaeological information pertaining to the project area were researched at the CSH library and other archives including the University of Hawai‘i at Mānoa’s Hamilton Library, the State Historic Preservation Division (SHPD) library, the Hawai‘i State Archives, the State Land Survey Division, and the Bishop Museum Archives. Previous archaeological reports for the area were reviewed, as were historic maps and photographs and primary and secondary historical sources. Information on Land Commission Awards (LCAs) was accessed through Waihona ‘Aina Corporation’s Māhele database (Waihona ‘Aina 2009) as well as a selection of CSH library references.

For cultural studies, research for the Traditional Background section centered on Hawaiian activities including religious and ceremonial knowledge and practices; traditional subsistence land use and settlement patterns; gathering practices and agricultural pursuits; as well as Hawaiian place names and *mo‘olelo* (stories, oral traditions), *mele* (songs), *oli* (chants), *‘ōlelo no‘eau* (proverbs) and more. For the Historic Background section, research focused on land transformation, development, and population changes beginning in the early post–Western Contact era to the present day (see Scope of Work above).

2.3 Community Consultation

2.3.1 Sampling and Recruitment

A combination of qualitative methods including purposive, snowball, and expert (or judgment) sampling, were used to identify and invite potential participants to the study. These methods are used for intensive case studies, such as CIAs, to recruit people who are hard to identify, or are members of elite groups (Bernard 2006:190). Our purpose is not to establish a representative or random sample. It is to “identify specific groups of people who either possess characteristics or live in circumstances relevant to the social phenomenon being studied . . . This approach to sampling allows the researcher deliberately to include a wide range of types of informants and also to select key informants with access to important sources of knowledge” (Mays and Pope 1995:110).

We began with purposive sampling informed by referrals from known specialists and relevant agencies. For example, we contacted the SHPD, Office of Hawaiian Affairs, Hawai‘i Island Burial Council (HIBC), and community and cultural organizations in the North Kona District for their brief response/review of the project and to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the study area and vicinity, cultural and lineal

descendants of Kahalu‘u, and other appropriate community representatives and members. For this report, CSH also worked with Kamehameha Schools who had identified descendants connected genealogically to the project area based on their outreach for the last five years.

Based on their in-depth knowledge and experiences, these key respondents then referred CSH to additional potential participants who were added to the pool of invited participants. This is snowball sampling, a chain referral method that entails asking a few key individuals (including agency and organization representatives) to provide their comments and referrals to other locally recognized experts or stakeholders who would be likely candidates for the study (Bernard 2006:192). CSH also employs expert or judgment sampling which involves assembling a group of people with recognized experience and expertise in a specific area (Bernard 2006:189–191). CSH maintains a database that draws on over two decades of established relationships with community consultants: cultural practitioners and specialists, community representatives, and cultural and lineal descendants. The names of new potential contacts were also provided by colleagues at CSH and from the researchers’ familiarity with people who live in or around the study area. Researchers often attend public forums (e.g., Neighborhood Board, Burial Council, and Civic Club meetings) in (or near) the study area to recruit participants. Please refer to Table 5, Section 6, for a complete list of individuals and organizations contacted for this CIA.

CSH focuses on obtaining in-depth information with a high level of validity from a targeted group of relevant stakeholders and local experts. Our qualitative methods do not aim to survey an entire population or subgroup. A depth of understanding about complex issues cannot be gained through comprehensive surveying. Our qualitative methodologies do not include quantitative (statistical) analyses, yet they are recognized as rigorous and thorough. Bernard (2006:25) describes the qualitative methods as “a kind of measurement, an integral part of the complex whole that comprises scientific research.” Depending on the size and complexity of the project, CSH reports include in-depth contributions from about one-third of all participating respondents. Typically this means three to 12 interviews.

2.3.2 Informed Consent Protocol

An informed consent process was conducted as follows: 1) before beginning the interview the CSH researcher explained to the participant how the consent process works, the project purpose, the intent of the study and how his/her information will be used; 2) the researcher gave him/her a copy of the Authorization and Release Form to read and sign (Appendix B); 3) if the person agreed to participate by way of signing the consent form or providing oral consent, the researcher started the interview; 4) the interviewee received a copy of the Authorization and Release Form for his/her records, while the original was stored at CSH; 5) after the interview was summarized at CSH (and possibly transcribed in full), the study participant was afforded an opportunity to review the interview notes (or transcription) and summary and to make any corrections, deletions, or additions to the substance of their testimony/oral history interview; this was accomplished either via phone, post or email or through a follow-up visit with the participant; 6) the participant received the final approved interview and any photographs taken for the study for record. If the participant was interested in receiving a copy of the full transcript of the interview (if there is one, as not all interviews are audio-recorded and transcribed), a copy was provided. Participants were also given information on how to view the report on the OEQC website and offered a hardcopy of the report once the report is a public document.

If an interviewee agreed to participate on the condition that his/her name is withheld, procedures are taken to maintain his/her confidentiality.

2.3.3 Interview Techniques

To assist in discussion of natural and cultural resources and cultural practices specific to the study area, CSH initiated semi-structured interviews (as described by Bernard 2006), asking questions from the following broad categories: gathering practices and *mauka* and *makai* resources, burials, trails, historic properties, and *wahi pana* (storied places). The interview protocol is tailored to the specific natural and cultural features of the landscape in the study area, identified through archival research and community consultation. For example, for this Kahalu‘u *makai* study, fishing, *ala hele* (trails), and limu gathering were emphasized over other categories less salient to project participants. These interviews and oral histories supplement and provide depth to consultations from government agencies and community organizations that may provide brief responses, reviews and/or referrals gathered via phone, email, and occasionally face-to-face commentary.

2.3.3.1 In-depth Interviews and Oral Histories

Interviews were conducted initially at a place of the study participant’s choosing (usually at the participant’s home or at a public meeting place) and/or—whenever feasible—during site visits to the project area. Generally, CSH’s preference is to interview a participant individually or in small groups (two–four); occasionally participants are interviewed in focus groups (six–eight). Following the consent protocol outlined above, interviews may be recorded on tape and in handwritten notes, and the participant photographed. The interview typically lasts one to four hours, and records the who, what, when, and where of the interview. In addition to questions outlined above, the interviewee is asked to provide biographical information (e.g., connection to the study area, genealogy, professional and volunteer affiliations).

2.3.3.2 Field Interviews

Field interviews are conducted with individuals or in focus groups comprised of *kūpuna* and *kama‘āina* who have a similar experience or background (e.g., members of an area club, elders, fishermen, hula dancers) who are physically able and interested in visiting the project area. In some cases, field visits are preceded with an off-site interview to gather basic biographical, affiliation, and other information about the participant. Initially, CSH researchers usually visit the project area to become familiar with the land and recognized (or potential) cultural places and historic properties in preparation for field interviews. All field activities are performed in a manner so as to minimize impact to the natural and cultural environment in the project area. Where appropriate, Hawaiian protocol may be used before going on to the study area and may include the *ho‘okupu* (offering) of *pule* (blessing) and *oli*. All participants on field visits are asked to respect the integrity of natural and cultural features of the landscape and not remove any cultural artifacts or other resources from the area.

2.3.4 Study Limitations

Cultural impact assessments are limited by the time frame and costs of the study as well as community participation. Often, researchers have little control over the time frame or budget

available for a project but may have more discretion over study design and the methodologies employed to elicit public participation. Various factors may affect participation, such as the availability of contact information for community members during the recruitment process, the interest of the community in the project, and the commitment of participants through several phases of the interview process. For example, once an interview is scheduled and conducted, CSH engages the interviewee at least one more time (in person or by emails or phone calls) to gain their approval of the interview transcript or summary and to incorporate any changes they make. The voluntary nature of community participation in this process, combined with restraints on time and costs, often limits the number of interviews and the depth of information gathered during the interviews.

2.4 Compensation and Contributions to Community

Many individuals and communities have generously worked with CSH over the years to identify and document the rich natural and cultural resources of these islands for cultural impact, ethno-historical and, more recently, TCP studies. CSH makes every effort to provide some form of compensation to individuals and communities who contribute to cultural studies. This is done in a variety of ways. Individual interview participants are compensated for their time in the form of a small honorarium and/or other *makana* (gift); community organization representatives (who may not be allowed to receive a gift) are asked if they would like a donation to a Hawaiian charter school or nonprofit of their choice to be made anonymously or in the name of the individual or organization participating in the study; contributors are provided their transcripts, interview summaries, photographs and—when possible—a copy of the CIA report; CSH is working to identify a public repository for all cultural studies that will allow easy access to current and past reports; CSH staff do volunteer work for community initiatives that serve to preserve and protect historic and cultural resources (for example in Lāna‘i and Kaho‘olawe). Generally our goal is to provide educational opportunities to students through internships, share our knowledge of historic preservation and cultural resources and the State and Federal laws that guide the historic preservation process, and through involvement in an ongoing working group of public and private stakeholders collaborating to improve and strengthen the §343 environmental review process.

Section 3 Traditional Background

3.1 Overview

This section focuses on the traditional background of Kahalu‘u Ahupua‘a and more specifically, the project area, located in the district of North Kona. According to Fornander, the Island of Hawai‘i was divided into six major *moku* or districts at the time when ‘Umi-a-Līloa ruled the island, around 1525 (Fornander 1973:100-102). The district of Kona extended from the shore across the entirety of Hualālai Mountain to the summit of Mauna Loa. Kona was divided into smaller regions or *‘okana* (district or sub-district, usually comprising several *ahupua‘a*) which comprised the region of North Kona (Figure 6). The southern portion of North Kona was known as “*Kona kai ‘ōpua*” which includes the project area, and the northernmost portion was “Kekaha.”

3.2 *Wahi Pana* (Storied Place Names)

A Hawaiian *wahi pana*, also referred to as a place name, “physically and poetically describes an area while revealing its historical or legendary significance” (Landgraf 1994:v). *Wahi pana* can refer to natural geographic locations such as streams, peaks, rock formations, ridges, and offshore islands and reefs, or they can refer to Hawaiian divisions such as *ahupua‘a* and *‘ili* (land section, next in importance to ahupua‘a), and man-made structures, such as fishponds. In this way, the *wahi pana* of Kahalu‘u tangibly link the *kama‘āina* (Native-born) of this *ahupua‘a* to their past.

The source for place names in this section is the online database of Lloyd Soehren’s (2011), *Hawaiian Place Names*. Soehren compiled all names from mid-nineteenth century land documents such as Land Commission Awards (LCA) and Boundary Commission Testimony (BCT) reports. The BCT lists boundary points for many of the *ahupua‘a*. The names of *‘ili ‘āina* and *‘ili kū* (land units awarded separately from a specific *ahupua‘a*) are compiled from the testimony in Māhele Land Commission Awards, from both awards successfully claimed and from those rejected. Place names found by authors on U. S. Geological Service (USGS) maps and Hawai‘i Survey Registered Maps (HSRM) were also added to the database. The Soehren database includes place name meanings from the definitive book on Hawaiian place names, *Place Names of Hawaii* (Pukui et al. 1974). For cases in which Pukui et al. (1974) did not provide a meaning, Soehren suggested meanings for simple names from the *Hawaiian Dictionary* (Pukui and Elbert 1986).

Due to numerous place names available for Kahalu‘u Ahupua‘a, most place names will be presented in Table 1. Each row within the table shows the place name, the type of place or feature, the meaning of the name, and the source from which the information was extracted. For some place names, information is unavailable. Other place names gathered from consultations with *kūpuna* and *kama‘āina* for this study, and other well known places names, will also be presented in narrative form.

Figure 6. Portion of 1996 U.S. Geological Survey 7.5 Minute topographic map (Kealakekua and Pu‘u Lehua Quadrangles), showing the location of the project area along the coast of Kahalu‘u Ahupua‘a

Table 1. Place Names of Kahalu‘u Ahupua‘a

Place Name	Type	Meaning (Source)	Description (Source)
Kahalu‘u	*Ahupua‘a*, bay	Diving place (Pukui et al. 1974:62); dripping trough (Thrum 1922:637)	Retained by V. Kamāmalu, LCA 7713:6; a land favored by chiefs where many *heiau* survive. The land was named for a high ranking chiefess called Kahalu‘u who was the wife of Keolonāhihi. In some accounts, Kahalu‘u is said to have been the wife of Keauhou, the ruling chief of Kona district and the parents of Mākole‘ā, famed for her beauty, who was engaged to the King of Maui, Kaka‘alaneo (Fornander 1916-1919:384-385).
Hali‘ipālala 1–5	*‘Ili ‘āina*	Spread wide (Pukui et al. 1974:39)	LCA 5671B, 5695, 5642; bounded by LCA 5673:1-3 and 5677:1, 2
Hāpaiali‘i	*‘Ili ‘āina*	Elevating chief (Pukui et al. 1974:42)	LCA 5915 (house site of award near Hāpaiali‘i Heiau)
Helekamahina	*‘Ili ‘āina*		Bounded by LCA 5690:1 and 5964:6
Hiloa 1–2	*‘Ili ‘āina*	Long *‘ili* land division (Soehren 2011)	LCA 5687-A
Hōkio 1–4	*‘Ili ‘āina*	Small gourd whistle (Soehren 2011)	LCA 5673, 5694
Kahuamoa	*‘Ili ‘āina*	The chicken egg (Soehren 2011)	LCA 5813-B, 3449-B
Kaloaulu	*‘Ili ‘āina*		LCA 6091
Kamuku 1–4	*‘Ili ‘āina*	Cut short (Thrum 1922:643)	LCA 5673, 5677, 6094
Ka‘ōpapa	*‘Ili ‘āina*		Bounded by LCA 6139
Kapio	*‘Ili ‘āina*		Bounded by LCA 6029
Kealaehu	*‘ili ‘āina*	The dusty road (Soehren 2011)	Bounded by LCA 5676, 5689
Kepani	*‘Ili ‘āina*		Bounded by LCA 5676, 5686
Kihikihi 1, 2	*‘Ili ‘āina*		LCA 5690, 3445-B

Place Name	Type	Meaning (Source)	Description (Source)
Koai‘e 1–3	‘Ili ‘āina	A native tree, *Acacia* koa (Soehren 2011)	LCA 3443-B, 10766
Kukuiha‘a	‘Ili ‘āina	Low candlenut tree (Soehren 2011)	LCA 6128, 5831, 5689, 3455-B, 3447-B
Kukui o ka hinu	‘Ili ‘āina		LCA 5966-B
Kumuhāwane	‘Ili ‘āina	Trunk of the *loulu* palm tree (Soehren 2011)	Bounded by LCA 5673-C
Lehuakona	‘Ili ‘āina	Milky Way star, perhaps Antares (Soehren 2011)	LCA 5688, 5632, 3440-B; bounded by LCA 5691
Makakiloi‘a	‘Ili ‘āina	Fish-observing point (Pukui et al. 1974:40)	LCA 5688, 5688-B, 6032
Mauiloa	‘Ili ‘āina	Distant Maui, perhaps (Soehren 2011)	Bounded by LCA 5686
Pahauopu	‘Ili ‘āina		LCA 5672
Pāhoa	‘Ili ‘āina	Dagger (Pukui et al. 1974:174)	LCA 6032, 5690, 3442-B; bounded by LCA 6091
Pāki‘i 1–6	‘Ili ‘āina	Flat, spread out (Soehren 2011)	LCA 5691, 5632, 6032, 5690, 3440-B
Pamaki	‘Ili ‘āina	Fatal illness, perhaps (Soehren 2011)	LCA 5678
Pāpua‘a 1–3	‘Ili ‘āina	Pig fence, or enclosure (Soehren 2011)	LCA 6139, 6029, 6080
Paulu	‘Ili ‘āina		LCA 6029
Po‘ohawai‘i	‘Ili ‘āina		LCA 6026; contains Po‘o Hawai‘i Pond
Puekahi	‘Ili ‘āina		LCA 5673, 6094

Place Name	Type	Meaning (Source)	Description (Source)
Pu‘u Hinahina	*‘Ili ‘āina*	Perhaps named for one of the several *hinahina* plants (Pukui et al. 1974:196)	LCA 5676
‘Ulumoe	*‘Ili ‘āina*	Reclining breadfruit tree (Soehren 2011)	LCA 5688-B, 5632, 6023, 3440-B; bounded by LCA 5691
Coastal *Heiau*			***Makai* of Ali‘i Drive near Kahalu‘u Bay**
Hanakalau‘ai	*Heiau*	Name of a star associated with Hana-kau-luna [a star], and the name of a legendary place (Soehren 2011)	Thrum only lists site (Stokes and Dye 1991:71; Thrum 1907a:44).
Hāpaiali‘i	*Heiau*	Elevating chief (Pukui et al. 1974:42)	According to Malanui, a local man interviewed by Stokes, Hāpaiali‘i was built by a Maui priest named Maa, around 1200 to 1400 ACE (Stokes and Dye 1991; Tuggle 1990). It was also said to have been constructed by Kamehameha in 1782 after the battle of Moku‘ōhai, were human sacrifices took place as well as being a place of refuge (*pu‘uhonua*) (Stokes and Dye 1991:71-74; Thrum 1907a:44).
Kapuanoni	*Heiau*	Indian Mulberry flower (Soehren 2011)	A place for prayers in general, built by Kalani‘ōpu‘u at the shore; little remains; one time residence of Alapa‘i nui (Stokes and Dye 1991:71, 80; Thrum 1907a:44, 1907b:72; Kekahuna and Kelsey 1954: Article 18)
Kapukini (Paniau)	*Heiau*	Many taboos (Pukui et al. 1974:90); Kapukini was also the name of a wife and a daughter of ‘Umi (Tuggle 1989:16)	“Called Heiau Paniau on Bishop Estate map [and TMK 7813:3], but Paniau is the name of the point above which it stands . . . This *heiau* and those hereabouts . . . were built by Kings Kuakini and Iwikaumaiikaua” (Reinecke 1930:2- 3); misnamed Paniau Heiau on TMK: [3] 7-8-013:003

Place Name	Type	Meaning (Source)	Description (Source)
Ke‘ekū (Kamaike‘ekū; Kamai‘ike‘ekū)	*Heiau*	Abrupt turn (Pukui et al. 1974:105)	Also called Kamaikeeku (Kamakau 1961:180; Stokes and Dye 1991:79; Thrum 1907a:45, 1907b:72); built by Lonoikamakahiki who offered Kamalālāwalu as a sacrifice; restored by Kamehameha (Stokes and Dye 1991:74-79; Kamakau 1961:180); also called Kamai‘ike‘ekū (Forbes 1800s).
Ke‘ekuapua‘a (Mākole‘ā; Haleokapuni)	*Heiau*	Rooting of [the] pig (Soehren 2011)	Also known as Mākole‘ā (Reinecke 1930:4); possibly same as Haleokapuni (Forbes 1800s, cited in Tuggle 1989:15)
Ku‘e Manu	*Heiau*	Thought to attract and net petrel birds (Clark 2002:199-200)	A small *heiau* and one of the few ceremonial sites devoted to the sport of surfing; chiefs of old would pray for good surfing conditions and ride the surf breaks called Kaleikini and Kapu‘ā (Kona Historical Society); presently owned and maintained by the County of Hawai‘i (TMK: [3] 7-8-014:004, 005); named in LCA 6071 by Ho‘opale who had two houses on the fenced lot which had been given to his father by Governor Kuakini (Stokes and Dye 1991:67–70; Thrum 1907a:44; Reinecke 1930:9)
Kū‘ula	*Heiau*	Red Kū, the god of fishermen; fishing *heiau*; stone god used to attract fish (Soehren 2011)	Site 11: “a small enclosure containing two *kuula* [any stone god used to attract fish] stones, a *kane* [male] and a *wahine* [female], to whom fish is offered” (Reinecke 1930:2)
Lahai or Lahae	*Heiau*		On boundary of Kahalu‘u and Kapala‘alaea at a place called Keawemua (Stokes and Dye 1991:65; Thrum 1907a:44; Reinecke 1930:1)
Maka‘uhane	*Heiau*		“Site 46 . . . Now in ruins . . . Said to be a *heiau* for making the king’s canoes” (Reinecke 1930:8)
Mākole‘ā (same as Ke‘ekuapua‘a)	*Heiau*	Name of a legendary princess; means “glowing red eye” (Pukui et al. 1974:1420	“Set back approximately 600 feet from shore, on the same tidal flat as Kapuanoni Heiau, Hāpaiali‘i Heiau and Ke‘ekū Heiau. This is a walled *heiau*, apparently facing to the west. Built or consecrated by Lonoikamakahiki and was used for prayers in general” (Stokes and Dye 1991:80)

Place Name	Type	Meaning (Source)	Description (Source)
‘Ōhi‘amuku-muku	*Heiau*		A *luakini* (human sacrificial) *heiau* traditionally said to have been built by the gods or possibly built by Lonoikamakahiki or Alapa‘i, repaired by Kalani‘ōpu‘u and Kamehameha I; repaired by Kalani‘ōpu‘u at which time Holoa‘e was its priest; lastly repaired by Kamehameha I; nothing remains as its stones were removed to build the adjoining Helani Church (Stokes and Dye 1991:70; Thrum 1907a:45; 1907b:71; Kamakau 1961:85, 180, 200)
Papakoholuia	*Heiau*		A minor *heiau*, much disturbed (Reinecke 1930:7, site 37)
Coastal Places			***Makai* of Ali‘i Drive near Kahalu‘u Bay**
Ahuahinaloa	*Kuleana*		“Site 58 . . . Ahuahinaloa [LCA 5684 to Kanahuimoana], where there was formerly a spring, Waiakane, and a small *heiau* for resting” (Reinecke 1930:9)
Helani Church	Church	A sky or a royal chief (Pukui et al. 1974:44).	Now a roofless ruin; remains of the first, smaller church lie a few yards south; it was built of stones taken from ‘Ōhi‘amukumuku *heiau*, adjoining on the south (Stokes and Dye 1991:70)
‘Inikiwai	Coastal point	Piercing water (Clark 2002:122)	Site 4. At the south end of the “*menehune* breakwater,” this once extended about 3900 feet to Kaumaha‘ole Point on the north side of Kahalu‘u Bay. There is an undersea spring of brackish water at ‘Inikiwai. Cf. Kauakoekoe (Reinecke 1930:1-4)
Kaho‘alii	Spring		A sacred spring of drinking water for royalty only (Kekahuna 1952)
Kahope	Place in sea		“Site 59 . . . at Kahope . . . , where kings used to swim through holes in the rocks under the water” (Reinecke 1930:9).
Kahuwaiwai	Spring		“Site 59 . . . at Kahope . . . Here there is a fine fresh water spring under the surface four fathoms, where the natives used to dive and fill their calabashes” (Reinecke 1930:9).
Ka‘ihimoku	Coastal point		“Site 59 . . . Kawai and Kaihimoku, points on which, if one makes nets, he will be successful in fishing” (Reinecke 1930:9)

Place Name	Type	Meaning (Source)	Description (Source)
Kaimuahoa	Place in sea		“Site 59 . . . two shallow places where manini fish are born and can be taken at new moon” (Reinecke 1930:ms. 3:9)
Ka Lā‘au o Kaleikini	*Pōhaku* (stone)	The club or stick of Kaleikini (Soehren 2011)	“. . . the huge rock laid in the sea as the very last stone of the [*Menehune* seawall]” (Kekahuna map 1952); Kaleikini was a legendary strong man who left his mark, and name, in several places (Reinecke 1930:ms.3:map)
Ka Lae o Līloa	Coastal point	The point of Līloa, named for father of ‘Umi-a-Līloa (Soehren 2011)	A surf called “Ka Nalu o Kapu‘a [was] off shore from the little point known as Ka Lae o Liloa” very near Ku‘emanu *heiau* (Reinecke 1930:ms. 3:9; Kekahuna and Kelsey 1954: Article 20)
Kaleikini	Surf	The many leis; Kaleikini was a legendary strong man (Pukui et al. 1974:76)	Kahalu‘u “bay’s splendid surf, known today as Ka Nalu o Kaleikini” was threatened by construction of the “Menehune sea wall,” but was saved by the intervention of Hinamoa, priest of the surfing *heiau* Ku‘emanu. Cf. Ka Lā‘au o Kaleikini (Kekahuna and Kelsey 1954: Article 20).
Kalopoipu	Cave		“Site 50, a tiny cave near the road” (Reinecke 1930:ms. 3:8)
Kaluokele (Kalua o keli‘i)	Sea cave	Cavern of the chief (Pukui et al. 1974:79)	“Site 27 . . . a hole about 5 fathoms deep, outside Keeku, where the Hawaiians used to offer *awa* root, food, etc. to the king shark Moanaliha” (Reinecke 1930:ms. 3:11)
Kamalālāwalu	Petroglyphs		“Outside the entrance to the *heiau* (Ke‘ekū) and towards the southwest area number of petroglyphs on the *pāhoehoe*. One is said to represent Kamalalawalu” (Sterling 1960:4)
Ka-naia	Stone		A *kū‘ula* stone (Kekahuna 1952)
Kanaluokapu‘ā	Surf	The surf of Kapu‘ā (Soehren 2011)	Surf called “Ka Nalu o Kapu‘a [was] right offshore from the little point known as Ka Lae o Liloa . . . ” very near Ku‘emanu *heiau*” (Kekahuna and Kelsey 1954: Article 20)
Kanupa	Cave	The deep cave (Soehren 2011)	“Site e . . . A burial cave with its entrance in a deep circular pit” (Reinecke 1930:ms. 3:11)
Kapapa	*Ko‘a* (fishing shrine)	The flat surface (Pukui et al. 1974:87)	Site 56 . . . The deep water for fishing just outside [Kuemanu *heiau*] is called Kapapa” (Reinecke 1930:ms. 3:9)
Ka-papa-ko	Dog		A legendary black dog (Kekahuna 1952)

Place Name	Type	Meaning (Source)	Description (Source)
Kapu‘ā	Surf		. . . waves of Kapu‘ā, right offshore from the little point known as Ka Lae o Li-loa, named for King ‘Umi's famous sire . . . near Ku‘emanu *heiau* (Kekahuna and Kelsey 1954: Article 20)
Kapua‘iwai	Spring		A spring of brackish drinking water only for the use of tenants (*ohua*) of a chief (Kekahuna 1952)
Kaua-kahi-okaoka	Dog		A legendary white dog (Kekahuna 1952)
Kauko‘eko‘e	Place		. . . the great Menehune [fishpond] wall . . . extends in a line of large scattered stones in the sea from the lava flat of Ka-ua-ko‘eko‘e, near the south end of Makole-‘a beach . . . Also called Inikiwai (Kekahuna and Kelsey 1954: Article 19)
Ka‘ulili	Spring		A commoners bathing spring (Kekahuna 1952)
Kaumaha‘ole	Coastal point	Not heavy (Soehren 2011); weightless (Clark 2002:169)	“Site 59 . . . the north end of the breakwater” (Reinecke 1930:ms. 3:9)
Kawai	Coastal point	The water (Soehren 2011)	“Site 59 . . . Kawai and Kaihimoku, points on which, if one makes nets, he will be successful in fishing” (Reinecke 1930:9)
Kawaikohali‘i	Coastal point		“Site 17. Dry well . . . about 8 feet deep and surrounded by concentric tiers of walls” (Reinecke 1930: 3:4)
Kawaiokapo	Pool	The water of Kapo (Soehren 2011)	“. . . out on a small flat of *pahoehoe* lies the once chiefly bathing pool of Ka Wai o Kapo, commemorative of Kapo, a sister of . . . Pele” *makai* of Po‘o Hawai‘i (Kekahuna and Kelsey 1954: Article 18)
Kawai‘ōpae	Pool		Pool in which red shrimps of royalty (*‘ōpae‘ula*) were raised (Kekahuna 1952)
Ke‘alialia	Lagoon		Kekahuna 1952
Keawaiki	Canoe landing	The small passage (Pukui et al. 1974:104)	South of St. Peter’s church (Reinecke 1930: 3: map 1)

Place Name	Type	Meaning (Source)	Description (Source)
Keawehala (also seen as Keawahala)	Pond		“A pond *kapu* to women during menstruation. Two *mo‘o* . . . one good natured and the other ill tempered, were custodians of the pond” (Reinecke 1930: 3:4)
Kēwā	Coastal boundary point	Anticipation (Pukui et al. 1974:109)	“The boundary at sea shore [between Kahaluu and Keauhou 1] is a *pali* called Paaniau [sic; pā-nī‘au] and a long wall from Kewa to [*makai* govt.] road” (Boundary Commission 1864-1935:1:318).
Kilauea	Fireplace		Ceremonial fireplace (*kapuahi kuni*) (Kekahuna 1952)
Kilohana	Pond	Lookout point, or outer tapa, or best superior (Pukui et al. 1974:111-112)	Between Mākole‘ā *heiau* and Keawehala pond; Kekahuna uses descriptive term “Ka-wai-‘ōpae [shrimp pond];” the pond was destroyed by a hotel (Kekahuna 1952).
Kuluaokeli`i	Sea cave	The cavern of the chief (Pukui et al. 1974:79)	Located “below the *heiau* of Keeku and Hapaialii;” it was believed that a shark chief lived here but did not disturb divers for sea urchins (*wana*) (Pukui et al. 1974:79).
Lapauila	*Pōhaku*	Lightning flash (Soehren 2011)	Site 47. Formerly along the roadside below ‘Ōhi‘amukumuku *heiau* (q.v.), the “stone called Lapauila,” described as a “strangling stone” is now (1989) at Hulihe‘e Palace in Kailua. Only the perforated top portion remains, identified as a “canoe anchor” by palace staff (Reinecke M. 3:8; Stokes and Dye 1991:70).
Lono-i-ka-makahiki	Residence		“Thought to be the residence of Lonoikamakahiki with complex walls, platforms and enclosures. Also is called Kapukini Heiau and Paniau Heiau for the point where it is located. 1812, this may also be the site of Kamehameha’s residence with the adjoining *heiau*’s” (Sterling 1960:6).
Mahina o Kiwala‘ō	Boundary point		“. . . A place where Kiiwalao [sic; read Kiwalao] was raised, an *alii kapu*” [Son of Kalani‘ōpu‘u]; on south boundary Kahalu‘u between Kuohae and Māmalahoa Highway (Boundary Commission 1864-1935:1:321)
Moku‘aweoweo	Fireplace		Ceremonial fireplace (*kapuahi kuni*) (Kekahuna 1952)

Place Name	Type	Meaning (Source)	Description (Source)
Malolo Kai O Paniau	Spring		Now almost completely covered by the present road (Kekahuna 1952)
Menehune Breakwater	Fishpond wall		See Pāokamenehune
Mokuahi‘ole (Kamoku-uwahi‘ole)	Residence, possible *heiau*	Firebrand, charred wood (Soehren 2011)	At Po‘o Hawai‘i; said to have been residence of Ke‘eaumoku and perhaps formerly a *heiau*; also may have been birthplace of Kaluaikonahale, John Adams Kuakini. Kalākaua later built a frame house on the site (Kekakuna 1952, Reinecke 1930: 3: site 45; Stokes and Dye 1991:70-71.); also called Kamoku-uwahi‘ole (Forbes 1800s).
‘Ōhiki	Coastal boundary point, cove	To shell out (Thrum 1922:662)	“A point on the south side of Paniau, and near to it” is the sea shore boundary between Kahaluu and Keauhou 1 (Boundary Commission 1864-1935:1:321, 322); now located in Keauhou 1 (Kekakuna 1952)
Pahuwai	Spring		A commoners’ spring of brackish drinking water (Kekahuna 1952)
Paniau	Coastal boundary point	Paniau: unknown; Pānī‘au: touch midrib (Pukui et al. 1974:178)	“Now the boundary between Kahaluu and Keauhou. Was formerly for diving” (Reinecke); “Paniau, the name of a *kupua* . . . turned into stone in the sea below, where it divides . . . Kahaluu from . . . Keauhou;” see Kapukini Heiau, misnamed Paniau Heiau on TMK: [3] 7-8-013:003 (Reinecke 1930:2-3; Kekahuna and Kelsey 1954: Article 20; Boundary Commission 1864-1935:318-320; Kekahuna 1952)
Pāokamenehune	Fishpond wall	Wall of the Menehune (Clark 2002:282)	The Menehune breakwater, built by the *menehune* (legendary race of small people) in one night (Clark 2002:282)
Pāpā	Well, spring	Perhaps, forbidden (Soehren 2011)	“Site 56 . . . The brackish well in the heaps of rocks south of the [Ku‘emanu] *heiau*, used for laundry, is called Papa” (Reinecke 1930:9).
Pōhaku-li-kanaka	Stone		Location of execution stone now at Hulihe‘e Palace (Kekahuna 1952)
Pōhakuloa	*Pōhaku*	Long rock (Pukui et al. 1974:186)	“Site 26. A large boulder lying on the lava flat covered at high tide . . . a shark of supernatural powers, changed to a stone because he refused to give fish to Pele” (Reinecke 1930:7)

Place Name	Type	Meaning (Source)	Description (Source)
Pōhaku o Kanaio	*Kū‘ula* (standing stone)	Stone of Kanaio (Soehren 2011)	“A companion *ku‘ula* stone [to Pohaku o Ulupalakua] was similarly imported from Kanaio, Maui, and now stands facing the sea in a stone wall just back of the beach” (Kekahuna and Kelsey 1954: Article 18)
Pōhaku o Ulupalakua	*Kū‘ula*	Stone of Ulupalakua (Soehren 2011)	“In the sea near Kapuanoni [*heiau*] . . . a fair sized flat stone named Pohaku o Ulupalakua after its former home on Maui”; companion to Pōhaku o Kanaio (Kekahuna and Kelsey 1954:18)
Poho o Kapo	Pool		A sacred bathing pool for royalty (Kekahuna 1952)
Po‘o Hawai‘i (same as Pōhaku o Kanaio)	*Kū‘ula*, pond		“A fish god, called Poo Hawaii . . . Originally it lay on the beach toward Kapuanoni . . . moved to its present position by Mr. Nahale . . . Near it was a pool . . . used by Kamehameha” (Reinecke 1930:8). A stone house was built here by Kuakini; Kalākaua replaced it (Kekahuna and Kelsey 1954: Article 31).
Ulu-pala-kua	Stone		A *kū‘ula* stone (Kekahuna 1952)
‘Umihale	Residence	House of ‘Umi (Soehren 2011)	Former name of the residence of Lonoikamakahiki, “said . . . to have been originally built by King ‘Umi” (Kekahuna and Kelsey 1954: Article 20; LCA 5682 mentions ‘Umihale)
Waiakāne	Spring	Water [made] by Kāne (Soehren 2011)	“Site 58 . . . Ahuahinaloa [LCAw 5684 to Kanahuimoana], where there was formerly a spring, Waiakane, and a small *heiau* for resting. The spring was sacred to Kane” (Reinecke 1930:9); destroyed by construction of Ali‘i Drive
Waikua‘a‘ala	Pond	Lichen water (Soehren 2011)	“. . . used for swimming by the king” (Reinecke 1930:8)
Waiku‘i	Pond, house		The name of the brackish water pond adjoining Ku‘emanu Heiau where chiefs of old washed the salt from their bodies after surfing (Kona Historical Society); also, a house site mentioned in LCA 5674
Inland *Heiau*			***Mauka* of Ali‘i Drive**
Ālainamona	*Heiau*		“Site h. Not visited [by Reinecke]; described by Kahulumu as a platform about 40 feet by 25 feet by 5 feet. Doubtless for agriculture” (Reinecke 1930:11)

Place Name	Type	Meaning (Source)	Description (Source)
Halelā‘au	*Heiau*	House of wood (Soehren 2011)	An agricultural *heiau* at 140 ft elevation near Halelā‘au cave (Stokes and Dye 1991:67, 68; Reinecke 1930:11; Thrum 1907a:44)
Haleokāne (Halekumukalani)	*Heiau*	House of Kāne (Pukui et al. 1974:38); house of the foundations of heaven (Stokes n.d.)	“Located 750 feet above sea level, 5000 feet from the sea . . . an unusual structure . . . ” (Stokes and Dye 1991:66-67). “. . . supposed to be the Halekumukalani of ancient time . . . ” (Thrum 1907a:44; listed by Kamakau 1976:145)
Ka‘io‘ena (Keahiolo)	*Heiau*		Also called Keahiolo; on boundary of Kahalu‘u and Keauhou, elevation 340 ft founded by Lono-i-ka-makahiki; named for a *kahuna* and strong man, Ka‘io‘ena (Reinecke 1930:10); “a large *heiau*” (Boundary Commission 1864-1935:321); “a large pile of stones like a *heiau*” (Boundary Commission 1864-1935: 322); Site a. On Keauhou boundary, 3,000 ft inland at 400 ft elevation; agricultural *heiau* founded by Lono-i-ka-makahiki; also called Ka-‘io-‘ena (Stokes and Dye 1991:83; Reinecke 1930:10; Thrum 1907a:45)
Keanalele	*Heiau*	The flying cave (Soehren 2011)	“Site c . . . said to be a *heiau* about 20 x 20 feet built in the bottom of a deep cave *mauka* of and between Ohia Cave and Keahiolo Heiau” (Reinecke 1930:11)
Ke‘ekū (*mauka*)	*Heiau*	Abrupt turn (Pukui et al. 1974:105)	A small *heiau*, 40 ft sq, built by Alapa‘i for agriculture; 250 ft *mauka* of upper government road; not seen by Stokes (1991:87)
Kēhau	*Heiau*	Dew; a gentle land breeze of Kona (Soehren 2011)	Shown on Bishop Estate map, but called a goat pen (Site 6) by Reinecke’s informant, Kahulumu (1930:ms.3:3)
Nohoanapalena	*Heiau*		Site k. A *heiau* named by Thomas Kahulumu; not visited; also, a cave (Reinecke 1930:12)
Pāo‘umi (Poumi)	*Heiau*		Possibly an agricultural *heiau* built by ‘Umi; also called Poumi (Thrum 1907a:45; Stokes and Dye 1991:80; Reinecke 1930:11)
Pu‘u o Kikone	*Heiau*	Hill of Kikone (Soehren 2011)	“There is also a *heiau* far *mauka* of the road, named Puuokikone . . . ” (Reinecke 1930:12)

Place Name	Type	Meaning (Source)	Description (Source)
Inland Places			***Mauka* of Ali‘i Drive**
Halelā‘au	Cave	House of wood (Soehren 2011)	“Site j . . . About 125 feet due north of [Hale laau *heiau*] is a cave . . . used in time of war and also as a burial cave . . . The entrance was used by the women for pounding *kapa*. There is a beach boulder here, the *ku‘ula* of the cave” (Reinecke 1930:3).
Kahinihini‘ula	Boundary point; *pōhaku* (stone)	The red moss (Soehren 2011)	“At the *mauk*a Government road where there are two *ahua pohaku*” (Boundary Commission 1864-1935:318); “Large *ahu* 15 feet high and 12 feet in diameter” (Bishop Estate Map No. 554); elevation about 1,270 ft on south boundary Kahalu‘u, 900 ft above Māmalahoa Hwy
Kalalahua	Boundary point		“Kalalahua, an *‘ōhi‘a akua* (an *‘ōhi‘a* deity) in the woods” on south boundary Kahalu‘u between Māmalahoa Highway and Kalaeohi (Boundary Commission 1864-1935:322)
Kuakini Wall			Wall inland of Ali‘i Dr, named between 1850–1892 for Kuakini, governor of Hawai‘i, who probably ordered its construction (Kelly and Barreré 1980:20)
Kumumāmaki	Water hole	Trunk of the *māmaki* tree (Soehren 2011)	Bishop Estate Map. No. 554, at an elevation of 1,775 ft
Kuohae	Boundary point		“Near *kukui* trees (a grove called Kuohae)” on south boundary Kahalu‘u between Kaioena and Mahina-o-Kiwalao (Boundary Commission 1864-1935:321)
Lauhue	Water hole	A variety of poisonous gourd (Soehren 2011)	On Bishop Estate map No. 554, elevation 1,740 ft
Nohoanapalena	Cave		“Site k . . . The cave’s mouth is now walled up. It was visited, but not the *heiau*” (Reinecke 1930: 12).
‘Ōhi‘a	Cave	*‘Ōhi‘a* tree (Pukui et al. 1974:140)	“Site c . . . has many ramifications, some of them unexplored; was used as a refuge and place of ambush in times of war, and of burial in times of peace; is said to connect with the cave near

Place Name	Type	Meaning (Source)	Description (Source)
			Ohiamukumuku *heiau* on the one hand, and with the cave *mauka* in which Keanalele *heiau* is built, on the other” (Reinecke 1930:11).
Pa‘ahao	Water hole	Prisoner (Soehren 2011; Thrum 1922:663)	“A waterhole in the woods” on south boundary Kahalu‘u between Kaleohi and Ka‘e‘amai‘a (Boundary Commission 1864-1935:322-323)
Pa‘apa‘alani	Boundary point		Ka ‘e‘a mai‘a [mountain banana patch] “called Paapaalani where banana trees used to grow in great numbers, aa on South side of this place is on Keauhou.” On south boundary Kahalu‘u between Pa‘ahao and Pu‘u Kanoa (Boundary Commission 1864-1935:322).
Pulepule	Water cave		On Bishop Estate Map No. 554, elevation 1900 feet.
Pupuawai	Water hole		Location uncertain; mentioned in Boundary Commission 1864-1935:322
Pu‘u Kanoa	Boundary point	Bowl hill (Soehren 2011)	“In the *koa* woods . . . At Puu Kanoa the boundary runs out of the woods. Wall’s house is on Kaumalumalu”; perhaps same as Kanoa on south boundary Kahalu‘u above Pa‘apa‘alani (Boundary Commission 1864-1935:322)
Pu‘u o Kukae	Hill	Hill of excrement (Soehren 2011)	“Site 154 . . . a slight elevation known as Puu o Kukae, near which there is an entrance to a cave used recently as a burial cave by Kahaluu residents and therefore not shown me” (Reinecke 1930:4:14).
Waiapaoa	Water hole		On Bishop Estate map No. 554, elevation 1,710 ft
Waohale	Water hole		On Bishop Estate map No. 554, elevation 1,650 ft

3.3 *Mo‘olelo*

The presence of many *mo‘olelo* (stories) in the study area suggest that Kahalu‘u Ahupua‘a (see Figure 6) was once well-populated. The following section presents *mo‘olelo* associated with the *ahupua‘a* and the numerous historic properties in the project area (Figure 7 and Figure 8).

3.3.1 Mākole‘ā

In the *mo‘olelo* of Kepakailiula of Paliuli, his father searched the island of Hawai‘i for a beautiful companion worthy of his son. As he travelled, he came upon such a woman in Kahalu‘u. She was Princess Mākole‘ā, daughter of the king and queen of Kona, Keauhou, and Kahalu‘u. Fornander (1917) writes the following:

> Kiihele left Kau and passed into Kona where he found Makolea, a woman who was as faultless as the full moon. Kahaluu was her father and Keauhou was her mother. Makolea, however, had been pledged to marry Kakaalaneo the king of Maui, for Makolea was a princess, her parents being the king and queen of Kona. [Fornander 1917:500]

3.3.2 Pāokamenehune

The *mo‘olelo* of Pāokamenehune, also known as the Menehune breakwall, occurs at Kahalu‘u. It is said that this wall, which was constructed in the surf to create a fishpond, was built by the *menehune* in the course of one night (Clark 2002:282). However, during the construction a rooster crowed before dawn, causing the *menehune* to abandon the site.

According to notes by Henry Kekahuna on a 1954 sketch of Kahalu‘u, the crowing rooster was actually the high priest Hino-Moo of the surfing temple Ku‘e Manu, who was troubled at the prospect of the wall completely enclosing Kahalu‘u Bay. In these notes, Kekahuna attributes the construction of the wall to Kaleikini. The Pāokamenehune is depicted on Figure 7 and Figure 8.

3.3.3 Surf chant at Ku‘emanu Heiau

According to Kepā Maly (Maly in Gutmanis 1983:101), Ku‘emanu was a *heiau* for surfers. If there were no waves, people would go to the *heiau* and the priest would gather up the *pōhuehue* then strike the water with the *pōhuehue*, and chant to create the waves for surfing. The chant is as follows:

Ku mai! Ku mai!

Ka nalu nui mai Kahiki mai.

‘Alo po‘i pu!

Ku mai I ka pohuehue

Hu! Kaiko‘o loa!

Arise! Arise!

Great surfs from Kahiki,

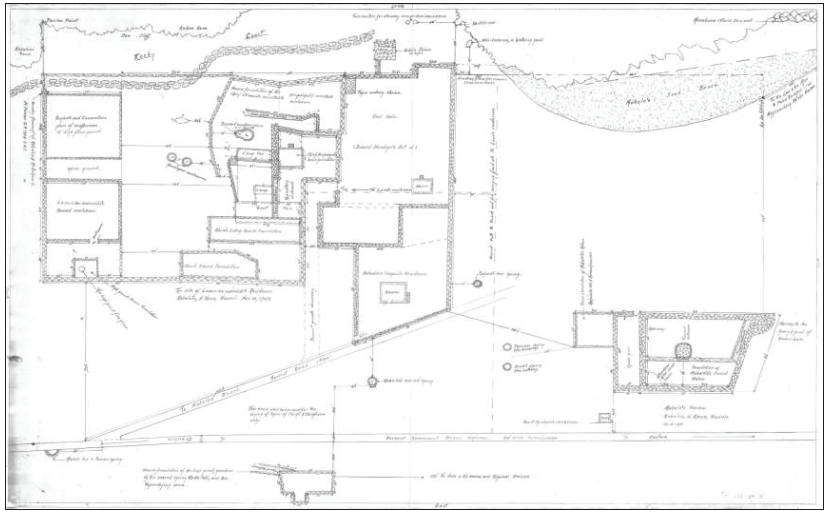

Figure 7. 1949 sketch of Kahalu‘u by Henry Kekahuna of the area from Kapukini Cove to Mākole‘ā Sand Beach residence

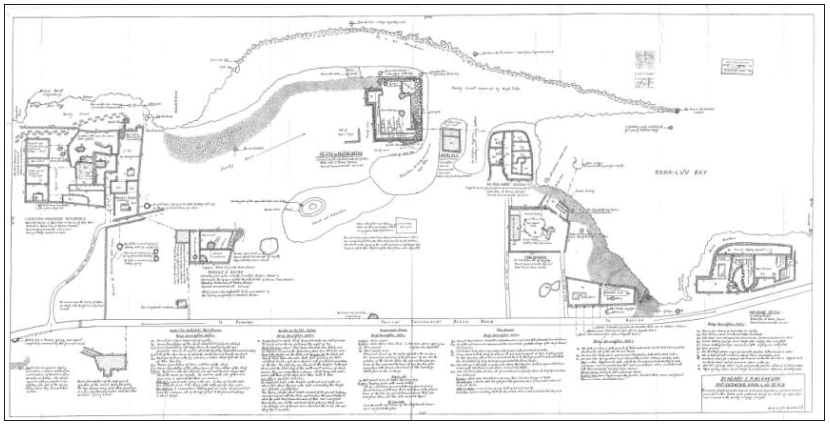

Figure 8. 1952 sketch by Henry Kekahuna of Kahalu‘u Beach, showing some of the place names within the project area (portions of this sketch detailed in following sections

Waves break together!

Rise with the *pohuehue* [beach morning-glory]

Well up, raging surf! [Maly in Gutmanis 1983:101]

Similarly, Maly relates that when the *koholā* (whale) are seen slapping their tails in the ocean on a clear day, the *kūpuna* believe they are doing the same thing as *kūpuna* striking the water with *pōhuehue*. They are asking for waves because they prefer to have waves (Maly in Gutmanis 1983:101).

3.3.4 Famous Sharks of Kahalu‘u

Reinecke (1930:2) wrote of the *mo‘olelo* of the famous sharks of Kahalu‘u. The people of Kahalu‘u would make offerings to the king sharks, Kehau and Laenui, who controlled the lesser sharks to ensure no men were attacked. This *kapu* (taboo) did not extend to the waters of neighboring *ahupua‘a*.

A 1952 sketch by Henry Kekahuna of Kahalu‘u Beach (see Figure 8) depicts the “Ka-lua-o-ke-‘lii cavern--named for a legendary shark,” located just off Pāokamenehune, north of Hāpaiali‘i Heiau. Reinecke (1930:2) identified this legendary shark as “the king shark Moanaliha,” noting that the feature was an offering place.

3.3.5 Twin *Mo‘o* Sisters of Keawehala Pond

Keawehala Pond (SIHP # Ha-D4-52) is shown in Kekahuna’s 1952 sketch (see Figure 8) as the home of the “supernatural twin *mo‘o* [reptile] sisters.” The sketch labels the pond as “Keawahala,” suggesting the sisters lived alongside an island situated near the center of the pond, and that the pond was fed with seawater at high tide. Kekahuna (1952) gives the following description:

> The mo‘o twins, supernatural born (hanau ‘e‘epa‘ai) were sisters, one sandy-haired (‘ehu), the other dark-haired (lauoha ‘ele ‘ele), who dwelt in the spring in the south-west corner of Keawe-hala Pond, in which their deified reptile-like fetuses were deposited. [Kekahuna 1952]

Kekahuna also notes a homesite “of the care-takers (*kahu*)” of the sisters, corresponding to LCA 5966, located north of the pond (see Figure 8).

3.3.6 “Kaao Hooniua Puuwai no Ka-Miki”

Throughout various publications, cultural historian Kepā Maly has translated portions of the “Kaao Hooniua Puuwai no Ka-Miki” (“The Heart stirring Story of Ka-Miki”) that appeared in the newspaper *Ka Hoku o Hawai‘i* between 1914 and 1917. Writing with his wife Onaona Maly, Maly (2012:31) states, “While ‘Ka-Miki’ is not an ancient account, the authors used a mixture of local traditions, tales, and family histories in association with place names to tie together fragments of site specific histories that had been handed down over the generations.” The legend provides details about life and the environment of Kona as well as for the entire island of Hawai‘i.

Ka-Miki, the quick or adept one, and his brother Maka‘iole (“rat or squinting eyes”), traveled around the island to participate in competitions ca. the thirteenth century when Pili-a-Ka‘aiea was the chief of Kona. The boys’ parents were Pōhaku-o-Kāne (male) and Kapa‘ihilani (female), the *ali‘i* of Kaloko and Kohanaiki. The legend relates that the supernatural brothers

> . . . were empowered by their ancestress Ka-uluhe-nui-hihi-kolo-i-uka (the great entangled growth of uluhe fern which spreads across the uplands), who was one of the myriad of body forms of the goddess Haumea, the earth-mother, creative force of nature who was also called Papa or Hina. [Maly and Maly 2012:32]

The twins were raised by Ka-uluhe, who taught them how to use their supernatural powers. Portions of the legend contain place names relevant to Kahalu’u and the project area:

> The village with the walled pond and grove of hau and coconut trees was Kahalu‘u, and Kahalu‘u-kai-ākea was the chief who controlled the ahupua‘a which bears his name.
>
> He was the father of the beautiful, glowing-skinned chiefess, Mākole‘ā. The beauty of Kahalu‘u is described with the saying ‘Kahalu‘u ua ‘āina ala i ka wai puka iki o Helani’ (Kahalu‘u is the land [known for] the small rising waters of Helani.)
>
> At Kahalu‘u, Hale‘ōpele was the āhua (hillock-agricultural feature) covered with coconut trees . . . [Maly and Maly 2012:32]

Departing from Kalama‘ula, Ka-Miki and Maka-‘iole set out on their quest around the island of Hawai‘i, to challenge disreputable *‘ōlohe* (experts skilled in fighting or in other competitions historically practiced by Hawaiians such as running, fishing, debating, or solving riddles) and priests whose dishonorable conduct offended the gods of ancient Hawai‘i. The journey took the brothers first through the lands of Kona—*O Kona i ka pohu nā‘ū ke keiki e kāohi ala i ke kūkuna o ka lā, O Kona ia!* (Kona in the calm where children take in their breath and then chant, claiming the rays of the sun as their own. Indeed it is Kona!). Their path took them to the *kahua* (contest arena) at Kāulaokalani (Hōlualoa), where they met with the representatives of the chief Kahalu‘u-kai-ākea; and then they traveled on to meet the priest Keahiolo, for whom the *heiau* near the Kahalu‘u-Keauhou 1st boundary is named (Maly and Maly 2012:33).

The Ka-Miki narrative names Halekumukalani as the *ilāmuku* (contest official) of the competitions at Kāulaokalani and “the general-counselor for the chief Kahalu‘u-kai-ākea and his daughter Mākole‘ā—the heiau Halekumukalani in Kahalu‘u was named for this ilāmuku of Kahalu‘u” (Maly and Maly 2012:33). Upon Ka-Miki’s defeat of the warrior Pālau‘eka at Kāulaokalani, the brothers traveled south:

> . . . and arrived next at the compound of Keahiolo, situated near the boundary of Kahalu‘u and Keauhou. Keahiolo was a ‘kahuna nui kēia a he kaulana pa‘a ‘āina’ (high priest and one who secured, or maintained peace upon the land) who served under the chief Pōhaku-nui-o-Kāne, who governed the lands between Keauhou and Mā‘ihi.

> This powerful priest was jealous of the abilities of Ka-Miki and Maka-‘iole, and he sought to kill them. Keahiolo called the brothers to share ‘awa with him, at the same time he picked up his pīkoi (tripping club) which he had hidden in a mat, and prepared to attack them . . .
>
> Ka-Miki knew the nature of Keahiolo, and Ka-Miki used the ‘olohū (an ‘ulu maika tripping stone) called Ka‘akuamā‘ihi to strike at the feet of Keahiolo, and thus defeated the ‘ōlohe priest. Keahiolo apologized for his deception, but Ka-Miki told him there was no value in his repentance, as it was made in fear of his death . . .
>
> Maka-‘iole took compassion and chanted to Ka-Miki asking him to spare the priest. Ka-Miki agreed, Keahiolo repented and prepared ‘awa and a feast for Ka- Miki mā. The heiau near the Keauhou-Kahalu‘u boundary was named for the priest Keahiolo.
>
> Keahiolo then took Ka-Miki (Nana-i-ke-kihi-o-Kamalama) and Maka-‘iole (Kahuelo-kui-ke-kihi-o-Kā‘elo) to the kahua of Kahō‘e‘e (at Keauhou 2nd) where contests were to occur. [translation in Maly and Maly 2012:32-34]

Here Ka-Miki undertook several rounds of fighting with Haumanomano and ‘Ōhi‘amukumuku. According to the tale, “‘Ōhi‘amukumuku was a ‘ōlohe pūkani pa‘a ‘āina for the chief Pōhakunuiokāne, the heiau by the name of ‘Ōhi‘amukumuku [in Kahalu‘u] was named for this famous warrior” (Maly and Maly 2012:35). During these contests, the brothers called upon their supernatural skills and emerged victorious once more, resuming their travels.

3.3.7 Lonoikamakahiki

3.3.7.1 Lonoikamakahiki and Kapaihiahilina

Kapaihiahilina was a favorite of Lonoikamakahiki who made him premier of Kona. During his premiership, Kapaihiahilina travelled to Kaua‘i during which time some chiefs and royal suite conspired to oust him from his position. They influenced Lonoikamakahiki who made a solemn pledge that he would never see Kapaihiahilina again. Kapaihiahilina heard that he was no longer the premier and favorite of the king so he set sail for Hawai‘i Island. Fornander (1917: 356) writes the following (also see Section 3.4):

> Whilst on the voyage to Hawaii on his canoes he commenced the composition of a song wherein was recited his travels with Lonoikamakahiki in the mountain glens, their escapes from dangers of many descriptions. On the way, he first landed at Kohala, as he desired to see the land which had been given him. Upon arriving there he found that a new konohiki had been installed on the land and the one placed there by him had been dismissed. It was then that he realized his downfall. He set sail for Kona to fully acquaint himself with the commands of the king.
>
> At that time Lonoikaniakahiki was living at Kahaluu and was then conducting temple services. When he came in sight immediately outside of Kahaluu, he was recognized at once by his canoes. In consequence thereof, Lonoikaniakahiki immediately gave orders that the doors of the house be closed. The doors were not, however, closed at once. At the time the canoes reached the shore and

> Kapaihiahilina commenced wending his way to the king, when nearing the fencing of the house the doors shut. Kapaihiahilina observing the door closing on him stood outside the fence where the sentinels stood. Raising his voice on high he described in chant their wanderings. [Fornander 1917: 356]

3.3.7.2 Lonoikamahiki and Battle of Kaiopihi

After the Kohala general, Kaiopihi, was slain, Lonoikamakahiki remained at the upper part of Pololū where the Battle of Kaiopihi was fought. His enforcements came from Hāmākua, Hilo, Puna, and Kona and soon after gained complete victory and all the rebellious chiefs were killed. Lonoikamakahiki became the ruler of the whole of Hawai‘i. Fornander (1917) writes the following:

> After this signal victory Lonoikamakahiki went to observe religious service at the temple at Apuakohau, and it is there that the temple called Muleilua is located. After this dedication he proceeded and held another ceremony at Puukohola. Having performed his duties at this place he went on, and at Kahalu‘u, in Kona, again held a dedication service at the temple of Makolea. [Fornander 1917:330]

3.3.8 Kapāihiākea

According to Kupuna Haumea (born 1913), heir of the land at Kahalu‘u, when a boy was born, whether the drums were still visible or not, the ringing of the drums would announce the birth of a male child. However, in about 1914, a girl child was born to that family face down and the beating of the drums was heard resonating from Hāpaiali‘i Heiau, but when they turned her over, it was a girl. Immediately, the *pahu* (drum) stopped ringing. This baby’s name was Kapāihiākea, “sacred resonating drums heard afar.” That name is handed down through generations (Maly 2008).

3.3.9 The *Iwi* (Bones) of Kuakini

The family of Chief Kaopua were stewards to Kuakini, Queen Ka‘ahumanu’s brother. The bones of Kuakini were prepared the traditional way for burial by this family, in a section of the project area where a commemorative house now stands.

3.3.10 Nāhale

Another prominent family in the Kahalu‘u area was the Nāhale family. There was a longer name, Nāhale Pa‘alihauniu; reportedly this was shortened to Nāhale. It was their thatched house that sat on that property during the time of Kuakini (Maly 2008).

3.*4 Oli*

There were many chants associated with the *ali‘i* and Kahalu‘u, demonstrating the historical and cultural importance of the project area to the rulers of Hawai‘i. For example, there was a chant by Liholiho upon his father’s return to Kona in 1811 that is linked to ‘Ōhi‘amukumuku Heiau. Below is an excerpt of another chant, recited by Kapaihiahilina for Lonoikamakahiki outside Kahalu‘u.

O Lonoikamakahiki kapu a Kalani,
O Kalani kapu a Keawe i hanau;
Hanau Kalani he alii ku halau,
He lau kapaahu nehe e Lono,
Mai ka papa aku
Ka ahuula kapu a Kumalana.
Ua hewa!
Ua hewa iaia la he hoomauhala,
Aohe ano hala i hoomau ai e Kalani.
Kuu makua a kalani,
Kaina i honua,
Hele ana i honua,
I Opikananuu, i Opikanalani.

I kahua a Kanuukewe
Ka papa o ka moku, ka honua,
Ke au aina o Wakea i noho ai.
O Wakea ke alii kapu
A Keawe i hanau (ai);
Hanau mai mamua ka pono
Ukali aku mamuli ka hewa.
Oi hele mai ka wa nui a hune
A mehameha kanaka ole
Hele koolua i ka nahele
I ka laau koa kumu ole
Mauka o Kahihikolo.
Hili aku i ka malo pau palai,

Hahaki i ka laui pea ma ke kua.
Hala ia mao a ka ua ilaila, e ke hoa-e,
Hele aku a ai i ka pua pala o ka hala
Hala ia la pololi o ka ua ilaila, e ke hoa.
He hoa i ka nahele lauhala loloa,
Mai Kilauea a Kalihi la;
O ka hala i aina kepaia,
O Pooku i Haualei-la.
Hala ia mao a ka ua, e ke hoa-e.
He ua kaee, ua makani,
Ua hookinakina e puni e ka ua.
Inu aku i ka awa o Koukou
I ka awa lau hinano o Mamalahoa,

Translation:

Lonoikamakahiki, the sacred one of the high chief,
The sacred chief given birth by Keawe.
The chief was born a king of large possessions.
Lono is like soft mats without number,
[Stretching] from ancient lines
Come the sacred feather capes of Kumalana.
It is wrong!
It is wrong for him to maintain his anger.
For the fault is as nothing for the chief to continue being angry.
My father! The great chief,
We have tramped the ground,
We have walked the ground
At Opikananuu, at Opikanalani,

At the plains of Kanuukewe,
The base of the isle, the foundation;
The foundation of the land where Wakea lived,
Wakea the sacred chief.
By Keawe was given birth;
The right was first given birth,
Then followed that which was wrong.
The going began with numbers and was continued till few were left;
Until lonely and deserted,
But two continued tramping in the forest,
To where grew the koa tree without roots,
Above Kahihikolo,
Loin-cloth of ferns was made,
Ti-leaf was broken and worn at the back;

Thus were we two sheltered from the rain, my companion.
We ate of the ripe pandanus in our wanderings,
Thus were our days of hunger appeased, my companion,
My companion of the tall pandanus,
From Kilauea to Kalihi;
The pandanus that had been partly eaten.
Of Pooku in Hanalei.

Thus did we two wander along, my companion.
Through the heavy and wind-blown rain,
The ceaseless and general rain.
We drank of the awa of Koukou,
The fragrant-leaved awa of Mamalahoa. [Fornander 1917:356-358]

3.5 *‘Ōlelo No‘eau*

Kahalu‘u-kai-ākea was a chief who controlled the *ahupua‘a* of Kahalu‘u which bears his name. He was the father of the beautiful, glowing-skinned chiefess, Mākole‘ā. The beauty of Kahalu‘u is described with the saying, “Kahalu‘u ua ‘āina ala i ka wai puka iki o Helani (Kahalu‘u is the land [known for] the small rising waters of Helani) (Maly and Maly 2012).

3.6 Subsistence and Settlement

3.6.1 Kahalu‘u Historical Town/Village

In 1823, missionary William Ellis of the London Missionary Society made a tour of an area that included Kahalu‘u. Most likely walking an alignment much like the modern Ali‘i Drive, Ellis (1969:121) reported 19 *heiau* and 610 houses between Kailua and Keauhou, and eight *heiau* and 443 houses between Keauhou and Ka‘awaloa. Ellis remarked on the stepping stone trail across a mile-wide stretch of *‘a‘ā* between the Kahalu‘u and Keauhou villages. Ellis (1969:121) noted the houses of “those who live among the plantations on the sides of the hills.” Keauhou was an outlier for the Kailua Mission Station. Missionaries from the American Board of Commissioners for Foreign Missions (ABCFM) periodically took sermonizing trips down the coast, often on their way to the Ka‘awaloa Mission. Artemis Bishop (1892:18) noted (ca. 1825) that the Hawaiian communities at Hōlualoa, Kahalu‘u, Keauhou, and Kainaliu routinely marshaled 500 or more people to meet him.

3.6.2 Agriculture and Kona Field System

Based on radiocarbon data, Burtchard et al. (1996:54) suggest the earliest settlement in Kona began around AD 900. The earliest settlement most likely was located around Kahalu‘u Bay with all its marine resources. The beginning of the Kona Field System is believed to have taken place by the mid-1300s. It was a system of planting unique to Kona which involved cultivating crops such as sweet potatoes, breadfruit, and dryland taro in narrow fields that ran from near the sea to the uplands (Bishop Museum 2014) (see also Section 4 for more details on the Kona Field System).

3.6.3 Fishing

Handy and Handy (1972) write of fishing settlements along Kahalu‘u Bay:

> Small bays generally had a cluster of houses where families of fishermen lived—as in Kona, Hawaii, in the specific localities of Kailua, Holualoa, Kahalu‘u, Keauhou, Napo‘opo‘o, Honaunau, Kealakekua, and Ho‘okena. [Handy and Handy 1972:287]

That the project area was integral to fishing is indicated by the presence of *kū‘ula* and Kapuanoni Heiau. Around 1950, Kekahuna was informed by Naluahine Kaopua that this *heiau* was used to bring in bountiful food and fish (Kekahuna 1952). Based on the various historical references to this *heiau* and its relationship to others nearby, Cordy (1986a) concluded it is likely Kapuanoni was used for worship in relation to farming and fishing. That the Kahulu‘u *makai* area continues to be significant for fishing practices is buttressed by community consultation which indicates the most prominent cultural use of the project area today is fishing.

3.6.4 Freshwater Resources

There are numerous freshwater resources throughout the project area (see Figure 8). One prominent pond was Po‘o Hawai‘i, used by royalty. For commoners or *maka‘āinana*, there was Pahuwai, a spring of brackish drinking water (Kekahuna 1952). Kilohana was a pond (as well as *kū‘ula*) reported to have been enjoyed by Kamehameha (Reinecke 1930:8). Poho o Kapo was another sacred bathing pool reserved for *ali‘i* (Kekahuna 1952). Waiakāne was a spring sacred to Kāne (Reinecke 1930:9) while Waiku‘i was a brackish water pond next to Ku‘emanu Heiau which *ali‘i* used to remove salt from their bodies after surfing (Kona Historical Society n.d.). For more information on freshwater resources in and near the project area, see Table 1.

3.7 *Heiau*

Along with the numerous *mo‘olelo* regarding the *wahi pana* in the area, the sheer number of *heiau* near and within the project area are indicative of the sacred spiritual aspect of this special place (Figure 8). There are five *heiau* contained within the project area, and three of them have been restored: Hāpaiali‘i, located south of Kahalu‘u Beach Park; Ke‘ekū, situated 150 ft southwest of Hāpaiali‘i Heiau; and Mākole‘ā, southeast of Ke‘ekū Heiau. The following Sections 3.8.1 through 3.8.17 describe some of the *heiau*, drawing mainly from information obtained in 1906 by John F.G. Stokes in his *Heiau of the Island of Hawai‘i* (1991).

3.7.1 Halela‘au Heiau

Halela‘au Heiau is an agricultural *heiau* located 1,100 ft from the sea at 140 ft elevation (Stokes and Dye 1991:67). Stokes describes this *heiau* as follows:

> Halela‘au is built on the high ground overlooking the village. The main platform is from 2 to 7 feet above the ground, depending on the contour of the land. At the middle of the western side is a bench 1.5 feet lower than the main platform, with steps leading up to it. A passage 3 feet wide leads to the south from the bench at the same elevation. It almost separates a portion of the main foot lower than the main platform. Near the northeast corner is a mound of stone or an oval platform 5 feet high, whose proximity would suggest a connection with the heiau. On the southern side is a pavement, a foot above the level of the ground, with two small semicircular enclosures exposing the earth. [Stokes and Dye 1991:67]

3.7.2 Hale o Kāne

Located at 750 ft above sea level, this *heiau* was 5,000 ft from the sea. Stokes (1991) describes this *heiau* as an unusual structure with small walls overlooked by a heavy wall or long platform. He writes the following:

> The floors of the eastern compartment was covered with loose stones, but the rest of the interior, including the small enclosure in the middle, was like the land outside—*pahoehoe* lava with a thin layer of soil. Towards the western end is a cave, just large enough for a man to crawl into. It is part of a lava tunnel, and it was stated that people used it for hiding in, but unless there was a larger compartment towards the sea on the west, there was not room for more than two people. [Stokes and Dye 1991:67]

Stokes also mentions that Mr. Thrum had given him the name Halekumukalani for a *heiau* in Kahalu‘u; however, no one there knew of that name. This led to Stokes’ speculation that the name Kumukalani—“the foundations of heaven, heavenly stem,” as applied to Kāne, was intended for this *heiau*.

3.7.3 Hanakalau‘ai

Hanakalau‘ai Heiau is on the land of Kahalu‘u, North Kona. It is a site only with no existing structure or history (Stokes and Dye 1991:71).

3.7.4 Hāpaiali‘i

Hāpaiali‘i translates to “elevating chief” (Pukui et. al 1974). It is estimated to be built sometime between A.D. 1200 to 1400. According to local sources consulted by Stokes in 1906, the *heiau* was constructed by Ma‘a, a *kahuna* from Maui and it is believed to be older than Ke‘ekū Heiau. It is a high platform *heiau* dedicated for prayers built on top of a *pāhoehoe* flow and surrounded during high tide (Stokes and Dye 1991:71-73).

It is located 1,000 ft south of Kahulu‘u Bay, with vertical retaining walls made up of enormous square stone blocks on the west, east, and north. The southwest corner of the *heiau* containing the largest blocks reaches up to 8 ft high, while the eastern wall contains smaller blocks. The platform surface contains a somewhat rough pavement (Stokes and Dye 1991:71). A smaller pavement located east of the center is more smoothly laid and is about half a foot above the general level (Stokes and Dye 1991:71). To the east are three small walls ranging in height from 1.5 ft high for the north and south walls to 3.3 ft high for the east wall and all with the width of 3.5 ft; these three walls form an enclosure with the small pavement (Stokes and Dye 1991:71-73).

3.7.5 Kapuanoni

Kapuanoni was reportedly built by Kalani‘ōpu‘u according to Malanui, the grandson of the final high priest for Kapuanoni and it was also named as “Alapai’s residence (Tuggle 1990:57). Kapuanoni Heiau was associated with Ho‘oului‘a, which translates to “the abundance of the sea, causing increase of the sea” (Maly 2008:18:03-18:28). It was also connected to nearby *heiau* Kauako‘eko‘e and Kamau‘ai, which like Kapuanoni, are *heiau* where prayers were offered to ensure rains and for crops to be successful (Maly 2008: 18:03-18:28). There is some suggestion that is might also be a *luakini* as well as place of refuge. Kapuanoni Heiau is situated on the beach (Stokes and Dye 1991:71).

3.7.6 Kapukini (Paniau)

This *heiau* is not recorded by Stokes (1991) but is described by Reinecke: “This *heiau* and those hereabouts . . . were built by Kings Kuakini and Iwikaumaiikaua” (Reinecke 1930).

3.7.7 Ke‘ekū (Kamaike‘ekū; Kamai‘ike‘ekū)

The name Ke‘ekū translates to “abrupt turn” (Pukui et. al 1974). Ke‘ekū Heiau is a *luakini heiau* where human sacrifices took place, and it was also a *pu‘uhonua* or place or refuge. Lonoikamakahiki built Ke‘ekū Heiau according to Malanui, who had been consulted by Stokes (see Tuggle 1990:54). When he defeated the invader Kamalālāwalu of Maui, Lonoikamakahiki offered up Kamalālāwalu as a sacrifice (Stokes and Dye 1991:75). Tradition also notes that Kuakini’s bones are buried in this heiau (Kekahuna quoted in Tuggle 1990:54). Stokes reports a number of petroglyphs on the *pāhoehoe* outside the entrance to the *heiau* on the southwest side, of which one is said to represent Kamalālāwalu. This field of petroglyphs and a Hale o Papa (a structure linked to rites for female gods) to the south of the heiau lends weight to the significance of Ke‘ekū (Tuggle 1990:54).

Located on the same tidal flat as Hāpaiali‘i Heiau, Ke‘ekū Heiau and its heavy-walled enclosure are about 150 ft away southwest of Hāpaiali‘i. The east, west, and north sides of the *heiau* are encircled by the high tide. The north and west walls have a height of 10 to 11 ft from the outside, and from the inside the four walls measure 6 to 6.5 ft, the same as the outside of the east and south walls (Stokes and Dye 1991:75). The south wall contains the entrance and at the time of Stokes’ fieldwork, the floor of level sand was 3 ft above the mean tide. Against the north wall and along the northern boundary of the floor is a “bench of stones” 2.5 ft wide by 1.5 ft high, leading to the west from a house platform of same height that was the Hale Pahu (drum house) (Stokes and Dye 1991:75). Although there were no existing structures that could be seen, Stokes described other houses of similar size and distance apart that were to the south, Hale Kailiili, Hale Wai Ea, and Hale Mana—all of which faced the west where the audience would have been seated (Stokes and Dye 1991:75-77).

3.7.8 Ku‘emanu

Ku‘emanu Heiau still exists today and is located on the *makai* side of Ali‘i Drive by St. Peters church on Kahalu‘u Bay. This *heiau* is described as a surfing *heiau*. Stokes (1991) provides the following description:

> The platforms are well built of waterworn stones and have a very attractive appearance. A *luapa‘ū* was pointed out; this bone pit is an accompaniment to the *luakini*, yet in spite of this and the fact that Mr. Thrums list included it with the *heiau luakini*, I doubt if it should be classed as such.
>
> The natives explained that it was a heiau for surf-riding, where they could pray for good surfing weather and consequently good sport. The terraces were excellent points of vantage from which to watch the sport, and the pool convenient for removing the salt on the return. The modern house on the upper platforms was much out of repair and seemed to have been there for a long time. As few natives had the temerity to build on the site of a real heiau, the presence of this house will help to confirm the correctness of my suggestion.
>
> Some of the features of Ku‘emanu—the pool, well, and platform for sightseers—recall the heiau of Keolonāhihi and I believe we can get a better understanding on the purpose of the latter after considering Ku‘emanu. The *luapa‘ū* may have

> belonged in past time to the place, and there may have been sacrifices of those who disregarded the surfing kapu, but then there were other very important sacrificial heiau at Kahalu‘u which I believe, would have claimed the victim. [Stokes and Dye 1991:68-70]

3.7.9 Kū‘ula

This *heiau* is not mentioned by Stokes (1991) but is described by Reinecke (1930) as Site 11 with “a small enclosure containing two *kuula* stones, a *kane* and a *wahine*, to whom fish is offered.”

3.7.10 Lahai or Lahae

This *heiau* is reported to have been located on the boundary of Kahalu‘u and Kapalaalaea. Stokes (1991) describes the *heiau* as follows:

> Composed of two platforms in line. The larger platform, to the north, measures 73 feet long and about 40 feet wide. The western portion has been destroyed by the sea. The smaller platform measures 20 feet long and 15 feet wide. [Stokes and Dye 1991:65

3.7.11 Maka‘uhane

This *heiau* is not mentioned by Stokes (1991) but is described by Reinecke (1930) as “Site 46 . . . Now in ruins . . . Said to be a *heiau* for making the king’s canoes.”

3.7.12 Mākole‘ā (Same as Ke‘ekuapua‘a)

According to oral tradition, Mākole‘ā Heiau is associated with a Kona chiefess by the name Mākole‘ā in the 15th century, and it is connected as well to Lonoikamakahiki in the 16th century (see Tuggle 1990:55). The name translates to “glowing red eye” (Pukui et al. 1974) and suggests the association with Pele. It is also the name of an *‘ili*, and is also the name of a bay near Ke‘ekū, which lends credence to the ancient significance of the name in Kahalu‘u (Tuggle 1990:55-56).

It is located on the same tidal flat as Hāpaiali‘i, Kapuanoni, and Ke‘ekū Heiau and is about 600 ft from the ocean (Figure 8). It faces the west and is a walled *heiau* built or consecrated by Lonoikamakahiki and used for prayers. The west side is a wall of 5 ft wide and 4 ft high, with walls that become more broad at the ends, inclining until the east wall is at the height of 6.5 ft. Broken *pāhoehoe* was used as the stone for the walls, and the enclosure floor is paved with smooth beach pebbles (Stokes and Dye 1991:80). The interior compartment is unevenly divided by a low wall or platform built similarly to the walls, but the platform is 3 ft lower. A pit about 2.5 ft or more deep is located in the southeast corner of the walls.

3.7.13 Makuahi ‘ole

Stokes (1991:71) records that this *heiau* was located on the beach, south of Kahalu‘u Bay, and that local information associated the *heiau* with Ke‘eaumoku‘s residence.

3.7.14 ‘Ōhi‘amukumuku

Tradition dictates that Ōhi‘amukumuku Heiau is a sacrificial *heiau* built by Alapai or Lonoikamakahiki to offer human victims for sacrifice (Stokes and Dye 1991:70). It is located on the *mauka* side of Ali‘i Drive opposite Kahalu‘u Beach Park. Stokes (1991) provides the following description of ‘Ōhi‘amukumuku:

> Located on the site of the former Protestant church, south of and adjoining the present church . . . The heiau stood on rising ground, and in a position to command the village. Below its site, the roadside, is a stone called Lapauila, described as a struggling stone. At one end of the stone is a perforation. The local tradition was that in certain cases a criminal was laid upon the stone and choked with a rope that passed around his neck and through the hole in the stone. [Stokes and Dye 1991:70]

3.7.15 Paoumi or Poumi

Known as either Paoumi or Poumi, this *heiau* is described as situated on the high ground overlooking the village 115 ft above sea level and 2,000 ft from the sea. Stokes writes (1991) the following:

> This is a partially walled heiau with a very heavy slope to the walls. The ground declines rapidly to the west, and on this side the retaining walls are very massive, making the appearance of the structure impressive. At the northwest corner, the floor of the heiau continues approximately on a level with the exterior of the north and west walls, giving the heiau the appearance of a high platform in this quarter. Diagonally opposite, a rounded platform as been built into the interior corner of the walls. The diagonal line between these two corners points towards the middle of the village and there is little doubt that the front of the heiau is the northwest section. [Stokes and Dye 1991:80]

3.7.16 Papakoholuia

This *heiau* is not mentioned by Stokes (1991) but is described by Reinecke (1930) as a much disturbed minor *heiau*, also known as Site 37.

3.8 Caves

There are several caves near the project area, some of which featured prominently as caves of refuge during turbulent times. Caves were used for burials, according to community consultation, and in some cases, reburial in caves is still an ongoing cultural practice. The following describes a few of the caves and their functions.

3.8.1 Kanupa

Soehren describes Kanupa cave as a “deep cave” (2011), while Reinecke lists is as “Site e” and describes it as “a burial cave with its entrance in a deep circular pit” (Reinecke 1930:11).

3.8.2 **‘Ōhi‘a**

This large lava tube is entered below ‘Ōhi‘amukumuku Heiau and goes up *mauka*. It was used for the purpose of concealing people during dangerous times. Beginning in the 1930s, ‘Ōhi‘a Cave has been extensively studied by K.P. Emory of the Bishop Museum and it has also been mapped and excavated (Tomonari-Tuggle and Allen 1983).

3.8.3 Kuluaokeli‘i

Kuluaokeli‘i is a sea cave, “the cavern of the chief” (Pukui et al. 1974:79). Its location is below Kē‘eku and Hāpaiali‘i. It was believed that a shark chief lived here but did not disturb divers for sea urchins (*wana*) (Pukui et al. 1974:79).

3.9 Burials

Burials are likely to be found in the sand dune areas of the project area, as indicated by community consultations. Caves were used as burial sites as well as for habitational purposes, with reburial in caves also practiced in contemporary times. The Kahulamu family cemetery is located close to the project area, according to interviews conducted for this CIA study.

3.10 Surfing

The presence of Ku‘emanu Heiau as a surfing *heiau* in Kahalu‘u Bay, near the project area, is indicative of the significance of this practice to the area historically. As shown in Section 3.3.3, the priest would often chant for waves at Ku‘emanu. Mr. Mitchell Fujisaka, born and raised in Kahalu‘u and interviewed for the proposed project, was among the first people to surf modern surfboards in Kahalu‘u. Today, the surf break at Kahalu‘u is one of the most popular surf breaks on the Kona coast drawing many visitors to Kahalu‘u for recreation.

Section 4 Historical Background

4.1 Overview

This section briefly summarizes, in approximate chronological order, the written historical background of the study area since Western Contact in 1778. The term “Contact” refers to Cook’s arrival in Hawai‘i which marks the beginning of many changes to traditional Native Hawaiian culture.

4.2 Early Pre-Contact Period

Kahalu‘u is known to have been a royal center and numerous *heiau* have been documented in the coastal portions of this *ahupua‘a*. It is generally agreed that the Kona region was initially settled sometime after AD 900 with habitation around Kahulu‘u Bay; by AD 1300 some of the upland areas had been cultivated, representing the beginnings of the Kona Field System. During the fourteenth through sixteenth centuries, settlements and the Kona Field System expanded inland. Between the sixteenth and eighteenth centuries, the Kona area became an important political center.

4.2.1 The Beginning of Settlement: Pre-AD 1000 to the 1300s

As mentioned in Section 3 above, the earliest settlement in Kona most likely was established around AD 900 (Burtchard et al. 1996:54). Early settlers around Kahalu‘u Bay relied on the marine and freshwater resources evident in the area. Kin-based social and economic ties linked coastal areas in the vicinities of the bay. By AD 1300, upland areas at least 4,000 ft inland were cultivated, with a calibrated date of AD 1350 for midden next to a habitation platform in nearby Keauhou *mauka* (Burtchard et al. 1996:83). This pattern is suggested to be the origin of the Kona Field System, which developed from lower elevations farther inland after this time (Tuggle 1989:18).

The general settlement pattern associated with the Kona Field System, based on ethnographic, ethno-historic, and archaeological sources, includes three main zones: coastal, intermediate, and upland. The Kona Field System has been further broken down into four sub-zones based on agricultural production. The four sub-zones and their correlations to the coastal, intermediate, and upland zones (Kelly 1983) are as follows:

Sub-Zone	AMSL	Zone
Kula	0–500 ft (0–152.4 m)	Coastal and portion of Intermediate
Kalu‘ulu	500–1,000 ft (152.4–304.8 m)	Intermediate
‘Āpa‘a	1,000–2,500 ft (304.8–762 m)	Upland
‘Ama‘u	2,500–4,000 ft (762–1,219.2 m)	Portion of Upland

The Coastal Zone can be characterized as a relatively narrow strip of land along the coast that had the highest concentrations of habitation and religious sites. The Intermediate Zone had agricultural features, temporary habitation sites, and some dispersed permanent habitation sites. The Upland Zone, like the Intermediate Zone, contained widespread evidence of agriculture and temporary and permanent habitations, but at the upper end there existed the *wao* or upland forest.

Beyond the upland forest was the Saddle Region where habitation, mostly temporary, was focused in lava tubes, with the main human activity being bird hunting. The current project area is within the lower portion (sea level) of the *Kula* (coastal) Zone, the prime coastal habitation and religious zone.

4.2.2 Settlement Expansion: the Fourteenth to Sixteenth Centuries

Initial development of the complex chiefdoms and social organization recorded at Western Contact began in this period. Genealogical traditions for the Kona coast are firm from the time of Līloa, the senior dynastic ruler of Hawai‘i Island, who, by genealogical count of 25 years to a generation, lived in the latter part of the fifteenth century (Emory et al. 1971:1). During his reign, the chiefs of already established district chiefdoms of Hilo, Puna, Kona, Ka‘ū, and Kohala acknowledged Līloa as their superior chief. Each subservient chief, including ‘Ehukaimalino (‘Ehu-kai-malino) ruling chief of Kona, sent a son to Līloa’s court at Waipi‘o, Hāmākua, his patrimonial chiefdom (Kamakau 1992:1-2). At this point in Hawai‘i Island’s history, ‘Ehukaimalino (or ‘Ehu) was second only to Līloa in seniority of descent from their common ancestor Pili, the chief brought from Tahiti in the thirteenth century to restore chiefly blood strains on Hawai‘i (Malo 1951:6).

Settlements and the Kona Field System expanded inland. Due to increased population and developing chiefdoms, intensification of zonal utilization occurred (Tomonari-Tuggle 1985:15-19). Expansion and intensification of agriculture into higher elevations and more formal fields was also taking place in response to population growth and a shift of political power to the Kona Region (Tomonari-Tuggle 1985:15-19). Additionally, evidence of the intensification includes the construction of large *heiau* complexes along the coast. Although it was built within the saddle region, one example of such a complex is Ahu-a-‘Umi, constructed around AD 1550.

According to information given to John F.G. Stokes in 1906 by a local informant named Malanui, the *heiau* of Hāpaiali‘i (SIHP # -3817; see Section 3.7.4), located within the project area, was built by a *kahuna* (priest) named Ma‘a during this period (later than the time of Pa‘ao [thirteenth century] but earlier than that of Lono [sixteenth century]; Stokes and Dye 1991:73). Kekahuna delineated this *heiau* on his 1952 map (see Figure 7 and Figure 8) and noted that it was the “. . . site of a residence, formerly with an adjacent family shrine.” He repeated Stokes’ attribution of its building to Ma‘a. Consultation for this project with Ms. Nicole Lui who traces her genealogy to the Ma‘a line also notes Ma‘a as the builder of the *heiau* (Section 6).

According to Ross Cordy (1986b:5), T.G. Thrum’s contention that this *heiau* was used for human sacrifices contradicts other oral information gathered on *heiau* of Kahalu‘u. Cordy (1986b) in assessing the role of Hāpaiali‘i Heiau as related in early histories and by native informants, indicates this *heiau* was probably used not as a *luakini* (human sacrificial *heiau*) or *pu‘uhonua* (place of refuge) but for “other important [unidentified] functions,” and that it was built sometime between AD 1200-1400.

Mākole‘ā Heiau was also probably constructed during this period, though most historical references mention it in relation to Lono-i-ka-makahiki. According to Kekahuna and Kelsey (14 March 1954), Mākole‘ā Heiau (SIHP # -3819) “was once the dwelling place of Makole-‘a, a most beautiful chiefess of great fame” (also see Section 3.2 and Figure 7). Reinecke (1930:6) related that the *heiau* was “Keekuapuaa” and that “Makolea” was the daughter of Keolonahihi

and Kahaluu.” According to Kekahuna (1952), Mākole‘ā was a lovely chiefess and wife of Chief Ke-paka-‘ili-‘ula who resided in the *heiau* (see Figure 8). In the legend of Kepakailiula, there is a chiefess by the name of Mākole‘ā and her parents are Kahalu‘u and Keauhou (Fornander 1917:IV:2:500), but there was no connection between her and any *heiau* in that legend. She was represented in the story as a wife of both Kepaka‘ili‘ula of Puna and of Kaka‘alaneo who was the ruler of Maui (Fornander 1919:IV:500). The latter name appears in genealogies as a contemporary of the fifteenth century Kona chief ‘Ehu (Fornander 1880:82).

4.2.3 The Time of ‘Umi-A-Līloa and Lono-i-ka-makahiki or the Late Traditional Period: Late Sixteenth to Eighteenth Centuries

This period marks the time of the first specific legendary information concerning Kahalu‘u, which saw a series of successive wars directed toward the expansion of political boundaries through force that extends into the time of initial Western Contact (Tomonari-Tuggle 1990:7).

After Līloa’s death, his oldest son Hākau was acknowledged as the superior chief over all Hawai‘i. When he was slain and his rule was usurped by his half-brother ‘Umi-a-Līloa, Līloa’s second son, the district chiefs recalled their sons from the court at Waipi’o and declared themselves independent (Kamakau 1992:14). ‘Umi-a-Līloa then proceeded to war against each of these chiefdoms, and he succeeded in subjugating each to effectively unite the island once more into one kingdom (Kamakau 1992:16-19). Tradition holds that ‘Umi-a-Līloa moved his court to Kona, stopping for a time at the Ahu-a-‘Umi in the uplands of Keauhou 2 (Baker 1917:63; see also Fornander 1917:IV:2:232). While ‘Umi-a-Līloa’s place of residence in Kona is usually tied to the Kailua area, Pā-o-‘Umi (SIHP # -3823), reportedly a *heiau ho‘ululu ‘ai* (a temple dedicated to the abundance of agricultural crops), was built by ‘Umi-a-Līloa above Kahalu‘u Village (Maly and Maly 2004:8; Stokes and Dye 1991:80-81).

Tomonari-Tuggle (1985) suggests the creation of refuge-type openings at major lava tubes, like ‘Ōhi‘a Cave in Kahalu‘u, was undertaken for purposes of concealment during the wars and political instability of this period. Habitation, particularly high-status habitation, appears to have focused on the lands back of Kahalu‘u Bay, where they could take advantage of the amenities of extensive inshore reefs and the proximity of brackish or freshwater ponds. Other habitation areas extended to the south, to He‘eia and Keauhou Bays, and were scattered among the agricultural fields.

The ruling chief Lono-i-ka-makahiki (or Lono), a grandson of ‘Umi-a-Līloa, is said to have resided in coastal Kahalu‘u Ahupua‘a at an impressive high-walled complex (the Lono-i-ka-makahiki Residence; Fornander 1917:IV:2:356). There is a brief mention of Kahalu‘u in the stories concerning Lono. During his reign, Kamalālāwalu, the chief of Maui, decided to make war on the chiefs of Hawai‘i. Kamalālāwalu sent out spies to count the number of people in the coastal villages of the district of Kona. One of these spies was a man named Kauhiokalani, a swift runner who ran from Kawaihae in South Kohala all the way to Ka‘awaloa, an *ahupua‘a* in South Kona. He described the areas that he traveled through, including the coconut groves of Hōlualoa and Kahalu‘u (Kamakau 1992:56). The historian John Papa ‘Ī‘ī describes how some of these groves were reserved for the *ali‘i* of O‘ahu:

> Before the king and chiefs went to Kahalu‘u for the Makahiki, were seen some strange coconut trees in the midst of a coconut grove. The leaves of some of them

> had been bent over the dried nuts and plaited from the base of the leaf to the trunk, thereby holding up the nuts. This was truly an uncommon procedure and one not seen by I‘i anywhere else. We were told that no one was allowed to take the dried coconuts. All the chiefs who own groves were on O‘ahu, and perhaps that was why the caretakers of the land protected each chief’s grove. Not long afterwards, when the people who were to consume the nuts returned, such bound-up trees were seen no more. [‘Ī‘ī 1959:113]

When Kamalālāwalu heard the report from his spies that “there were many houses, but few men,” he was eager to stir his chiefs, his sons, and warriors to make war on Hawai‘i (Kamakau 1992:56-57). Kamalālāwalu and his army landed in Kohala and moved south to Kawaihae, but found no one there as the people were gathered in Waimea for “services at the heiau of Mailekini” (Kamakau 1992:58). Two old men of Kawaihae falsely advised Kamalālāwalu to dismantle his canoes and take his army to the Pu‘oa‘oaka battlefield in Waimea, knowing that the advantage would lie with the warriors of Hawai‘i Island. Indeed, Kamalālāwalu was killed, his army defeated on the grassy plain of Puakō (Kamakau 1992:60).

The details regarding the death of Kamalālāwalu as recounted in the earliest recorded traditions (e.g., Kamakau and/or Fornander) are contradicted by later accounts asserting that upon his defeat, Kamalālāwalu was brought to Kahalu‘u and sacrificed at either the *luakini* of ‘Ōhi‘amukumuku or Ke‘ekū. While Kamakau and Fornander do not specifically mention this sacrifice, they do they generally recognize these *heiau* as *luakini*.

Thrum was given information that the Maui king was sacrificed at ‘Ōhi‘amukumuku Heiau, (Emory et al. 1971:4; Thrum 1907b:71). Stokes’ informant Malanui, a grandson of the last priest of nearby Kapuanoni Heiau, placed the sacrifice of Kamalālāwalu at Ke‘ekū Heiau (SIHP # -3818; see Section 3), located in the project area (Stokes and Dye 1991:77). Kekahuna and Kelsey (17 March 1954) combined these traditions, writing that on ‘Ōhi‘amukumuku Heiau “the body of King Kama-lala-walu, of Maui, was ceremoniously displayed, following his sacrifice by King Lono-ika-makahiki in the noted Ke‘eku Heiau down on the shore.” Reinecke’s informant Kahulamu told him that “Kamalalawalu was impaled for ten or eleven days on the beach by Keeku, and then, as he still lingered, slain, and his body towed out for the Niuhi sharks” (Reinecke 1930:6). The 1952 Kekahuna map bears a notation indicating the “Compartment in which Chief Kama-lala-walu was held prisoner till sacrificed on the day following the night of Kū (see Figure 8).

Thrum (1907b:71) mentions that Kamalālāwalu’s two dogs, Kapapako (black dog) and Kauakahiokaoka (white dog), supposedly died beside the walls of Ke‘ekū and were buried there. Kekahuna’s 1952 map (Figure 8) includes the names of these dogs, indicating that “they were deified and proclaimed guardians of Ke-‘eku; the white dog was buried at the temple’s south-west corner, and the black dog at the north-west corner, of which corners they are respectively in charge.” This map (Figure 8) also indicates that at some point the bones of Kamalālāwalu and his dogs were taken back to Maui (Kekahuna 1952). Southwest of Ke‘ekū on a *pāhoehoe* flat in the tidal zone is a field of petroglyphs (“Ke‘ekū Petroglyphs,” SIHP # -12954). On his 1952 map (see Figure 8) Kekahuna indicates these petroglyphs marked the location where Kamalālāwalu was killed, and one of the petroglyphs is believed to represent Kamalālāwalu himself (see also Stokes and Dye 1991:77-79). Stokes was also given the information that Ke‘ekū served as a

pu‘uhonua, presumably some time after Kamalālāwalu’s invasion and defeat (Stokes and Dye 1991:77).

Thrum (1908a, 1908b; 1938) described Kapuanoni Heiau (SIHP # -10997; see Section 3, Figure 9, and Figure 10), also located in the present project area, as an “ancient *luakini* and *puuhonua*” built during the reign of Lono. This assessment was disputed by Stokes’ informant Malanui, who attested that Ke‘ekū and ‘Ōhi‘amukumuku were the only *luakini* in the area, and that Kapuanoni was used generally for prayer (Stokes and Dye 1991:70, 71, 77). Furthermore, Stokes attributed the construction of Kapuanoni to Kalani‘ōpu‘u (Stokes and Dye 1991:71). Reinecke was informed that this *heiau* was once the residence of Alapa‘inui, a ruler in the mid-1700s (Reinecke in Walker and Rosendahl 1989:10). Around 1950, Kekahuna was informed by Naluahine Kaopua that this *heiau* was used “to increase food and fish.” Based on the various historical references to this *heiau* and its relationship to others nearby, Cordy (1986a) concluded that it is likely Kapuanoni was used for worship in relation to farming and fishing (Walker and Rosendahl 1989:10).

According to Fornander (1880:122), Lono went around the island “. . . consecrating [existing] heiaus as acknowledgment to the gods for his victories.” One of these *heiau* was Mākole‘ā (Fornander 1917:IV:2:330). Thrum (1907b:71) and Stokes (Stoke and Dye 1991:80) mention Mākole‘ā Heiau only in connection with Lono. Kekahuna’s 1952 sketch (see Figure 8) notes that “Chief Lonoikamakahiki held ceremonies in the [Mākole‘ā] heiau, formerly a women’s heiau.” Lono is also said to have built Keahiolo Heiau (also called Ka‘io‘ena, SIHP # -4621), situated on the boundary of Kahalu‘u and Keauhou 1st (cf. Fornander 1969, Stokes and Dye 1991, and Reinecke 1930). More information about the *heiau* within the project area is given in Section 3.7.

In the “The Story of Lonoikamakahiki,” (Fornander 1917:IV:2:356), Lono was said to have lived at Kahalu‘u after his travels and wars were through. The connection of Lono with the *heiau* of Ke‘ekū may have led to the designation of a nearby dwelling site as the “Lonoikamakahiki Residence” (SIHP # -1576, also referred to as Kapukini or Paniau Heiau). Henry Kekahuna labeled this feature as such on his 1949 and 1952 sketches (see Figure 7, Figure 8, and Figure 11), although he later placed its construction with ‘Umi-a-Līloa (Kekahuna and Kelsey 1954).

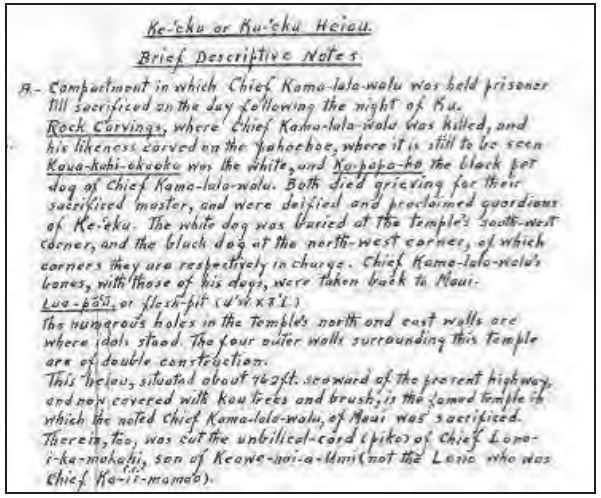

Figure 9. Portion of the 1952 sketch by Henry Kekahuna of Kahalu‘u Beach, showing the handwritten notations about Ke‘ekū Heiau and nearby petroglyphs

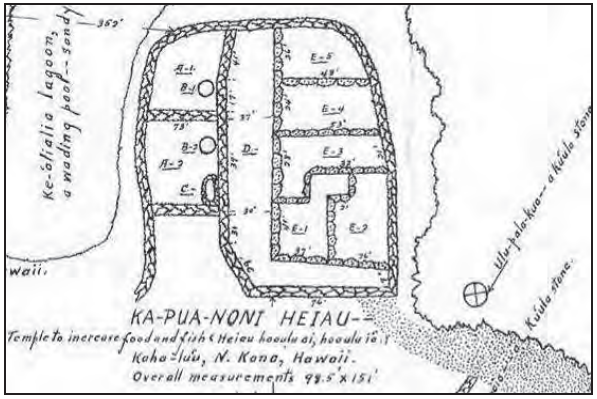

Figure 10. Portion of 1952 sketch by Henry Kekahuna of Kahalu‘u Beach, showing Kapuanoni Heiau and other significant cultural sites

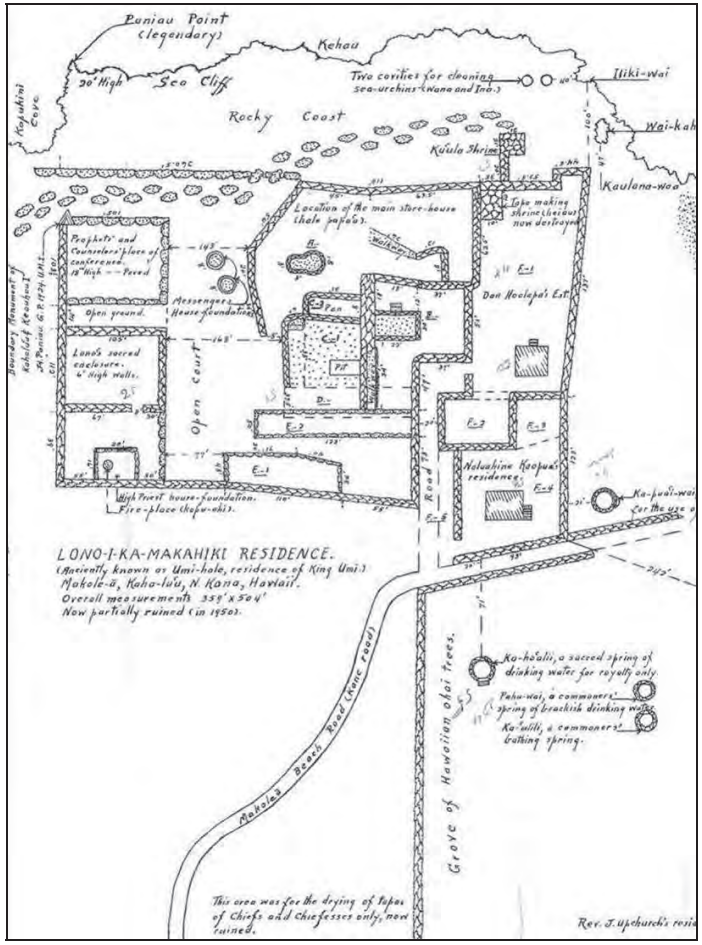

Figure 11. Portion of 1952 sketch by Henry Kekahuna of Kahalu‘u Beach, showing the Lono-i-ka-makahiki Residence, the Kahoali‘i, Kapua‘iwai, Ka‘ulili, and Pahuwai springs, and other cultural features

4.3 The Late Pre-Contact and Early Contact Period

4.3.1 The Time of Kalani‘ōpu‘u and Kamehameha I: Eighteenth Century to the Early 1800s

When Captain Cook died in 1779, it is said that the ruling chief Kalani‘ōpu‘u resided for some time around Kahalu‘u and Keauhou, occupying his time with *hula* (dance) and surfing (Kamakau 1992:105).

After a defeat on Maui, Kalani‘ōpu‘u spent a year preparing another army and building “houses for his war god Ka‘ili, ‘Ohi‘amukumuku at Kahaluu, and Keiki-pu‘i-pu‘i at Kailua as heiaus against sedition and for vengeance upon the chief of Maui” (Kamakau 1992:85). Fornander (1880:151-152) said that Kalani‘ōpu‘u “repaired and put in good order” these two *heiau*, implying they were already in existence. This may have also been the reason Kapuanoni was attributed to Kalani‘ōpu‘u by Stokes’ informant (see Section 3.7). According to Kekahuna and Kelsey (1954), in modern times the stones of ‘Ōhi‘amukumuku Heiau were used in building the first Helani Church; nothing remains of this structure today.

At the death of a high chief, it was the tradition to redistribute lands to the supporters of the new high chief. It was Kalani‘ōpu‘u’s wish that his son Kīwala‘ō, whose advisers were the chiefs of the Ka‘ū and Hilo Districts, would control his land, while his cousin, Kamehameha, who was allied with the Kohala and Kona District chiefs, had the care of his war god, Kūkā‘ilimoku. In the redistribution, presided over by his uncle Keawema‘uhili, many of the chiefs received only the lands they had previously controlled, including Kamehameha, who received only his original lands in Kohala. His supporters believed the six districts should have been divided equally, three districts to each Kamehameha and Kīwala‘ō. Keoua, the twin brother of Kīwala‘ō, was dismayed that neither he nor his brother received any new lands from the division by Keawema‘uhili. He questioned his brother about the lands:

> ‘Are Ola‘a and Kea‘au ours?’ The chief answered, ‘They have been given away; they are not ours.’ ‘How about Waiakea and Ponahawai?’ ‘They have been given away; they are not ours.’ . . . ‘Kahalu‘u then, and the two Keauhou?’ ‘They have been given away; they are not ours.’ ‘Then I am to have nothing in this division?’ ‘You are I are left without land in this division. Our uncle has taken it. Our old lands you will have.’ [Kamakau 1992:120]

Keoua was angry and gathered his fighting men. The next day they went to Ke‘ei and got into a quarrel with some of the men of Kamehameha’s party. They killed some of the men and took them to Kīwala‘ō who sacrificed them at his *heiau*. This action convinced Kamehameha and some of his allies to rebel. At the battle of Moku‘ōhai, Kīwala‘ō was slain by Ke‘eaumoku, and Kamehameha became the ruler of Kona, Kohala, and western Hāmākua. Over the next few years, Kamehameha conquered the entire island of Hawai‘i and then united all of the Hawaiian Islands under his rule (Cordy 2000:323-326; Kamakau 1992:118-124).

Both Kalani‘ōpu‘u and Kamehameha attempted to gain the support of the deities by constructing or rededicating the many *heiau* of Kahalu‘u. It is said that after his defeat by the Maui chief Kahekili ca. 1775, Kalani‘ōpu‘u built (or rededicated) the *heiau* of ‘Ōhi‘amukumuku at Kahalu‘u and Keikipu‘ipu‘i at Kailua as *heiau* against sedition and for vengeance (Kamakau 1992:85). Kamehameha is also said to have built (or rededicated) Kamaike‘ekū and

‘Ōhi‘amukumuku Heiau (Kamakau 1992:180). ‘Ōhi‘amukumuku in particular appears to have been regarded as particularly auspicious, for upon Kamehameha’s return to Kona in 1813, “his first object was to pray to the gods and for this purpose he made *kapu* the *heiau* of Hikiau and then that of ‘Ōhi‘amukumuku at Kahalu‘u” (Kamakau 1992:200). Kamehameha and his court are said to have resided at Kahalu‘u for about a year following his return (‘Ī‘ī 1959:113).

4.3.2 *Ali‘i Nui* (High-Ranking Chiefs) at Kahalu‘u

As noted above, Lono-i-ka-makahiki, Alapa‘inui, Kalani‘ōpu’u, and Kamehameha lived in Kahalu‘u (Tuggle 1989:10). Several other high-ranking chiefs were born at Kahalu‘u. Tomonari-Tuggle (1985) suggests that the association of these *ali‘i* births with Kahalu‘u was not one of any particular auspiciousness (as in *ali‘i* birthing places such as at Kūkaniloko, O‘ahu and Pōhaku Ho‘ohānau, Kaua‘i), but rather was the association of these lands with the ruling chief Ke‘eaumoku who was kin to these chiefs. Ke‘eaumoku played a major role in Kamehameha’s political ascent by personally killing his rivals Kīwala‘ō and Keoua (Tomonari-Tuggle 1985:23). This ruthless and independent “Kona Uncle” of Kamehameha the Great appears to have been awarded the *ahupua‘a* of Kahalu‘u and Keauhou for his services. Kalākaua (1972) writes the following:

> With the death of Kiwalao [in 1782] . . . the victory made Kamehameha master of the districts of Kona, Kohala, and Hamakua . . . Keeaumoku’s brilliant part in this first of the battles of the period for the sovereignty of Hawaii established him at once in the favor of Kamehameha, and raised him high in the esteem of the distinguished chiefs whose valor ennobled the closing years of barbaric supremacy in the group. [Kalākaua 1972:363]

The traditional site of Ke‘eaumoku’s residence, Moku-ahi-‘ole at Po‘o Hawai‘i (SIHP # -12953; see Section 3), is located within the project area. This site is identified as the “Ancient Home Site of Royalty” on Kekahuna’s 1952 sketch of Kahalu‘u Bay (see Figure 8). It was perhaps here that Ka-lua-i-konahale Kuakini (also known as John Adams Kuakini), the long-time governor of Hawai‘i Island, was born. At his birth in 1791, there was a great *hula* at Kahalu‘u, attended by a female cousin of Ke‘eaumoku to whom the child was given to suckle, and “. . . with him the land of Keauhou” where she raised the chief (Kamakau 1992:388). Keopuolani, the sacred chiefess of Maui who became the state wife of Kamehameha, may have been living in Keauhou by then (Kamakau 1992:260). Kuakini played an important role in shaping the future of Kona, and upon his death in 1844, his body was prepared for burial on the shore of Kahalu‘u (Kekahuna and Kelsey 1954:7-8). Kamakau (1992:389, 391, 394) also wrote of the high chiefess, Kekāuluohi, who was brought up in Kahalu‘u and Keauhou by her grandparents Ke‘eaumoku and Namahana (ca. 1794-1803).

4.4 Western Contact at Kahalu‘u: 1794 to 1819

By 1794, there was a foreigner in residence at Keauhou engaged in the manufacture of charcoal to supply visiting western ships (Menzies 1920:149). While this operation played a part in keeping the port there viable, it seems probable that the population of Kahalu‘u overall declined rapidly in the early historic period. This would have been due not only to introduced diseases but also to demographic shifts to Kailua and Ka‘awaloa. With its many *heiau* suddenly

abandoned, people no longer visited Kahalu‘u with their hogs and other offerings (Mann et al. 2003:9).

4.4.1 Merchants and Missionaries: 1820 to 1850

The departure of the center of the Hawaiian Kingdom’s government from Kona, Hawai‘i to Lahaina, Maui and Honolulu, O‘ahu in 1820 was a demographic catastrophe for places like Kahalu‘u, which must have relied at least in part on royal patronage. This loss would have been partially off-set by the continuing victualing trade with visiting foreign ships and the trade in sandalwood. Mackintosh (1838:2) wrote that the anchorage at Keauhou Bay “is resorted to by vessels for cargoes of firewood, sandalwood and other commodities of produce.” Keauhou was well-suited to funnel the bounty of the Kona Field System, which quickly included new cultigens such as coffee, melons, maize, Irish potatoes, beans, and citrus to supply shipping. Keauhou may have always been particularly well-suited geographically for the transportation of forest resources to the coast and the sandalwood of a vast interior could have been transported down through Keauhou to the waiting ship holds at Keauhou Bay.

It was missionary William Ellis of the London Missionary Society who provided a description of Kahalu‘u in 1823. As mentioned above, Ellis had reported 19 *heiau* and 610 houses between Kailua and Keauhou, and eight *heiau* and 443 houses between Keauhou and Ka‘awaloa (Ellis 1969:121). Describing a stepping stone trail across a mile-wide stretch of *‘a‘ā* which connected the Kahalu‘u and Keauhou villages, Ellis also took note of the houses of people on hillsides (Ellis 1969:121).

4.4.2 The Māhele ‘Āina (Land Division)

In 1845, the Board of Commissioners to Quiet Land Titles, also called the Land Commission, was established “for the investigation and final ascertainment or rejection of all claims of private individuals, whether natives or foreigners, to any landed property” (Chinen 1958:8). This led to the Māhele ‘Āina of 1848, the division of lands between the King of Hawai‘i, the *ali‘i*, and the *maka‘āinana* (common people), which introduced the concept of private property into Hawaiian society. Previous to the Māhele, all land belonged to the *akua* (gods), held in trust for them by the paramount chief, and managed by subordinate chiefs.

Under the Māhele, Kamehameha III divided the land into four divisions: certain lands to be reserved for himself and the royal house were known as Crown Lands; lands set aside to generate revenue for the government were known as Government Lands; lands claimed by *ali‘i* and their *konohiki* were called Konohiki Lands; and habitation and agricultural plots claimed by the common people were called *kuleana* (Chinen 1958:8-15). Land Commission Awards (LCAs) for *kuleana* parcels were awarded to commoners and others who could prove residency on and use of the parcels they claimed. In theory, this “setting aside” of hundreds of thousands of acres as potential *kuleana* parcels ultimately led to about 10,000 claimants obtaining approximately 30,000 acres, while 252 chiefs, for example, divided up about a million acres. Many or most Hawaiians were simply disenfranchised by these acts.

In the division of lands, or Māhele ‘Āina, of 1848, Victoria Kamāmalu was awarded the 5,443 acres of Kahalu‘u (LCA 7713:6; Royal Patent 6856). That these lands were retained by the Kamehameha dynasty reflects their apparent value. However, the documentation of large royal

land awards provides little specific land use data. It was subsequent *kuleana* award documents that offer the most detailed land use data.

There were a total of 89 *kuleana* claims by commoners in Kahalu‘u, of which 59 were awarded (Table 2). As is typically the case, the sizes of the *kuleana* LCA parcels were relatively small, ranging from 0.07 to 4.40 acres in size. Of the 56 LCA awarded in Kahalu‘u, 46 included at least one house lot near the shore; 28 of these house lots were clustered around the north end of Kahalu‘u Bay and 18 were scattered south of the bay; suggesting only ten claims in upland Kahalu‘u. Seven LCA parcels were awarded within the current project area (Table 3; Figure 12). These *kuleana* included up to 11 discrete parcels (*‘āpana*). The *kuleana* awards within the project area indicate that, at the time of the Māhele, habitation was the primary activity; the claims mention houses, roads and/or paths, and walls and/or fences (presumably including house site enclosures). More than one testimony mentions that the land was “idle,” and while there are claims of *kīhapai* (cultivated patches, gardens), no specific crops are named.

An interesting feature of the land claims is that many of the awardees did not claim possession of the land over a long period of time, and (as noted above) were up-front about the occupying families having moved onto vacant or idle land (Tomonari-Tuggle 1985:30). Archaeological evidence clearly indicates a wide belt of permanent habitation had contracted to a narrow coastal strip in the early historic period. By 1850, many of the families that once resided in Kahalu‘u had either died out or moved away. Depopulation, the collapse of the religious center, the focus of trade on Kailua and Ka‘awaloa, and the depredations of cattle, horses, and goats inland of the Kuakini wall would all have been factors underlying this demographic change (Tomonari-Tuggle 1985:30).

Table 2. LCAs in Kahalu‘u Ahupua‘a (Waihona ‘Āina 2009); Bold Entries Fall within the Project Area

LCA Number	Awardee	*‘Ili*
3440-B	Kaluahinui	Pakii 2
3441-B; 5635-H	Naaho	Makoha
3443-B; 128-C	Kuia	Koaie 3
3444-B; 130-B	Kapihe	Koaie 3
3445	Kahananui	Kihikihi
3446-B	Kahue	Kukuihae
3447-B	Palaukae	Kukuihaa 5
3455-B	Maikeiki, *wahine*	Kukuihaa 3
5632	**Keikihookama**	**Makolea, Lehuakona, Pakii 1, Ulumoe**
5635-B	Imakakoloa	
5635-E	Keomano	Kumuhawane
5635-P	Maiikeiki	Kukuihaa 3
5635-Q	Kauiaa	Pahoa 2

LCA Number	Awardee	*‘Ili*
5642	Kokuahine	Haliipalala
5671-B	Kanehewahewa	Haliipalapala 3
5672	Kahalelahaole	Pahauopu
5673	Kamalo	Hokio 2
5673-B	Naahau	Kamuku
5673-C	Naahau	Puekahi
5676	Keliaihue, W.H.	Puuhinahina
5677	Kauwa	Kamuku
5678	Kauwale	Pamaki
5682	Keaupuni, *wahine*	Umihale
5683	Kualu	
5683-B	Kamauhili	
5683-BB; 5681	Keliihelelau	Hokio
5684	Kauahulimoana	
5685	Keakahaapoli	
5686	Keau	
5687	Kuaana ma	
5687-A	Papa	Ililoa
5687-B	Kaukihelani	
5687-E	Moeloa	
5688	Leleola	Lehuakona, Makakiloia
5688-B	Kameeui	Makakiloia
5689	Nahoounauna	Kukuihaa, Koaie, Lehuakona
5690	Kanakole	Kihikihi 2, Pakii, Pahoa
5691	Kamaui	Makolea, Pakii 1
5693	**Koolau**	
5694	**Kawakoekoe**	**Hokio**
5695	Kaulike	Haliipalala 5
5831	Kaeha	Kukuihaa 4
5831-B	Kanalu	Kukuihaa 1, Kaunamoa
5895	Peekoa	
5915	**Pawai**	**Hapaialii**
5966	**Maheu**	

LCA Number	Awardee	*‘Ili*
5966-B	Imakakoloa	Kukuiokahinu
6026	**Lanai, Ikaaka**	**Poohawaii, Hanapouli, Waioha**
6027	**Kapiimi, *wahine***	
6029	Nakea	Paulu?
6030	Noholowaa	Paulu?
6032	Napio	Makailoia, Makolea, Ulumoe, Pakii 6, Pahoa
6071	Hoopale	
6091	Malaihi	Kaloaulu
6094	Umiumi	Kamuku 1
6128	Napipi	Kukuiohaa
6129	Nawaimaka	
6139	Nakowana	
6143	Naauhau	Kealaehu
*7713*H*	*Kamamalu, Victoria*	*Ahupua‘a Award*
10258	Maikai	Kaohia, Haleape, Waipio, Haliipalala
10766	Pio	Kamuki, Ioaie

Table 3. Land Use in the LCAs Located within the Project Area

LCA Number	Awardee	Land Use
5632	Keikihookama	Eleven *‘āpana*; one house lot; 20 *Kīhāpai*/*Pākanu*; one Royal Patent
5693	Koolau	One *‘āpana*; one house lot; two houses
5694	Kawakoekoe	Seven *‘āpana*; 19 *Kīhāpai*/*Pākanu*; one Royal Patent; awarded two *‘āpana*, Kawakoekoe and Koolau
5915	Pawai	One *‘āpana*; one house lot; one Royal Patent; two houses
5966	Maheu	One *‘āpana*; one house lot; one Royal Patent; Claim 1 is awarded two *‘āpana*, two houses
6026	Lanai, Ikaaka	Two *‘āpana*; two house lot; one Royal Patent
6027	Kapiimi, *wahine*	*One ‘āpana*; one house lot; one house

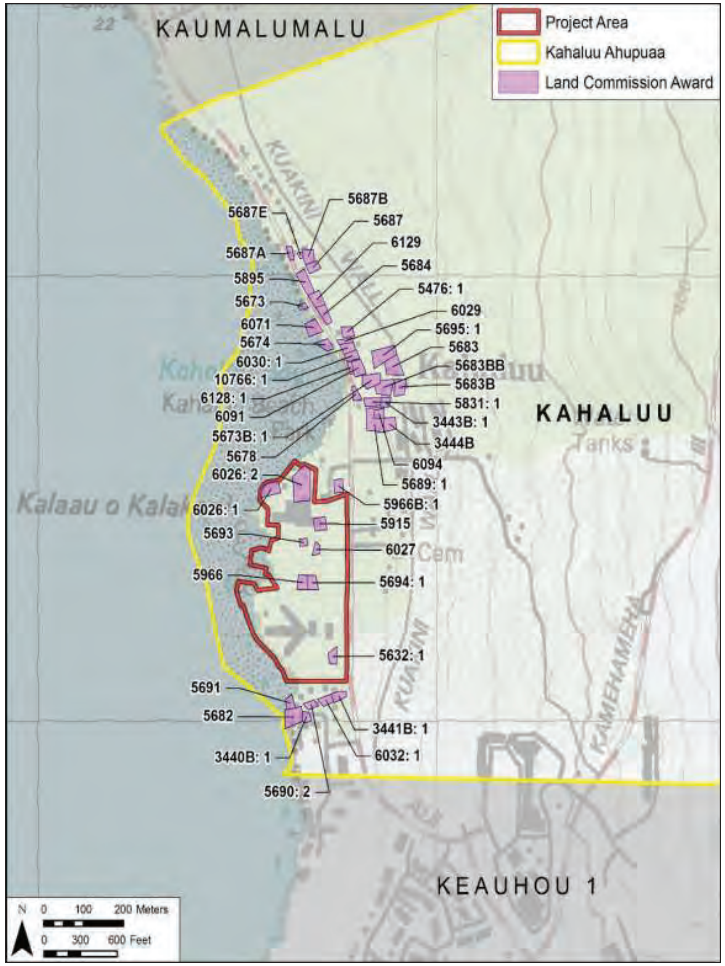

Figure 12. Portion of 1996 Kealakekua USGS 7.5-Minute topographic quadrangle showing locations of LCAs within and in the vicinity of the project area

4.4.3 Early Land Tenure

Maly and Maly (2012:444) report that the earliest record of land title with the Bureau of Conveyances for the Kahalu‘u-Keauhou area dates to 1856; it was in the decade following that “numbers of records began to be registered in the collection of public conveyances.” Land conveyances within the Kahalu‘u Ahupua‘a were mainly *mauka* of Government Road (currently known as Ali‘i Drive), and were either deeded or five- to 20-year leaseholds transferred to native heirs or foreigners to plant coffee, ranch, gather timber for firewood, or build houses and/or fences (Maly and Maly 2012:444–522). Land conveyances *makai* of Government Road were either deeded or one- to seven-year leaseholds transferred to native heirs or foreigners to gather coconuts for food purposes or graze livestock (Maly and Maly 2012:444–522).

A 23 May 1905 lease application for a roughly 2,800-acre portion of *makai* lands at Kahalu‘u and Keauhou 1 and 2 indicate activities such as fishing, grazing, and cultivation of coffee and fruit. The proposed lease was to except and reserve “. . . all *kuleana*s not owned by the lessors, also reserving such rights of way that may be necessary from the *mauka* Government road to the sea” (Maly and Maly 2012:410).

4.4.4 *Ala Loa* and *Ala Pi‘i*

Concurrent with the Māhele ‘Āina, business interests in the region were expanding, necessitating improved road systems to facilitate the use of horses and wagons (Maly and Maly 2004:67). Oftentimes traditional trail routes were improved for this purpose, as these trails usually followed ideal routes across the landscape. At that time, one *ala loa* (lateral trail crossing through the district) encircled the island near the shore, following the current Ali‘i Drive alignment through the lands of Kahalu‘u and Keauhou. A second *ala loa*, known as “Kealaehu” crosses through the uplands in the vicinity of the current Māmalahoa Highway (Maly and Maly 2004:67).

Within an *ahupua‘a*, *ala pi‘i*, or *mauka-makai* trails, served to provide native tenants with access to their *kuleana*, which were usually situated at several elevational zones from the shore to the upland forests (Maly and Maly 2004:67). Three trails valued as traditional *ala pi‘i* by elder *kama‘āina* of the Kahalu‘u-Keauhou area include the Keauhou Trail, extending from Ha‘ikaua on Keauhou Bay; the Kahalu‘u or Mākole‘ā Trail, extending from near the Po‘o Hawai‘i on the shore to the forest and in use up the late 1940s and the historic Keauhou-Kāināliu Trail (St. Paul’s Trail) extending from Keauhou Bay to the *mauka* village of Kāināliu (Maly and Maly 2004:135). Reinecke (1930:1) also indicated “a network of lesser paths” through the area.

4.4.5 Boundary Commission and Land Survey Documents

The apportionment of land under the Māhele ‘Āina and subsequent sale of Government Lands required the establishment of a Boundary Commission (1864–1935), tasked with determining the boundaries of each of the island *ahupua‘a*. This involved conducting field surveys as well as hearing testimonies of native residents who were familiar with traditional boundaries and landmarks. These testimonies, though at times contradictory, often provide a wealth of information including traditional place names and land uses.

Surprisingly, the LCA and the Boundary Commission testimonies reveal striking changes in the vegetation in the nineteenth century. Informants stated that the forest zone was expanding. References include, “When I was young there were no trees there. But now the trees have grown up” (Boundary Commission testimony of Waiau, 1875); “At that time [i.e., going with his father] this place was above the woods and you could see from Kiha to Waio, now the trees are all grown up” (Boundary Commission testimony of Kahulialo, 1873); and “The woods extend there now. In olden times there were hardly any trees there” (Boundary Commission testimony of Keakaukawai, 1873).

Chronological references in the Boundary Commission testimonies are in terms of major events, not to specific dates. For example, informants related their births to “the death of Kamehameha I” (Keakaukawai), “The time of Kuewai o la lae” (Palea). Chronologically, this represents informants testifying in 1873, who were born in the early 1800s.

For specific information on the testimonies, surveys and Certificates of Boundaries for Kahalu‘u Ahupua‘a, see Maly and Maly (2004:74-78; 2012:351-358). Also see accompanying AIS for this project area (Wheeler et al. 2014).

4.5 Middle to Late Nineteenth Century

Lacking sufficient water and easily convertible land, the Kona Coast of Hawai‘i was largely spared the changes associated with plantation agriculture that affected so much of Hawai‘i. Economic opportunities created by this commercial agriculture elsewhere was another pull for relocation away from Kahalu‘u. Tomonari-Tuggle (1985) notes that according to Kingdom of Hawai‘i tax ledgers, the population of this area dropped from 72 in 1857 to 24 in 1881. While the overall importance of the Kona Coast diminished, the relative importance of Keauhou on that coast may have increased, as Kealakekua Bay (Ka‘awaloa and Napō‘opo‘o) became less important as an entry point.

The impetus of getting market-oriented produce to port centers like Keauhou, Kailua, and Kealakekua shifted the remaining population. This is made evident by the relatively large number of LCA parcels, 19 in Keauhou 2nd and 50 in Keauhou 1st. In addition, at Keauhou Bay there were a few stores, a church, and a schoolhouse. Based on the government license ledger for retail outlets between 1855 and 1870, “Keauhou may have been one of the more active areas along the coast” (Tomonari-Tuggle 1985:31-32). In her survey of Government license ledgers between 1855 and 1870, Tomonari-Tuggle (1985:32) notes 11 applications (by five individuals) for enterprises at Keauhou in comparison with 25 applications at Kailua, ten for Kealakekua, seven for Napō‘opo‘o, four for Ka‘awaloa, and three each for Hōlualoa and Hōnaunau. Curiously, fishing appears to have been a minor enterprise during this period.

The uplands of Kahalu‘u/Keauhou became more important as the century drew to a close with the growth of the ranching operations and small plantations used to grow coffee. The uplands from approximately 457.2 to 1,371.6 m (1,500 to 4,500 ft) in elevation were at first used for grazing cattle, goats, and other livestock. Uplands from approximately 182.9 to 457.2 m (600 to 1,500 ft) in elevation were used for the cultivation of small plantations growing oranges and coffee. The trustees of Victoria Kamāmalu leased large portions of her award in Kahalu‘u for grazing land and for coffee cultivation (Maly and Maly 2004:98-100). Coffee in Kahalu‘u, as evidenced by the LCA information, was grown as an early commercial enterprise in small

individual plots. The coffee industry went through a number of booms and depressions through the late 1800s, due to introduced diseases and price fluctuations.

Chinese and Japanese immigrants who had fulfilled their labor contracts to sugar plantations eventually became the dominant coffee growers. The coffee farmers for the most part lived on the farms in the upland agricultural zone, with no corresponding coastal habitation. Keauhou Bay still contained a church, a school house, post office, and by 1920, a single store. The focus of settlement was the *mauka* government road (i.e., Māmalahoa or Belt Highway).

4.6 Twentieth Century

The early 1900s continued the pattern of population movement from the coastal areas to the uplands. During this period, Keauhou was known as the “end of the road” in the Kona region (Walker and Rosendahl 1989:11). Albert S. Baker, a clergyman of Kona and Ka‘ū, described the seacoast in the area of Kahalu‘u-Keauhou as it appeared about 1915 (Emory et al. 1971):

> A half-mile north of Keauhou is still found a short branch trail to the shore, of ancient stepping-stones brought from the beach at Keauhou. Another half-mile brings us to Kahalu‘u, an ancient sacred locality of many heiaus . . . by the upper side of the trail just before the stone church, is a part of the old execution stone used in Kuakini’s time . . . Just a little above, 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 . . . [Emory et al. 1971:9]

It appears there were a few somewhat unsuccessful attempts at growing sugar in Kahalu‘u during the late nineteenth century. The Kona Sugar Company had a short life, operating from 1898 to 1903. In 1906, the property was bought and redeveloped by James B. Castle, who founded the Kona Development Company, which harvested sugar on the lands for the next 20 years. During this time 11 miles of railroad were installed, with a station at the Kona mill. The West Hawaii Railway Company developed with the intent of further connecting the railway to North and South Kona (30 miles of track) with access to bays along the coast. This idea lost steam and the original 11 miles remained the extent of the railroad though North Kona.

The early twentieth century saw a boom in the coffee industry in the Kona uplands. Habitation along the coast was generally abandoned, as coffee growers moved to one of the many small towns that sprang up along the upland Māmalahoa Highway to be near their coffee farms and a convenient transportation route to the boat landing at Kailua-Kona.

Tourism grew almost exponentially in the decades after World War II, and the boom starting just a couple of decades later radically changed the face of Kahalu‘u. Figure 13 and Figure 14 show the Kahalu‘u coastline in 1962; these photographs document the relatively undeveloped nature of the area at that time. Later that decade, a golf course was built in Kahalu‘u-Keauhou (Keauhou Resort). After the completion of the golf course, hotel condos and single family residences sprang along its edges, thus returning residential occupation of significant numbers to the coastal zone. The construction of the Outrigger Keauhou Beach Resort (KBR) in 1968 and the former Kona Lagoon Hotel in 1975 (both within the project area) capitalized on this increased tourism. Since the early 1980s the Keauhou-Kahalu‘u area of North Kona has become

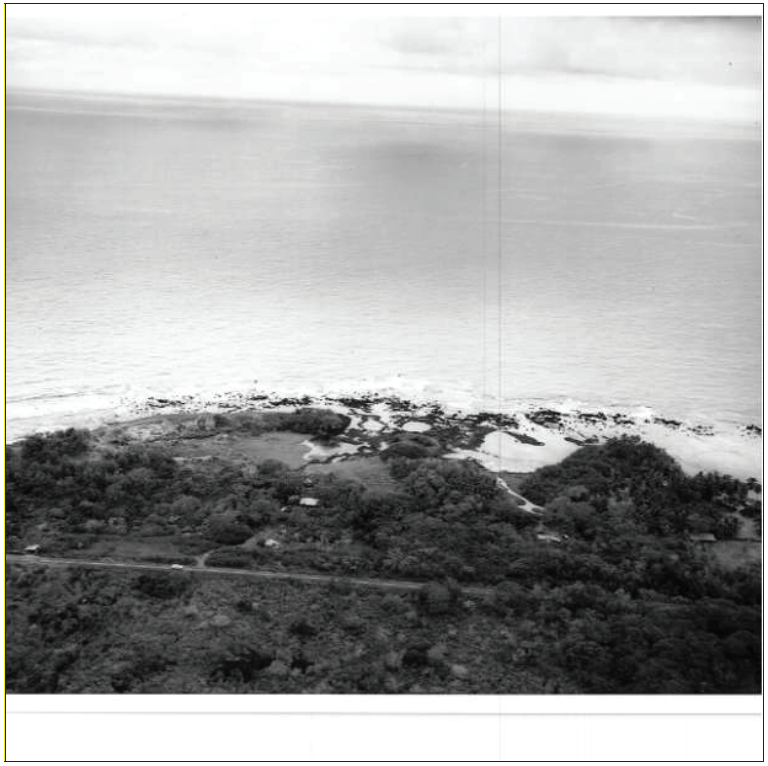

Figure 13. 1962 aerial photograph (courtesy of client) showing the relatively undeveloped Kahalu‘u coast with Ke‘ekū and Hāpaiali‘i Heiau within the present project area

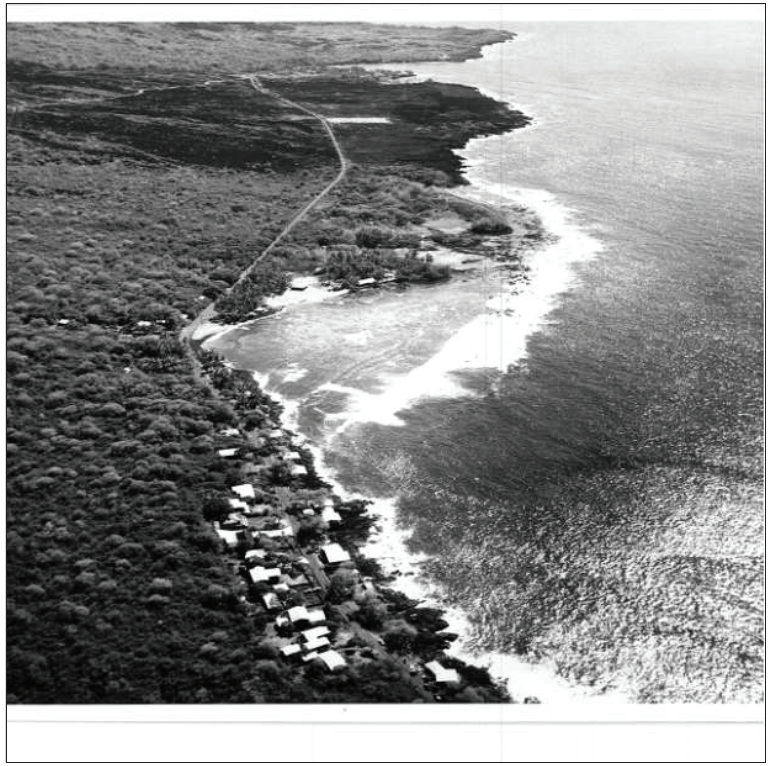

Figure 14. 1962 aerial photograph (courtesy of client) showing the relatively undeveloped coastline of Kahalu‘u and Keauhou

a major resort center with coastal hotels, new shopping centers, golf courses, and residential developments (see Figure 5).

The Kona Lagoon Hotel, the arrow-shaped structure appearing on the modern USGS map (see Figure), was situated over the site of Keawehala Pond (Site # Ha-D4-52). Many locals believed the hotel was cursed because of its location on and amongst many significant archaeological sites. It ceased operation in 1988; subsequent proposals to redevelop the property fell through.

4.7 Twenty-First Century

Presently, some of the prime agricultural lands of Kahalu‘u remain under coffee cultivation and the Belt Highway is still a focus of the local community.

The Kona Lagoon Hotel was demolished in 2004; this activity was monitored under an archaeological monitoring plan prepared by Haun and Henry (2004a and b). This area is now a landscaped cultural preserve.

In 2007 and 2008, T.S. Dye & Colleagues, Archaeologists, Inc. prepared preservation plans for Hāpaiali‘i, Kapuanoni, Ke‘ekū, and Mākole‘ā Heiau and Po‘o Hawai‘i, to be carried out by Kamehameha Investment Corp. Inc. (KIC), a for-profit subsidiary of Kamehameha Schools (Stanton 2008). Restoration work was made in consultation with several Hawaiian organizations and local individuals and was based on historical sources (e.g., the works of John F.G. Stokes and Henry Kekahuna) and modern archaeological investigation. The main goal of restoring these features is to return them to their appropriate cultural use and support educational programs; the stabilization of Po‘o Hawai‘i is designed to restore it as habitat for native animals (Dye and Ayau 2007:1, 2008:1). Three *heiau* have been restored: Hāpaiali‘i Heiau, Mākole‘ā Heiau, and Ke‘ekū Heiau (Figure 15).

As of 31 October 2012, the KBR hotel has been closed.

Figure 15. 2013 CSH photograph showing the restored Ke‘ekū Heiau

Section 5 Archaeology

5.1 Archaeological Research in the Area

Keauhou/Kahalu‘u is one of the most studied areas in Polynesia. A large majority of the studies, especially archaeological surveys of the large habitation/*heiau* complexes, are near the coast, *makai* of Ali‘i Highway. Many of these sites are part of the Kahalu‘u Historic District (SIHP # -04150), which was placed on the National Register of Historic Places (NRHP) in 1974 and encompasses the project area. Virtually all of the archaeological studies documented not only provide evidence of human occupation, but also evidence of permanent habitation and agricultural development in areas that have not been previously disturbed. The extensive agricultural complexes in the inland portion of Kahalu‘u are part of the Kona Field System (SIHP # -6601), which was nominated to the NRHP in 1977.

The first archaeological study in the area was the survey of prominent structures, mainly *heiau*, by Bishop Museum archaeologist John F.G. Stokes in the early 1900s. This was followed by a similar study by Bishop Museum archaeologist J.E. Reinecke from 1929–1930. In the 1930s, the first study of the large underground refuge cave, ‘Ōhi‘a Cave (SIHP # -7962), was made by K.P. Emory of the Bishop Museum. Numerous additional studies have been conducted at ‘Ōhi‘a Cave and the surface sites in ‘‘Ōhi‘a Reserve, including extensive mapping and excavations (e.g., Tomonari-Tuggle and Allen 1983).

Since the 1970s, a large number of studies in Kahalu‘u were conducted for the Kamehameha Investment Corporation (KIC), in an area originally called the Keauhou-Kona Resort, but now referred to as the KIC Development Parcels. This development area extends from the coast to Kuakini Highway and from Kahalu‘u through Keauhou 1 and 2.

By 1983 (summary in Tomonari-Tuggle and Allen 1983:6), 217 sites had been recorded in the KIC development area; these consisted of an almost continuous spread of agricultural sites along the slopes of Hualālai Volcano, with concentrations of features within and adjacent to swales. A wide belt of permanent habitation began at the coast, with scattered permanent habitations extending up the slopes to at least the elevation of the modern Kuakini Highway. While it has generally been understood that the optimal area for agriculture lies above 1,000 ft elevation, there are widespread indications of fairly intensive agriculture at lower elevations as well. This record of pre-Contact/early post-Contact habitation and agriculture was disturbed in several areas by mid-nineteenth century habitation sites associated with Māhele LCA homesteads, the destruction and/or modification of old agricultural features for the new cultivation of coffee in the nineteenth and twentieth centuries, and later residential and commercial land development. For a more extensive discussion of the archaeology of the Kahalu‘u area, see companion AIS (Wheeler et al. 2014).

5.2 Archaeological Studies within the Project Area

Including the earliest coastal surveys (e.g., Stokes 1906-1907 and Reinecke 1930), nine archaeological studies have been conducted within the present project area (ten if accompanying AIS is included; see Wheeler et al. 2014). It should be noted that while the present project area is

understood to be defined on the *makai* side by the high-tide line, some of these archaeological studies typically extended beyond this limit into the sea, leading to the documentation of sites within the surf zone, such as Pāokamenehune. These studies are further discussed in the forthcoming AIS (Wheeler et al. 2014).

5.3 Sites Recorded Within the Project Area

Thirteen sites have been recorded within the present project area, taking into consideration the subsumation of temporarily numbered features into single SIHP sites, and including those sites no longer present. Of the 13 sites in the project area, four are recognized as part of the Kahalu‘u Historic District (SIHP # -04150). These include SIHP # -03817 (Hāpaiali‘i Heiau), SIHP # -03818 (Ke‘ekū Heiau), SIHP # -03819 (Mākole‘ā Heiau), and SIHP # Ha-D4-34/-01616 (burial platform destroyed by the Kona Lagoon Hotel construction). These sites are summarized in Table 4 and are indicated on a 2010 aerial photograph (Figure 16) and TMK map plat (Figure 17).

Table 4 lists the SIHP number as well as other site numbers where applicable; the place name associated with the site where applicable; past archaeological studies under which the site was documented; the formal site type and function; the probable site age; the significance evaluation and recommendation (most current as determined through research into previous archaeological studies); and the present status of the site and/or any other applicable comments.

Information from Table 4 is derived from the Archaeological Information Consolidation Project (AICP) in 2009 which Kamehameha Schools-Land Assets Division (KS-LAD) created to manage the large amount of data on the Kahalu‘u and Keauhou 1 and 2 area for future planning and development (Komori 2009:2). The project resulted in three informational databases, including previously recorded sites and Geographic Information System (GIS) data for the subject *ahupua‘a*. Table 4 represents a synthesis of information found in these databases and current background research. For more information, see Appendix B of companion AISP (Wheeler et al. 2013) and companion AIS (Wheeler et al. 2014).

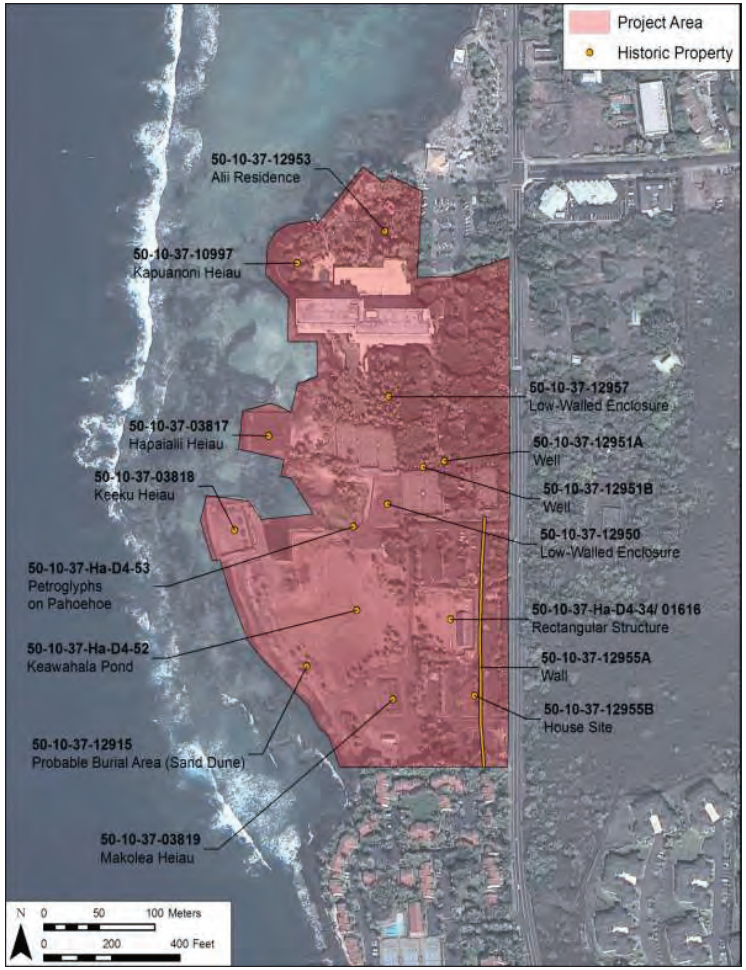

Figure 16. 2010 aerial photograph (Google Earth 2010) showing sites previously recorded within the project area

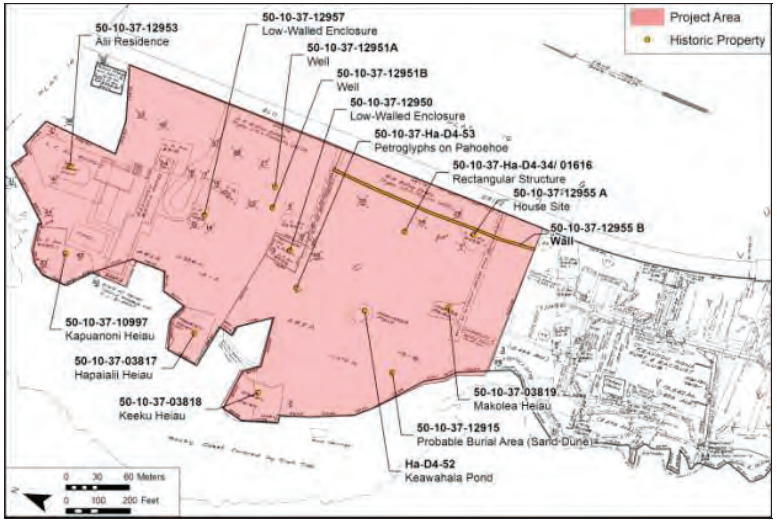

Figure 17. Tax map plat 7-8-013 (Hawai‘i TMK Service) showing sites previously recorded within the project area

Table 4. Sites Previously Recorded Within the Project Area

SHP Number	Other Site Number	Site Name	Past Studies	Site Type	Site Function	Site Age	Significance Evaluation*	Recommendation(s)	Status and Comment(s)
50-10-37-03817	50-Ha-D4-2, H-00165-25	Hāpaialiʻi Heiau	Stokes 1906-07; Reinecke 1930; Sterling 1960; Cordy 1986b; Walker and Rosendahl 1989; Tuggle 1990	Enclosure, *heiau*, pavement, platform	Ceremonial, religious	Pre-Contact; built between AD 1200s or 1300s–1400s	Walker and Rosendahl (1989): a, b, and c	Restoration, preservation	Restored
50-10-37-03818	50-HA-D4-3, H-00073-4, H-00165-24	Keʻekū Heiau	Stokes 1906-07; Reinecke 1930; Sterling 1960; Emory et al. 1971; Walker and Rosendahl 1989; Tuggle 1990; Haun and Henry 2004a, b	Depression, enclosure, *heiau*, platform	Ceremonial, religious	Pre-Contact; built between AD 1200s–1300s	Walker and Rosendahl (1989): a, b, and c	Restoration, preservation	Restored; nominated to Hawaiʻi Register of Historic Places (HRHP) on 24 July 1972
50-10-37-03819	50-Ha-D4-5, H-00073-6, H-00165-22	Mākoleʻā Heiau or Keʻekua-puaʻa Heiau	Stokes 1906-07; Reinecke 1930; Sterling 1960; Emory et al. 1971; Walker and Rosendahl 1989; Tuggle 1989, 1990; Haun and Henry 2004a, b	Enclosure, *heiau*, pavement, wall	Ceremonial, religious	Pre-Contact	Walker and Rosendahl (1989): a, b, and c	Restoration, preservation	Restored; nominated to HRHP on 24 April 1972
50-10-37-10997	H-00073-2, H-00165-41	Kapuanoni Heiau	Stokes 1906-07; Reinecke 1930; Sterling 1960; Cordy 1986a; Walker and Rosendahl 1989; Tuggle 1990	Enclosure, *heiau*, pavement	Ceremonial, religious	Pre-Contact	Walker and Rosendahl (1989): a, b, and c	Restoration, preservation	Not yet restored
50-10-37-12915	H-01426-AZK-7	--	Tuggle 1990	Sand dune	Probable burial	Unknown, likely pre-Contact	None found	Archaeological monitoring for any earth-disturbing activity; will be placed in a Conservation category if proven as a burial site (i.e., if remains exposed at a future date)	No current information on exact location of burials; listed as a "probable site" (as of 1990)
50-10-37-12950	PHRI 439-50, H00769, H01426	--	Walker and Rosendahl 1989; Tuggle 1990	Complex	Habitation	Historic; dates from nineteenth century	Walker and Rosendahl (1989): a	Additional data recovery	Site is remnant of a *kuleana* lot (LCA 5966), shown on Kekahuna's (1952) sketch as the home of the caretaker of the twin *mo'o* sisters of Keawehala Pond
50-10-37-12951	PHRI 439-51, PHRI 439-52, H-00769, H-01426	--	Walker and Rosendahl 1989; Tuggle 1990	Faced well complex (Features A and B)	Habitation	Historic; dates from nineteenth century	Walker and Rosendahl (1989): a	No further work recommended for wells	Present though likely modified in modern times

SHP Number	Other Site Number	Site Name	Past Studies	Site Type	Site Function	Site Age	Significance Evaluation*	Recommendation(s)	Status and Comment(s)
50-10-37-12953	PHRI 439-53, H-00165-43, H-00748-11881	Poʻo Hawaiʻi	Reinecke 1930; Walker and Rosendahl 1989; Tuggle 1990	Complex including walled pond and adjacent habitation area	Habitation	Unknown	Walker and Rosendahl (1989): a, b, and c	Restoration, preservation	Not yet restored; adjacent Kalakāua's Residence reconstructed in the 1970s
50-10-37-12955	PHRI 439-55, PHRI 439-56, 50-Ha-D4-47, 50-Ha-D4-49,	--	Emory et al. 1971; Walker and Rosendahl 1989; Tuggle 1990; Haun and Henry 2004a, b	Complex	Boundary, habitation	Historic; dates from early 1800s to the mid-1900s	Walker and Rosendahl (1989): a	Conditional preservation *until* additional data recovery can be conducted	Site is remnant of a *kuleana* lot (LCA 5632:1) granted to Keikiboʻokama; to be restored under present project; mistakenly identified by Emory et al. (1971) as containing a portion of Kuakini Wall
50-10-37-12957	PHRI 439-57	--	Walker and Rosendahl 1989; Tuggle 1990	Complex	Habitation	Historic; probably dates from the mid- to late nineteenth century	Walker and Rosendahl (1989): a	Conditional preservation with archaeological monitoring of earth-moving activities in area outside the site *until* additional data recovery can be conducted	Site is remnant of a *kuleana* lot (LCA 5693)
50-10-37-Ha-D4-34	50-Ha-D4-34	--	Emory et al. 1971; Barrera 1971	Platform	Possible burial	Unknown	None found	N/A	Destroyed by construction of Kona Lagoon Hotel (per Walker and Rosendahl 1989:24)
50-10-37-Ha-D4-52	50-Ha-D4-52	Keawehala Pond	Emory et al. 1971; Barrera 1971	Stone-lined pond	Bathing pool	Unknown; likely pre-Contact	None found	N/A	Traditionally considered to be the home of twin *mo'o* sisters; filled for construction of Kona Lagoon Hotel; site now a level landscaped area (per Walker and Rosendahl 1989:24)
50-10-37-Ha-D4-53	50-Ha-D4-53	--	Emory et al. 1971; Barrera 1971	Petroglyph field	Rock art / communica-tion	Unknown; likely pre-Contact	None found	N/A	Likely destroyed by construction of Kona Lagoon Hotel; not confirmed by Walker and Rosendahl (1989:24)

Section 6 Community Consultation

Throughout the course of this assessment, an effort was made to contact and consult with Hawaiian cultural organizations, government agencies, and individuals who might have knowledge of and/or concerns about traditional cultural practices specifically related to the study area. CSH compiled the list of community contacts below with assistance from Kamehameha Schools. The outreach effort was made by letter, email, telephone, and in-person contact beginning in October 2013 to March 2014.

In the majority of cases, a letter, map, and an aerial photograph of the project area were mailed. In most cases, one to multiple attempts were made to contact individuals, organizations, and agencies apposite to the CIA for the project. The text of the letter was as follows:

> At the request of Helber Hastert & Fee Planners, Inc. and Kamehameha Schools (KS), Cultural Surveys Hawai‘i, Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the establishment of an educational complex and cultural center in the ahupua‘a of Kahalu‘u, North Kona District, on the island of Hawai‘i. The Project area consists of 22.73 acres of land along the Keauhou-Kahalu‘u coastline, adjacent to and immediately south of Kahalu‘u Bay on Tax Map Key parcels: (3) 7-08-013: 002, 013, 042, and 043. The former Kona Lagoon Hotel (KLH), demolished in 2004, was located on the project site and the recently closed Keauhou Beach Resort (KBR) still exists on the property. The Project area is depicted in Figures 1 and 2.
>
> This project triggers the State of Hawai‘i’s (State) environmental review process under Chapter 343 (Environmental Impact Statements), Hawai‘i Revised Statutes (HRS), as amended, because the project involves:
>
> > 1. Use within a historic district (The entire project site is within the Kahalu‘u Historic District (SIHP No. 50-10-37-4150) that is listed in the National Register of Historic Places);
> >
> > 2. Demolition activities within a State property extending makai (seaward) of the shoreline.
>
> Kamehameha Schools (KS) is a private charitable educational trust endowed by the will of Princess Bernice Pauahi Bishop to provide educational opportunities to improve the capability and well-being of Hawaiian learners in Hawai‘i and across the nation. KS operates an educational system serving over 6,900 students of Hawaiian ancestry at 31 preschool sites statewide, and three Kindergarten thru 12th grade campuses located on the islands of O‘ahu, Maui, and Hawai‘i. In addition, ‘āina (land)-based education programs, such as its Keauhou-Kahalu‘u Education Group (KKEG), provide educational opportunities for numerous learners each year. KS partners with the State of Hawai‘i Department of Education, University of Hawai‘i, KS campus and enrichment programs, a variety of private education organizations, and non-profit organizations within the Keauhou and Kahalu‘u communities.

> The ahupua‘a of Keauhou and Kahalu‘u possess unique natural and cultural resources that have tremendous educational value. Therefore, KS proposes to establish an educational complex and cultural center on its 22.73 acre-property that integrates education, land-stewardship, culture and community-building. This initiative would be unique by accessing these resources *in situ* (in context), rather than relying on traditional in-classroom teaching methods. The establishment of the educational complex, would involve the following activities:
>
> 1) the demolition of the former KBR hotel and remnants of the KLH facilities;
> 2) construction of several new structures on the property;
> 3) and preservation of historic sites.
>
> The purpose of this CIA is to gather information about the Project area and its surroundings through research and interviews with individuals who are knowledgeable about this area in order to assess potential impacts to the cultural resources, cultural practices and beliefs identified as a result of the planned Project. We are seeking your kōkua and guidance regarding the following aspects of our study:
>
> - **General history and present and past land use of the Project area. This CIA study will include the ahupua‘a of Kahalu‘u and Keauhou.**
> - **Knowledge of cultural sites which may be impacted by future development of the Project area - for example, historic sites, archaeological sites, and burials.**
> - **Knowledge of traditional gathering practices in the Project area, both past and ongoing.**
> - **Cultural associations of the Project area, such as legends and traditional uses.**
> - **Referrals of kūpuna or elders and kama‘āina who might be willing to share their cultural knowledge of the Project area and the surrounding ahupua‘a lands.**
> - **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the Project area.**

The results of the community consultation process are presented in Table 5. Summaries of interviews with individuals are presented in Section 7.

Table 5. Community Outreach Table

Name	Affiliation	Comments
Alapai, Barbara	Kahalu‘u lineal Descendant, ‘Ōhi‘a Cave burials	CSH emailed letter and figures on 8 November 2013
Alapai, Ralph K.	Kahalu‘u lineal Descendant, ‘Ōhi‘a Cave burials	CSH emailed letter and figures on 8 November 2013; CSH contacted Mr. Alapai on 6 February 2014 to set up interview; CSH interviewed Mr. Alapai on 11 February 2014; CSH dropped off interview summary on 5 March 2014 and mailed summary on 7 March 2014; Mr. Alapai mailed his revisions on 10 March 2014 and CSH received them on 12 March 2014
Anakalea, Josephine	Kahalu‘u cultural Descendant, ‘Ōhi‘a Cave burials	CSH emailed letter and figures on 8 November 2013
Ayau, Halealoha	Hui Mālama I Nā Kupuna O Hawai‘i Nei	CSH emailed letter and figures on 28 March 2014
Bertelmann, Pomai	KS Educational Partner; Na Kalai Wa’a	CSH mailed letter and figures on 31 January 2014; Ms. Bertelmann emailed on 5 February 2014; CSH called on 13 February 2014; on 17 February 2014 in a community event, CSH met and briefly talked with Ms. Bertelmann regarding the project; Ms. Bertelmann replied that she will contact CSH at a later date; CSH called Ms. Bertelmann on 24 February 2014 and left message
Crabbe, Dr. Kamana‘o	CEO, OHA	CSH emailed letter and figures on 28 March 2014
Duarte, Ka‘eo	Kahalu‘u cultural Descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013
Freitas, Hannah H.	Kahalu‘u lineal descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013

Fujisaka, Mitchell M.	Kahalu‘u lineal descendant, ‘Ōhi‘a Cave burials	CSH met Mr. Mitchell Fujisaka on 30 October 2013 for a site tour with SHPD and CSH archaeologists; CSH mailed letter and figures on 8 November 2013; CSH visited Mr. Fujisaka on 13 November 2013 to review his site visit summary for the archaeological inventory survey plan; Mr. Fujisaka reviewed the summary but also requested more time; he agreed to an interview on 16 November 2013 and provided his phone number to call him and schedule; CSH called Mr. Fujisaka on 15 November 2013; CSH interviewed Mr. Fujisaka on 19 January 2014; CSH called, mailed, and dropped off interview summary and transcript on 4 March 2014; CSH received revisions on 13 March 2014; CSH called Mr. Fujisaka on 17 March 2014; CSH called Mr. Fujisaka on 21 March 2014; Mr. Fujisaka approved his interview on the same day
Hamm, Kalani	Kahalu‘u lineal descendant, ‘Ōhi‘a Cave burials	CSH met Mrs. Kalani Hamm on 30 October 2013 for a site tour with SHPD and CSH archaeologists; CSH mailed letter and figures on 8 November 2013; CSH interviewed Mrs. Hamm on 19 January 2014; CSH met Mrs. Hamm on 4 March 2014 to drop off interview summary and also emailed and called the same day; CSH received corrections on 11 March 2014 and emailed revisions on 18 March 2014; Mrs. Hamm approved interview on 21 March 2014
Kahalioumi, Floyd	Kahalu‘u lineal descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013; CSH interviewed Mr. Kahalioumi on 19 January 2014; CSH emailed interview on 4 March 2014 and emailed follow-up on 6 March 2014; CSH called on 6 March 2014; CSH mailed it on 7 March 2014; CSH received corrections on 11 March 2014; CSH emailed revised interview on 18 March 2014; CSH called on 20 March 2014 and talked with Mr. Kahalioumi; CSH emailed on 20 March and 24 March 2014; CSH emailed follow up on 24, 15, and 26 March 2014; Mr. Kahalioumi emailed CSH on 5, 24, and 25 March 2014 when he approved his revised interview
Kahalioumi, Ronald	Kahalu‘u lineal descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013

Kahulamu, Wayne P.	Kahalu‘u lineal descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013; CSH interviewed Mr. Kahulamu on 11 February 2014; CSH met and dropped off interview on 5 March 2014; Mr. Kahulamu approved his interview 8 March 2014
Kahulamu, Mr. Willy	Kahalu‘u lineal descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013
Kanahele, Pualani	KS Educational Partner; Edith Kanaka‘ole Foundation	CSH emailed letter and figures on 31 January 2014
Kanuha, Zachary	Kahalu‘u cultural descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013
Kauahi, Velma	Kahalu‘u lineal descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013; CSH interviewed Mrs. Kauahi on 19 January 2014; CSH met and dropped off interview on 4 March 2014; Mrs. Kauahi approved her interview on 12 March 2014
Hoomanawanui, Kauanoe M.	Burial Site Specialist, Hawai‘i Island, SHPD	CSH emailed letter and figures on 28 March 2014
Keanaaina, Duane	*Kama‘āina*	CSH mailed letter and figures on 8 November 2013
Kipapa, Gabriel	Kahalu‘u cultural descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013
Kong, Lily (Makuahine Namakaokaia Haanio Kong Po‘o)	Kahalu‘u cultural descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013
Lee, Kimo	Chair, HIBC	CSH emailed letter and maps on 28 March 2014

Lui, Nicole	*Kama‘āina*	CSH met Ms. Lui on 20 January 2014; CSH interviewed Ms. Lui on 21 January 2014; CSH emailed Ms. Lui on 13, 21, and 24 March 2014; Ms. Lui called CSH on 17 March 2014.;Ms. Lui emailed CSH with corrections on 19 March 2014 and approved her statement on 23 March 2014
Nahale, Charles	Kahalu‘u cultural descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013
Rivera, Hiram	Kahalu‘u lineal descendant, ‘Ōhi‘a Cave burials	CSH mailed letter and figures on 8 November 2013
Vitousek, Michael	Archaeologist, Hawai‘i Island, SHPD	CSH met Mr. Vitousek on 30 October 2013 for a site tour with *kūpuna* Mr. Fujisaka and Mrs. Hamm, archaeologists, and KS representatives; CSH mailed letter and maps on 28 March 2014

Section 7 Interviews

Kama‘āina and *kūpuna* with knowledge of the proposed project and study area were contacted to participate in semi-structured interviews for this CIA. From October 2013 to March 2014, CSH contacted 26 individuals and organizations of which seven responded with a formal interview. Six of the seven interviews were organized with Mr. Māhealani Pai, cultural resource specialist for Kamehameha Schools Keauhou-Kahalu‘u Education Group.

7.1 Acknowledgements

The authors and researchers of this report extend our deep appreciation to everyone who took time to speak and share their *mana‘o* (thought, idea, belief, opinion) with CSH whether in interviews or brief consultations. We request that if these interviews are used in future documents, the words of contributors be reproduced accurately and not in any way altered, and that if large excerpts from interviews are used, report preparers obtain the express written consent of the interviewee/s.

7.2 Group Interview with Mr. Mitchell Fujisaka, Mrs. Kalani Hamm, Mrs. Vel Kauahi, and Mr. Floyd Kahalioumi Sr.

CSH met and interviewed four lineal descendants from the project area on 19 January 2014, on site at Hale ‘Ike, in Kahalu‘u, Hawai‘i. Also present was Māhealani Pai of Kamehameha Schools Keauhou-Kahalu‘u Education Group. The four interviewees included Uncle Mitchell Miki‘ala Fujisaka, Auntie Vel Konanui Kahulamu Alapai Kauahi, Auntie Elizabeth Kalaniola Kahulamu Kahinu Wilson Hamm, and Uncle Floyd Kahalioumi Sr.

The group interview began with everyone introducing themselves and sharing their general observations about the history and cultural resources, practices, and beliefs of Kahalu‘u.

Uncle Mitchell Fujisaka is 77 years old and comes from the Kahulamu and Kahinu *‘ohana* (family) from Kahulu‘u. He was born and raised in Kahulu‘u and can recall the *heiau* in the project area when he was growing up. In fact, Uncle Mitchell was just a young boy in the 1950s when the *heiau* was mapped by Henry Kekahuna and Theodore Kelsey with the invaluable assistance of Tūtū Naluahine Kaopua, who was an expert in *lā‘au* (medicine), a legendary *paniolo* (cowboy), and fisherman as well as cultural historian descended from bird-catchers whose knowledge of trails, water resources, and *ahupua‘a* boundaries informed many others (Hawaii Cattlemen’s Council 2014). His job was to assist in measuring the *heiau* such as Ke‘ekū and Hāpaiali‘i using chain links that had to be kept straight even if there was rock or a tree blocking the way.

During his childhood, Kahalu‘u was a fishing *ahupua‘a*. He learned “the old *kūpuna* way” of fishing, stating “you fish for the *‘ohana*” and for the people who cannot fish, such as those who are sick and elderly. But in 1954, things changed in part due to the establishment of the Kahulu‘u Beach Park. The old ways of fishing sustainably were lost, although Uncle Mitchell passed on his knowledge of the culture to his own sons:

> I couldn’t pass it on, everything changed. People would come and say, ‘Why, you don’t own the beach?’ Once the park came in 1954, everything changed . . . my kūpuna’s biggest thing was, you fish for yourself, you fish for the people who cannot fish, you fish for the old people. If you’re satisfied, they all satisfied . . .

Uncle Mitchell was always taught to “*hō‘ihi* (sacred) respect” the *heiau* rocks or the *heiau*, as it was forbidden. The *heiau* was sacred to his grandparents and uncle, so they would always go around the *heiau*.

Auntie Elizabeth Kalaniola Kahulamu Kahinu Wilson Hamm, or Auntie Kalani Hamm, is 73 years old and also grew up in the area like Uncle Mitchell who is her relative. She is connected to the Kahulamu and Kahinu *‘ohana* from the Kahulu‘u *makai* area. She confirmed that the *heiau* area was always off-limits to her so she and other children would avoid it despite being *nīele* or curious. It was only when she first saw the Kekahuna map that was created in the 1950s that she finally was exposed to the full extent of the significance of the Kahalu‘u *heiau*.

While the men were fishermen, the women were the *limu* (seaweed) gatherers, according to Auntie Kalani. The women from her *‘ohana* frequented special places to gather *limu* and she learned to do it by watching her mother who would also fish in the water for small fish using her *mu‘umu‘u* (loose gown):

> You would never catch women in a pair of shorts, never, in those days. The women had their *mu‘umu‘u*, they caught fish, the small little fishes, with their *mu‘umu‘u*, they would *pa‘ipa‘i* [slap] the water, and all of that.

In the back of the Kahulamu *‘ohana’*s residence close to the project area is the family burial site which contains the *iwi* (bones) of beloved ancestors. The *iwi* are attended to by members of the *‘ohana* even today, noted Auntie Kalani:

> It is significant to note that our family has been in Kahulu‘u for generations. Our Kahulamu *‘ohana* is still living there and taking care of the burial site. It is very important to us. And our family through the relationship with the land knew their *kuleana* [right, privilege]. You always looked up in thanksgiving and in everything you did, you did in prayer.

Describing the first time he saw the Kekahuna map about five years ago, Uncle Mitchell related that at that moment, he realized the outcome of all the hard work he did many years ago. He didn’t understand it at the time, because elders were never questioned and were always addressed and treated with respect.

> No question. At that time, you don’t question. Because they were the older ones. We were brought up to respect the elders. So everybody in the area that was oldest, they were all our *tūtū*s [grandparents, elders]. That’s how we respected them. We didn’t know their names, but we call them *tūtū*. A Filipino man, we call him *tūtū*. There was a German that lived in this area—he was also a *tūtū*. How were they related to us? By respect. That’s what we are losing now . . .

The whole process of mapping the *heiau* took two years, as it was not continuous and work was usually done during the summer on weekends to do the mapping. “Now, I say mapping, but at that time, it was walking through the bushes,” recalled Uncle Mitchell, smiling.

When asked how he felt upon seeing the map, Uncle Mitchell elaborated:

> Now I can appreciate what I did . . . I can appreciate listening to the person that told me to go there. Listening to all the scoldings that I had when I didn't do what they said I was supposed to do. I appreciate it now, because it's here (pointing to the map).

Auntie Kalani Hamm also shared her shock at seeing the map, as all she knew about the area was that it was *kapu* (forbidden):

> The land area was much larger than what we were told, and what a tremendous impact. Because when we are looking at it, we see all our *kūpuna*. Earlier than Kamehameha, for many generations. When you see the impact, you go back in time. The impact is so huge . . . because we are not talking about one family, we are talking about many families, some of whom are now gone.

Auntie Vel Konanui Kahulamu Alapai Kauahi is 64 years old and her *‘ohana*'s house was located in the project area and can also be seen on the Kekahuna map. She literally grew up surrounded by *wahi pana* such as the *heiau* and recounts her childhood playing in the area, gathering *‘opihi* (limpets) and watching her father throw net:

> For me, when I was growing up, for me at the time, we lived right there. We had a big area to play. We even had to walk down to the beach, which almost took forever from my house to the beach, through the bushes. There were all kinds of *kiawe* tree, *ēkoa* tree—you had to make your way down to the beach. Whenever I came down to the beach with my dad, to throw net, you cannot follow him where he's at . . . because all he has to do is look at you, and 'shut up!'

Often, when her father would stand between the Ke‘ekū and Hāpaiali‘i Heiau, a group of porpoises would stop and jump out of the water, dancing:

> At the time, there were porpoises. They used to swim down along the wall. For some reason or another, half of the group would stop. One would totally throw itself in the air, and I would go, 'Wow! They are dancing for my dad!' Because it always happens when my dad was in the area. I am sitting on the sand, watching him . . . So for me, that's how it was, going with my dad, throw net.

The family of Uncle Floyd Kahalioumi Sr., 68, is from the Keauhou and Kahalu‘u *ahupua‘a*. Uncle Floyd recalled that the sand was "high, really high." He shared what happened when the old Kona Lagoon was built on the sandy ground.

> When they decided to build Kona Lagoon, the Hawaiians told them, water come behind here. The *haoles* [white person, any foreigner] . . . said 'No, water would never reach here.' When they built the hotel, the water reached.

Although he was raised to respect the *heiau*, like the others, Uncle Floyd had no clear idea of its size and its enormous importance. Sea water and the constant tidal action had deteriorated the walls of the *heiau* through the years, and only here and there were stones and remnants of walls. He shared his thoughts when he first saw the Kekahuna map:

> The only thing I can remember is when you look at the map, the map showed me a whole lot of things that I didn't know was here. But we knew those two *heiaus*. That we knew, because the *kūpunas* would say, 'no touch.' They didn't even have to be there. You just don't bother with it. We come down, my cousin and I, we come down and go throw net . . . we used to dive, come back, and walk around. But when we come to the *heiaus* . . . you don't step on top, you go around. 'Cause out here all *papa* [reef], all flat. We used to walk around and no one had to tell you, 'Don't go over there.' You just didn't do it.

Uncle Floyd mentions that he would pass by Tūtū Naluahine's house site whenever he came down to the project area. As for Auntie Vel, her house was located a few feet away from Tūtu Naluahine's residence. It meant that she had many chances to visit him at his house and he would also have coffee and talk story at her house. She related the following:

> Sometimes we would go over there and visit. But for me, when I was growing up, I was so afraid of Tūtū Naluahine. Because of the way he looked, because he was older. If he talked in Hawaiian . . . for me, I was scared, the way he talked . . . until I got into high school.

Once Auntie Vel was in high school, she got over being intimidated and regularly headed to Tūtū Nahluahine's house to have breakfast with him. "When I got to high school, it was like, 'okay, grandpa,' I would go down to his house and . . . or he would come over to our house."

Auntie Vel indicated to CSH the area where she used to play, where Hale 'Ike is currently located. She noted that she was usually here along with her brothers who would fish or do other activities. If the water was high, she would jump off from the rocks into the water or sit and wait for her father to throw net. She had no idea that the area she considered her childhood playground was such a place.

> It was like, 'Wow, this was the big rocks that we were jumping off and on?' Then when Māhealani showed us the map, it was like, 'Oh my God, how much, what was here before.'

Pointing at the map, Auntie Vel noted that there used to be a *mo‘o* (lizard, reptile, water spirit) pond that had fresh water. It was large enough that it extended all the way to where a group of coconut trees used to be. The house she grew up in was marked on the Kekahuna map, and using it as an indicator, she noted that it is at "the top corner of the first gate. Right there, more closer to the road." Tūtū Naluahine's residence was also marked on the Kekahuna map and it was located where there are now condominiums.

When CSH asked if *kūpuna* ever related exactly what was in the project area, several of the community interviewees noted that although they did not know the details about the *heiau*, they knew enough to respect that the *heiau* were *kapu*. Uncle Floyd stated that "we knew there was sacrificial things down on the heiau, that's about all I remember . . . they'd say, "don't go over there." Uncle Mitchell's understanding was if one was to break the *kapu*, it would bring harm to those he loved:

> Things bad would happen. Things bad would happen not to you, but to the family. It will come through you, because you did the bad thing . . . it would hurt one of the family. That's what my understanding was.

Both Uncle Mitchell and Auntie Kalani shared their memories of attending English school, and how Hawaiian was not taught to the students, with Auntie Kalani relating the long walk from Kahalu‘u to Keauhou that her family had to take in order to attend school. She also detailed the genealogical connections between her and the other group interviewees, noting that she is related to Auntie Vel whose great-grandfather was Robert Kahulamu and who had a brother, Ben Kahulamu. Uncle Mitchell is also close to Auntie Kalani on both her mother's and father's side.

Speaking of the appearance of the men in her family, Auntie Kalani described that the men were generally tall so they tended to enter the professions of being cowboys, policemen, and farmers. She recalled pounding the poi with her mother, watching her *tūtūs* make fish net and asking how to do it, and being told it was not for girls:

> And they would say, not for the girls. I used to complain to my uncle why us *wahines* could make fish net. He didn't explain so I didn't ask anymore. I had to be quiet . . .

Uncle Floyd confirmed that he was taught the same thing, although he did not know the reasons. Auntie Kalani suggested that making fishnets was probably *kapu* due to the women's menstrual cycle.

The discussion then turned to the trails that once or still exist in the project area. Auntie Kalani noted the following:

> This place was fishing number one, but there's trails. I wanted to point out the trails here our *‘ohana* would use, *mauka* that went *makai*. That run from the back of the family house to Kahulu‘u *mauka*. But there's valuable trails, up and down.

There were four main trails that went *mauka-makai* in Kahalu‘u, according to Uncle Mitchell. Those trails were Paniau, Mākole‘ā, Kaholele, and Kapa‘ala‘alaia. Other nearby trails included Kahalu‘u, La‘aloa, Pāhoehoe which was a flat trail, Hōlualoa, Kamalumalu (a big trail), Judd trail, and Puapua‘a. In addition, there were smaller trails that interconnected with the larger ones.

Auntie Kalani shared her memories of going up and down the trails, on old *kēkake*, or donkeys, with Uncle Mitchell recalling the names of the Kahulamu donkeys as "Kuna Kuna" and "Maile." The donkeys were used to carry packs and had wooden saddles that were "the hardest thing" to ride, according to Auntie Kalani. But her mother would ride the donkey up *mauka* carrying her sister Hannah who was a baby at the time. Along the way, the family would visit the other families, according to Auntie Kalani:

> But on the way there, on the trail, there were many *hale* (houses) that you would stop by to visit to show your respect.

Noting that Hawaiians are "smart on trails," Auntie Kalani described the presence of fruit trees like mai‘a (bananas) and mango trees that gave both fruit and shade for travelers using the trail. It was *kula* (plain, field) land up *mauka* and it was used for taro, plantains, sugar, and *‘ulu* (breadfruit). Down *makai*, along the seashore, she described how people could cultivate sweet potatoes:

> Even though you lived down the beach, the soil was rich if you know how to malama (care). There was plenty of water, there was plenty of fresh water that came from underneath.

Auntie Kalani observed that for the *ali‘i* who once lived in the project area, all that they needed had to have come from the people and the place. The project area offered plenty of fish and ponds where the *ali‘i* could bathe as well as use for freshwater resources. Uncle Mitchell added that there were certain ponds they could use to swim in and take baths, but there were others that they could not use. Anything related to *ali‘i* was off-limits, such as Po‘o Hawai‘i, according to Auntie Kalani and Uncle Mitchell.

There were also *‘ōpae ‘ula* (small red shrimp) ponds, and Uncle Mitchell recalled a big one in particular, Kilohana. Whenever Tūtū Naluahine would call for the cleaning of Kilohana pond, they would all come and clean by cutting back the overgrown *ēkoa* bush:

> Because the *ēkoa* bush was overgrowing, so we used to cut it down. Open it up for the sun. Without the sun, the *‘ōpae* is clear, no color. If you go early in the morning, the *‘ōpae* is white. With the sun, the *‘ōpae* would turn red. There is a small *ōpae‘ula*, but this one was a bigger size.

‘Ōpae ‘ula was used as bait for *‘ōpelu* fishing. But the *‘ōpae ‘ula* that grew in Kilohana was not as small as the regular *‘ōpae ‘ula*. Uncle Mitchell described the *‘ōpae ‘ula* as hardy survivors who find a way to live no matter where they may be.

Plants that grew in the area included *hau*, coconut, *ēkoa*, tamarind, and *‘ōhai* known as "monkeypod." According to Uncle Mitchell, there were several kinds of *‘ōhai* and there were several groves of *‘ōhai* trees that once existed:

> There is one [*‘ōhai*] called ‘ylang ylang;' it has brown pods and sweet smelling flowers. The big *‘ōhai* that is used for landscaping now has a black pod. There was a grove in the area called Ulumoi, it was where the condos are, part of it was Ulumoi. In the lower end, where Tūtū Naluahine's house was, it was called Umi.

There was a giant *hau* bush in particular that was once located right in front of the now-shuttered Keauhou Beach Resort hotel. The *hau* bush was part of the playground of his youth. He also described a sandy pond called Ke‘ali‘ali‘a, and commented on how proper names get lost through time and improper usage:

> If you ask kids nowadays, 'What's the name of that?' If the hau bush was there, they'd tell you Hau Pond, Ke‘ali‘ali‘a. From Ke‘ali‘alia, went down to ‘Ali‘alia, Li‘alia, Hau Pond. That's how names get lost but I remember because I was told. That was the proper name.

Because the project area was primarily a fishing area, just about every fish variety associated with the shoreline could be found, including *manini*,*‘ū‘ū*, and *hinalea*, to name just a few. There was plenty of *limu* of all kinds, including *limu ele‘ele*, *limu waina*, *limu lipoa* (for use with *‘ōpihi*), and *limu kala*. There was no *limu kohu* in the Kahalu‘u *makai* area, so those who lived in Kahalu‘u would ask permission from the residents of Keauhou to pick *limu kohu* there.

Limu kala was used for medicinal purposes as well. Auntie Kalani shared that when she lived in Honolulu, she looked up information at the archives to prepare the seaweed as medicine. With the help of her cousin, Auntie Kalani asked the archivist for Tūtū Naluahine's transcript related to *limu*. Knowing that he only spoke Hawaiian, Auntie Kalani described what happened next:

> She said, ‘Hold on.’ Come out with one piece of paper . . . I was so happy to see . . . what Tūtū has to say . . . There was a small portion written in English . . . I wanted to cry, and it was about the limu . . . it was a recipe how to use limu as medicine for arthritis. You boil, you steep and you soak . . . That was the best day in my life, I heard from him.

Kahalu‘u *makai* was teeming with plenty of water resources, brackish as well as fresh. The water came from underground and would bubble to the surface, explained Uncle Mitchell. They knew where to go and get fresh water if they were down by the beach. As for daily drinking water, they would use freshwater catchment back at their *hale* and the water for the cisterns would come from the rain. Auntie Kalani noted that they would minimize using the water from their cisterns as much as possible by taking baths and washing their laundry at the beach.

The topic of *iwi* and how to care for them was addressed by Uncle Mitchell, who shared that one of his granduncles was the caretaker of the burial cave of the Kahalu‘u area. His father was trained to care for it, and when it was time, they asked Uncle Mitchell to take over the responsibility. “I didn’t want to do it,” noted Uncle Mitchell. “They were sad, but I didn’t want to do it. That’s when you bury in a cave.”

The traditional way of mourning and preparing the dead was related to him by his great-aunt. Whenever a family member dies, everyone gathered at the home to grieve. And when the deceased love one was buried, everyone but those designated to accompany the body must stay at the home. The body was wrapped with cloth or *tapa* and tied to the carrying poles. The number of carriers depended on the size of the person. Since his granduncle was the *kahu* of the burial cave, all preparations were made by him:

> You designate four people; two ahead, two in the back and so many other ones to carry the deceased. And you would walk up on the trail. The two people in the front to watch if anybody is coming down the trail—they go off or back. Go off the trail. The two people in the back watch that the family don’t come up the trail. Because if you grieve so much, you want to come and follow. Those are the people who were designated to bury. It’s not to hide—they knew where they were going to bury.

Uncle Mitchell described too many people at the mouth of the cave to be “like a bunch of flies” and it was more respectful to let the loved one be buried in peace. Auntie Kalani explained that the responsibility of caring for the dead was “so great, so heavy” that the bereaved families had to place all of their trust to the designated caretakers.

> The *‘ohana*, they did all that. Have you ever been to an old style Hawaiian funeral? They start wailing. And they wail. And they wail. Everything was done at home. But this is one that gives the ceremony in taking care of the *iwi*. There were no questions asked from the families. They just trusted. That’s the word. They just trusted the designated group . . . that *‘ohana* that is supposed to take care, to take care of the *iwi* because . . . they had to be trained by the previous *kūpunas*, to do what they do. And they knew all that had to be done. So they trusted.

Those assigned to a certain burial site had to all be trained and they were not less than eight men, related Uncle Mitchell. Auntie Kalani stressed that the *iwi* is seen as sacred.

> The *iwi* that we have in our own burial site is a sacred *iwi* . . . The tradition of today is so different from yesterday. And then so, the tradition of today is so different than yesterday. We cannot repeat yesterday’s because we really don’t know all the stuff that comes with it. The responsibilities that comes with it, the ceremonies that comes with it and the dedication and the things that comes with it, we don’t know. So, we only know what we find in research and all of that . . .

During the old days, there were no morticians, Uncle Floyd pointed out. Therefore, a body had to be prepared well as the funeral had to take place within a couple of days. Salt was utilized. Auntie Kalani was trained by her mother and aunts on how to cleanse the body:

> So, they told me what they want. Me to do for them and the cleansing of the body and all this kind of stuff and that goes with that. And then they get concerned because all the other rest, *hala* [passed away] already yeah? They might be the last one and then they’re by themselves so they’ll talk to somebody in the *‘ohana* or they say, ‘no need worry, is ok.’ They’re not gonna leave that responsibility on you . . .

Uncle Mitchell noted that the entire body had to be washed first, with ashes as well as salt. Such protocol of carefully cleaning the dead and preparing them for burial is part of respecting the whole of a person’s life, stated Auntie Kalani:

> The ceremonies and protocol they applied in those days are just as old as old can be. Such understanding of knowledge that they had . . . they did things before they went into the *heiau* in preparation before . . . going to the *heiau*. And we need to utilize and then we talk because the research and the studies we have now. We have *heiaus*, how to cleanse ourselves and be purified ourselves before we even go up. We’re not gonna pray to the rocks. We’ll honor the sacredness of it. We’re not gonna make *kāpulu* [careless, unclean]. We’re gonna honor the sacredness. So when you *mālama* somebody who make a request with your *‘ohana*, the person in the wholeness, his whole life. And we prepare the whole life of that person for his leap into the next world.

Hawaiians honored the physical, mental and spiritual body of individuals, emphasized Auntie Kalani. “When you’re laying down, they’ll tell the *keikis*, “Don’t ever walk over the body.” We love the body. Honor the body. We honor the bodies of another.”

Responding to CSH’s question of whether there were *iwi* found in the project area, Uncle Mitchell related that there were sometimes *iwi* that would come up in the sand after rough seas or big waves. They would just pick it up and put it back in the sand. If he and other children were planning on sleeping on the beach, they would ask for Tūtū Naluahine’s permission as he was aware of where burials were:

> First time we went to Mākole‘ā beach at night to sleep was full moon. You don’t go on dark nights. You know, we’d go see and ask Tūtū Naluwahine, if okay. Tūtū told us where to sleep, because he knew no *iwi* in that area.

Because the whole area had already been worked over, if the existing structures were to be taken down, there might not be any *iwi* found. When the Keauhou Golf Club was being built, lots of sand was taken from Kahalu‘u *makai* to be placed in the golf course. Uncle Floyd recalled what happened in 1966:

> That was my first job, building the golf course and a lot of the sand for the traps and stuff like that were taken from this bay. In fact, they had one machine down here that would scoop sand and they'd haul it by trucks back to Keauhou . . . there'd be bones that would pop up . . . I don't know what happened to the bones.

When bones were found, everything was stopped. Uncle Mitchell recounted the time that he saw a skull that rolled down when a machine was being used to push the pile up. Uncle Floyd stressed that burials in the sand were common, especially in Kona, where people buried where they can dig. Caves as well as lava tubes were also utilized as burial sites because tools that can dig through stones were not available. "So in a lot of caves, a lot of where you see a depression with stones . . . placed by humans, more than likely is burial," stated Uncle Floyd. No markers were used and the grave was committed to memory.

There were all types of burials, noted Uncle Mitchell:

> We consider that all different. You know, sand burial, earth burial, cave burial. You can say that's all different kinds. What's modern now is earth burials. Right? You go according to the law. But at that time, it's whatever is convenient.

Caves were used as shelters, for living and refuge, and not all caves were used for burial, shared Uncle Mitchell. The use of the cave depended on the year and the circumstances that were occurring at the time. Stated Auntie Kalani:

> All depends what year, what century we're talking about. The whole village would go and hide in caves until the warning came that it was okay for them to return to their homes. And the caves he's talking about is that, we have one cave that's high enough for you to stand in, and suitable enough to live in for a limited time, the time when the people have to go find refuge. [If] there was a war going on, the families could not stay in their hale.

There are no caves in Kahalu‘u *makai* project area. But there are caves on the hillside. The only burials immediately in the project area were in the sand that has already been turned over, Uncle Mitchell pointed out.

Mo‘olelo about the project area include that of the *mo‘o* pond, which Auntie Vel shared was located in front of the current coconut trees seen from Hale ‘Ike. It involved two sisters, one who was evil and one who was good. They would travel to and from the pond. The pond was taken care of by Tūtū Naluahine and her father. Auntie Vel recalled that Tūtū Naluahine owned two box-shaped canoes that he used to launch in the area where the brackish water pond was located.

The proper name for the wall in Kahalu‘u Bay is not Menehune Wall, as it known today, but Kala‘auokali‘ikini, stated Uncle Mitchell. Relating that he learned about the Menehune Wall in school, Uncle Mitchell narrated the legend:

> *Menehune* was, I can recall, it was the little people. They were little people. So, a whole bunch of them would come and they would finish this wall. They were

> supposed to cover the whole bay in one night. So, after the chief from Ku‘emanu Heiau realized if they was to enclose the whole thing, he couldn't surf. They would block off the surf. So, he crowed like a rooster in the middle of the night so the *Menehune* thought the sun was coming up so they left their work incomplete.

Other *mo‘olelo* associate the project area to the spirits of *ali‘i* who were there such as the sixteenth century Maui ruler Kamalālāwalu and his two faithful *nā ‘ilio* (dogs), Kapapako and Kauakahi‘oka‘oka. Uncle Mitchell narrated what he had heard from Auntie Vel's father:

> Yeah. He came fishing, throw net. He passed the *heiau*, the sun just about ready to set. He passed the *heiau*, he turned around, and he seen this big man, standing on the *heiau* with a dog. So he went, he turned around, he looked at the person, he didn't get scared. I would've run. [Everyone laughs] I would've run on the water if I had to. But he turned around and he told that person standing there, 'I'm not here to do wrong.' He went, he came back, it was like that.

According to Auntie Kalani, seeing and talking to spirits was something that was accepted during previous times:

> We can also understand, there's a time of that generation, that they can see down here, and there's talk. Talk to those that come and visit. I mean, no big deal. To us it is, but not to them. They would come into the kitchen and sit down and just feel at home and would have a conversation with them.

One had to be there at the right time for the spirits to express themselves. Auntie Kalani's father was one of those individuals that would "see a lot." He was not afraid of spirits, neither was her uncle. Spirits are always around even if people cannot see them:

> You hear sweet music in this area . . . So where the music come from? Because when they, the spirits return, they return to the place where they loved or had fun with their families and they do things just like the way we do things. So some can see, some cannot and for those, like Uncle Keawe, he could see and he talked . . . And he just look and he can understand that but when it comes to the next generation, the younger ones, they look and they're gone. They're one like, touched by an angel or something like that. But there is, there always is. Even when we don't understand them, we don't see it, there IS.

In answer to CSH's question about what Kahalu‘u *makai* was in the past, whether it was part of a royal complex, Uncle Mitchell emphasized that it was a sacred place with each site having its own prayer:

> If you look at the heiaus, they were associated with our religion. Prayer. We're talking about prayer. You count all of these sites, all of these sites, to every site that is marked, they had a different—when we went to measure it out, there was a different prayer. Before we started, Tūtū Naluahine would pray. There was a different prayer for every site that we marked. Even for the pond. So, if that was done then, when we did it, they [the early Hawaiians] were doing it before. It was sacred. So you have to ask permission to do what you want to do.

Discussing the reasons why the *ali‘i* would have been attracted to Kahalu‘u, Uncle Mitchell shared that he does not have a definite answer.

For Uncle Floyd, it was the resources that were available which attracted the *ali‘i*:

> Here, the freshwater, the flat lands, the fishing. Maybe because of the way the beach was, like I said before, it was higher than what you see. This area provided protection, provided their needs. The main thing was the two *heiau*. All of this [referring to map], I never knew was here to tell you the truth. But just judging from what we see that was here, the availability of fresh water, the ponds, the fishing, natural place of congregation, I'd think . . . 'Ok, this place is providing everything.' The *ali‘i* took it and said, 'This is our place. This is where we going [to] live.' I think.

As for the house site of Lonoikamakahiki, which is outside the project area, Uncle Mitchell related that it was mostly mapped out by Kekahuna by the time he assisted with the measuring. The discussion then turned to the construction of the road now known as Ali‘i Drive. Uncle Mitchell noted it was a trail before. If one was going to Kailua, one would simply say "I'm going to Kailua." If going the other way, one would say, "I'm going to Keauhou."

Referring to the road going down to Tūtū Naluahine's house and Lonoikamakahiki, Uncle Mitchell stated the following:

> I think that road was put in by the military. This wasn't a road at one time. It was a trail but when we came . . . that road that come through here. The Hawaiians, they didn't ride, they walked. So why do they need something wide like that? So, this was put in.

The road construction damaged some of the historic and cultural sites in the project area, which Uncle Mitchell pointed out. He referred to the project area as Kahalu‘u. "This whole area was called Kahalu‘u. This whole area here [points to south side of property] was called, Mākole‘ā." Uncle Mitchell named the boundary between Kahalu‘u and Keauhou as Paniau.

The name Mākole‘ā refers to the *heiau* (south of Hale ‘Ike), as well as the whole beach, but Uncle Mitchell emphasized that the entire area was Kahalu‘u. As for the meaning of the name Kahalu‘u, Uncle Mitchell suggested it has to do with diving.

When asked how far back can he remember, Uncle Mitchell shared that his memories of the area go back to at least when he was four, if not younger. He can recall the events that happened to him and what he was taught:

> I'd say, six years old because that's when I went to school. Five years old, I got bit by a dog going to church. Four years old being dragged around in Kahalu‘u Bay by my *tūtūs* and my uncles, so that I would learn all the fishing *ku‘unas* [place where a net is set in the sea; to let down a fish net] and their names and where and how the nets were set.

Unlike *ko‘a* (fishing grounds) which are located in the deep, Uncle Mitchell stated that *ku‘una* refers to areas in the shallows where fish could be caught. Being dragged around to locate *ku‘una* taught him to remember where all their locations were, and by the time he was five years old, he could swim like a fish.

> Just hanging on to the floaters or *‘ako*. They dragged me from *ku‘una* to *ku‘una*. Where they would set out the net depended on the *ku‘una*; they'd say that you need certain number of people this side and certain number that side. When all was set, a signal was given then they would start *kapeku* [To splash the feet in the water, as in scaring fish; the person who splashes thus].

Each family also had a specific kind of fish that was *kapu* for them to eat. For Uncle Floyd, he does not remember the name of the fish, but it was a little dark fish that was used for medicine by his family and his grandfather told him that it could not be eaten.

For Uncle Mitchell, the fish that were *kapu* were the ones that would lure others:

> What I was told at the time and saw it done, was the fish that was *kapu* are the fish that would bring other fish in. It could be a *manini*, it could be a *kihikihi*, or the *la‘i pala* or other fish. What the *tūtū* did was put marks on the fishes. They bite off the top or bottom of the tail or bite part of the top or bottom fin. These are the *kapu* fish. Most of the *ku‘una* had two or three; when they are caught in the net, you must let it go. Because after awhile, the fish would feel safe everytime you catch ‘em and let ‘em go.

Uncle Mitchell further added details about specific *ku‘una* and described their characteristics:

> Certain *ku‘una*, the big ones like Ko‘omea or Pokowa‘a had big flat boulders on the bottom close to where the net is set. Whatever fish run and hid under the boulders is *kapu*, as this fish will bring in more fish. It was still *kapu* up until the mid-sixties.

There was *‘ōpelu* fishing outside Keauhou, and there were also *‘ōpelu* caught outside of La‘aloa. When asked about surfing in the area, Uncle Mitchell chuckled. He described surfing way back in 1954, before it was considered "modern surfing."

> We were the first ones to start modern surfing, right out here in Kahalu‘u in 1954 . . . [laughter] . . . with a big hollow paddle board, 13 foot long. I think we started it. Kahalu‘u was the only surf that was safe . . . Lyman's wasn't Lyman's, Banyan's wasn't called Banyan's, Honu's wasn't called Honu's. They all had different names. Some people will tell you that 'I was the first one who surfed Banyan's' [laughter]. I surfed Banyan's; I cannot say I am the first. Kamehameha must have surfed it before me but modern [surfing], I can say I was the first . . .

Uncle Mitchell recited the list of surf spots in the 1950s. The names were usually related to the people that lived right by there:

> Before Lyman's, it was Tommy Whites, Mackenzie's, Hōlualoa, Kamoa, Moa, Kamoamoa . . . It wasn't Banyans. Banyan's was called Hinds, Seymour, Kobayashi.

But Kahalu‘u was always called Kahalu‘u. All other surfing spots were named due to either someone mispronouncing the name or another reason altogether:

> All the other names, you could tell who is telling a story. Oh, they could say 'I was the first one who surfed Lyman!' They might be the first one, to surf

> Lyman’s after it was called Lyman’s . . . I think it [Lyman name] was in 1959. This guy named Johnnie Peacock. Going there he called it Lyman’s. He couldn’t say the Hawaiian name, Kamoa. It’s true. [Laughter]. The house is right on the hill named Pu‘u o Hilo by the fork.

Pu‘u was the surf by Ohi‘o, because it was the highest peak. Nearby Ku‘emanu Heiau was a surfing *heiau*, attesting to how ancient the cultural practice of surfing is. According to Uncle Mitchell, the surf spots out there were Kehau and Kapua, with Kapua being inside and Kehau located outside. There was also a third surf wave there.

Uncle Floyd shared his surfing memories:

> I remember my cousins . . . all of us would come down weekends. We’d use their canoe made out of iron roof. We would have to hurry up and paddle go out . . . catch a wave and hopefully make it all the way in before it sinks [laughter] . . . that was a long time ago.

There was also a family shark god, called U‘u Kanipo that was cared for by Mervin Kahulamu, who also composed the well-loved song “Ku‘emanu.” He was never recognized as the composer but Auntie Kalani remembered him as one “unique guy.”

7.2.1 Part 2 Group Interview Regarding Preservation Plan

After a short break, the group convened and began discussion on maintenance, access, and preservation issues related to the proposed project. On hand to continue facilitating the discussion was CSH, *kūpuna* who are lineal descendants of Kahalu‘u and Keauhou (Mr. Mitchell M. Fujisaka, Mrs. Vel Konanui Kahalamū/‘Alapa‘i Kauahi, Mrs. Elizabeth Kalaniola Kahulamu Kahinu/Wilson Hamm, and Mr. Floyd Kahalioumi Senior), and Mr. Māhealani Pai, of Kamehameha Schools Keauhou-Kahalu‘u Education Group.

While the first part of the meeting was dedicated to discussing the cultural aspects of the project area, the second half was concerned with planning issues pertaining to the establishment of the proposed heritage center as seen from the perspective of the *kūpuna* and community. The following summary is an overview of the second part of the meeting.

The discussion began with a description of the ceremony that took place after the *heiau* of Hāpaiali‘i and Ke‘ekū were restored. Mrs. Elizabeth Kalaniola Kahulamu Kahinu/Wilson Hamm, otherwise known as Auntie Kalani, explained the significance of that event:

> Those [families] that was there, represented us. Not only their immediate family but they represented the others. We’re always representing the others ‘cause our intention is, the others. Our intention is to serve others besides ourselves. When they lifted up and carried the first rock, Mitchell was there. They had to carry that first *pōhaku*. That first *pōhaku*, besides the *heiau*, represented the community. It really represented the community and they were sincere about not making that type of mistake again. Like how those, that came before them, did . . . The restoration of the *pōhaku* is like the people. The people are the living *pōhaku*. The people are the living stones and so the families need to be here. Māhealani and the rest of the very active genealogy team that we have . . . Vel and Barbara Alapai and myself and cousin Florence Kalawa Tabag gathered families together to see

> the genealogy connections. That day, the ceremony came and you knew that there were the presence of not only us there but there were the presence of all those that passed. That was the first time I felt I could walk in the back, step back into that time, and then step forward . . . We are all part of this big event—the legacy that the princess left. [Uncle Mitchell] and I walked backwards and . . . when we walked forward and they were setting the *pōhaku* on that *heiau*, it was putting back the families. The restoration started much more and there’s much more to come. So, the *kūpunas* that had passed are in the back, and we, the living, are so grateful.

Auntie Kalani emphasized the importance of family. She explained that knowing genealogy is central to the program because it establishes connection to the place through family:

> The program is drawing the *keikis* of those *kūpunas*. The program’s not drawing as much as we want to but it will . . . How? Find the genealogies. The *keikis* have to get the genealogies and we teach the genealogy, we teach history. But when we teach the genealogy, [we can tell them], ‘You know your *tūtū* used to live in this area.’ Even though they didn’t know that, their parents didn’t know that, but there is a connection. They[‘d] . . . connect to this area because of [their] *tūtū* even though [they] live way up north or . . . in Kohala, or . . . come from Ka‘ū, . . . Puna, Pahoa, Hilo, or another area of the island or state. You could see this connection coming in. This stream, and the *keikis* are coming in. They’re coming in through this program . . . through the summer time. They’re coming across the islands! Coming across the islands from Ni‘ihau to Kaua‘i, Maui, and all the islands and they’re coming out from California into different programs that they sign up for in the summer time. And that is exciting because we can see the healing process into the eyes of that *keiki* and the knowledge that she receives and we say, ‘Listen, you go home and teach. You tell them what you’re doing . . . take your book, go home, and share what you learn, and if you have your *tūtū*, talk to your *tūtū*. Tell her where you came. Ask her questions. Sit down. Call her up. [Ask her] who she is. Where she comes from and especially if she comes from Kona, you’ll get the roots of it.’

The group discussed the various education programs that currently take place within and *mauka* of the project area. They shared their thoughts on the programs. “I think [it’s] in the right direction,” said Uncle Mitchell. “They wanted to restore the *heiau* so I say, okay. It’s restored. So, it’s okay. Whatever else come up around here . . . is okay.” Auntie Kalani stated, “We all agree about . . . the plans that are already set forth. We all agree to that.” She added that the project is going well so far and that the education should be for all children and not limited to Native Hawaiian children. Uncle Floyd also supports the education programs and explained:

> This educational part here, I think you’ll have more . . . Hawaiian kids participating because there’s no opportunities in Kona. There’s nothing. Kamehameha Schools is in Kea‘au, 120 miles from us. Kids that go there, or . . . Kapalama in Honolulu but to have something like this available, of course, it’s good. It’s always good that we can educate the young ones and teach them where they’re from, how it was . . . They’re bright people but they need the opportunity

> and I think—this is something that will . . . give them a place to learn from—is how I look at this and is why I want this place to be. Not for me, not for cousin Kalani, but for the younger ones. Give them some place that they could learn.

Uncle Floyd explained that his generation did not know their culture that well because much was “held back” from them so they only know what their grandparents showed them. The *heiau* were *kapu* to them and they were taught not to ask questions. However, he sees the younger generations today with their questions and admits he can’t answer all of them. Uncle Floyd continued:

> I know what I know but it’s not maybe correct or not all the answers they need [so] a place like this with Māhealani, who researches, who has the knowledge, they can teach our kids to appreciate and to learn where they’re from, what their people was all about. I think we need this in Kona. We don’t have anything like this in Kona. I think it would be a good thing.
>
> After it’s built, hopefully . . . my grandkids come here . . . the thing is here, they have the opportunity to learn, and hopefully they make use of the place. Thanks to KS [Kamehameha Schools]. At least, place like this is being built and some place they can come . . . If I were to do it all over again, well of course, our days, no more Pūnana Leo where you could go learn Hawaiian. You had to learn Hawaiian at home and a lot of it was not spoken at home. My grandpa spoke but anyway, I would encourage my grandkids to go up there and learn. Pūnana Leo.

In discussing the impacts of the education programs on children, two of the *kūpuna* with grandchildren who have been among the first to participate in the education programs, shared their experience. Auntie Kalani began with her grandson La‘akea:

> Our grand-*keikis* are participants in the program and out of the grand-*keikis*, one of them is a ninth grader with Kamehameha Scholars. The other one, she’s in the seventh grade at Kamehameha School, which is a good thing. They started more than seven years ago in the program. My grandson, La‘akea, went on to community college. He’s taking a break to make more money to go to the next semester and that’s a very good thing. We’ll be learning the chants and part of the ceremonies to continue what has to be done for the next generation to come.

Auntie Vel added:

> My grandson is Alton. He’s been in the program since day one like about six or seven years now I think. He just got out of school. He’s 18 now and has to go to night school to get more of his education but he has learned a lot .. . . in the program with Māhealani and different groups. But so far he’s been doing okay as far as for the program . . . [I]t brought him more into respect—more of what we haven’t learned when we were younger. He’s got that knowledge now from the time he started on Hawaiian culture—everything from fishing, to swimming, to sailing. Yeah, he’s learned a lot from the program.

Auntie Kalani also explained that many of the students come from elementary and middle schools. She stated that the program changes the relationship between students and parents particularly in how students respond to their parents. She fondly recalled the previous graduation

event where students created their own *kihe* to tell their individual stories about their journey through the program. She shared that experience:

> When they got through their presentation, we were all choked. Choke[d] in the sense that they have matured so fast because we didn’t tell them what to put down on their *kihe* and they explained their growth as walking this path and . . . finally, the relationship with their parents. They’re talking to their parents and how they’re climbing that hill in learning about themselves and culture relationship and all that they see . . . So when they presented their *kihe* to us, we were so overwhelmed because all the different age level[s] had to come in the front and talk . . . . It works.

Mr. Pai of Kamehameha Schools explained that through working with the children and families participating in the education programs, they are learning that for families who enjoy the programs, the children want programs for the parents so that the entire family is included.

When asked how the program should proceed in the future, Uncle Mitchell stated:

> You look at the *heiau*, okay? You look at the [hotel] building. I don’t want to see nothing like that there. That’s all there is. You can start whatever’s planned now. You know, the future, it’s gonna expand. I know how it was back then to how it is now . . . from walking around half-naked to [now] you cannot do that anymore. So, just like what’s proposed for here. It’s not for me . . . it’s for everybody. It’s for everybody. That’s what we’re striving for. Whoever comes here, learn about, you know, what’s here. Might be in the future, teach my great-great-great grandchildren about what happened here. So, it’s a good vision but let’s make that vision—put it on the ground that we can see. Once you put it on the ground now, they have to make it work . . . The book is on the ground. Right here. The book is here. The page, whoever reads it . . . Who’s in the back of the children? Parents, guardians, grandparents. If the grandparents can learn, the family can learn. Just a little bit to encourage the children. The book is here. It’s who opens it.

With regards to utilizing the internet as a resource to advertise and provide information about the heritage center, Auntie Kalani maintained that a period of time is needed for the program to progress before putting it on the internet. “Maybe five years after the project has moved along then we put it on the internet. Not right away . . . [because] once you use that as a resource, you’re gonna have thousands of people, ” she said.

Several rules are proposed to ensure that the integrity and authenticity of the natural and cultural resources of the site are maintained, such as limiting the number of daily visitors and establishing standard protocol for visitor conduct while on site. Also included are access ways to the site. Currently, three public access ways are proposed for the project area.

Mr. Pai explained that the draft conceptual site plan calls for a heritage center and is intended for the general public to visit the educational and cultural resources of Kahalu‘u *makai*.

The group agreed with limiting public access. Uncle Mitchell stated that ten public parking spaces are sufficient and added that parking spaces up on the Keauhou Shopping Center nearby can be utilized. However, while there are two access ways on the northern and southern

boundaries of the property, he questioned the necessity of a third access-way in the middle of the site. “Why does the access ha[ve] to be in the middle of it? Distraction,” he said.

The discussion raised concern over the impact of commercial activities nearby on traditional Native Hawaiian practices of fishing, particularly along the southern coastal area of the heritage center around Mākole‘ā. According to Mr. Pai, surfboard and kayak businesses often bring their tours along the shoreline and their activity chase away fish and disrupt fishermen throwing net in the area. The group would like the traditional Native Hawaiian customary practice of fishing rights to be established as part of the practice at the heritage center—that those identified as lineal descendants of Kahalu‘u Ahupua‘a maintain fishing rights to the shoreline while those outside must ask permission to do so. Mr. Mitchell explained, “Anybody in the *ahupua‘a*, could fish. If you come from the outside, you’d have to ask permission, so, the whole *ahupua‘a* is from the ocean to the mountain. Whoever is in there, can fish. The outside needs permission.” The group also stated that similar rights should extend to the usage of the project area by identified lineal descendants for funeral services.

The discussion turned to the maintenance of resources within the heritage site. Concerning *heiau*, Uncle Mitchell stated that his number one concern is to keep the sites clean. The current practice of maintaining the *heiau* includes those who are identified as lineal descendants of Kahalu‘u. The group expressed that their participation in this process is important and should be continued into the future although they stated that they did not know the cultural protocol for maintaining and cleaning the *heiau* and recommend that cultural practitioners be consulted.

Kūpuna also agreed that information should be provided, whether as signs or as pamphlets, throughout the site providing information not only about the history of the sites but also about protocol for visitor conduct. The issue of visitors still walking on the *heiau* despite existing signs on site prohibiting such actions is a concern. To mitigate this problem, the group recommended placing signs strategically or placing barriers, such as plants, on the sites to prevent people from walking over sites.

When asked whether they would like to participate in the future operation of the heritage center, all *kūpuna* agreed that they would like to be involved, reiterating their love for the place and for the perpetuation of Native Hawaiian culture. Uncle Mitchell explained,

> After it’s built, I’ll still come and see what I see now. I still tell my family what it was before the building goes up. The building to me is just like another tree. It’s what goes on in the building or what goes around the building that will make the big difference. But, I would like to see it. I would go out there, I will explain to my family especially my grandson, what I expect of him or whoever. And then, I can keep the smile on my face and when they come back and they tell me, ‘Eh, I learned something new today!’ Or, my biggest thing is that if they can come home and chant to me.

7.3 Interview of Mr. Ralph Alapai and Mr. Wayne Kahulamu

CSH met with Mr. Ralph Alapai and Wayne Kahulamu, hereafter referred to as Uncle Ralph and Uncle Wayne, at the project site in Kahalu‘u on 11 February 2014, to discuss the cultural resources, beliefs, and practices of the project area and extending to the larger *ahupua‘a* of

Kahalu‘u. Also present during the latter part of the interview was Mr. Mahealani Pai (MP) of Kamehameha Schools Keauhou-Kahalu‘u Education Group. The following is a summary of the discussion that transpired. To distinguish between quotes amongst those present, the following initials will be used to refer to Ralph Alapai (RA), Wayne Kahulamu (WK), and Māhealani Pai (MP).

Uncle Ralph and Uncle Wayne are first cousins who are related through the Kahulamu family. They were born and raised in the *ahupua‘a* of Kahalu‘u and they both lived within the project area during their early childhood years. Uncle Ralph was born on 1 September 1946, and he was raised in a house that still stands across the street from Kahalu‘u Bay. He currently lives not too far away from that house, down the road along Ali‘i Drive. He was baptized in the small St. Peter’s Church next to Ku‘emanu Heiau in Kahalu‘u Bay. He recalls moving from there to a house near Hōlualoa Bay and then moving back to Kahalu‘u in the 1940s. Today, he spends most of his days as a *paniolo* (cowboy) working up on Pu‘u Wa‘awa‘a Ranch.

His cousin, Wayne Kahulamu, was born the following year on 5 May 1947. He too, lived in Kahalu‘u for most of his life by the Catholic church near the bay. Uncle Wayne explained that there is a family cemetery about a quarter of a mile up the road from the project area. Though both cousins made references to living in Kahalu‘u Ahupua‘a for most of their lives, part of that experience included living in a house on the southeastern end of the project area which they pointed out once stood in the area between a tamarind and coconut tree, visible on the property.

“[We lived] right up to the highway [Ali‘i Drive], before, when the road was more narrow than what it is now,” said Uncle Wayne. The project area was their front yard when they lived above Mākole‘ā Heiau. They pointed out that the area from the south side of the project area up to the large *hau* tree that once stood *makai* of the existing hotel and extending seaward was known as Mākole‘ā. Everything north of the *hau* tree was considered Kahalu‘u.

Both cousins reminisced about living in that house and how they spent their days. They shared fond memories of hauling 5-gallon buckets of water from a brackish *‘ōpae ‘ula* pond near Mākole‘ā Heiau, up the hill to their house for household chores like washing clothes and dishes.

Uncle Wayne laughed when he recalled the following: “[We] had to pack our own water, up the hill, wash dishes, wash clothes.” Uncle Ralph laughed too and added, “[There were only] two girls, so we was the dishwasher and groundskeeper. The girls . . . they cleaned the house, that’s all.” With a small rainwater catchment tank of about 3,000 gallons, they had to supplement their water supply with water from the brackish *‘ōpae ‘ula* pond near their house and other freshwater springs in the surrounding project area property. Uncle Ralph recalled these ponds as being, “Couple *punawais* (springs) da kine. Small kine, and [there was] one right over there by the *makai* house.”

They also explained that the houses in the area were built near the ponds and then walls and steps were built around the ponds to protect and keep them clean. Though they never used the *‘ōpae* for fishing, Uncle Ralph explained that the little red shrimp filtered the water and kept the pond clean. “The *‘ōpae* filtered . . . was a clean pond, never was dirty. Always was clean because always [we were] taught not to dirty our resources.” They also used the water from the *‘ōpae* pond for drinking, bathing, and cooking. They added that salt in the water made the rice taste better and last longer.

They recalled the landscape of the project area as being covered in bush, with many trees like *‘opiuma*, a grove of coconut trees, and a large *hau* bush in front of where the existing hotel structure is located. The *hau* bush helped block the surf when storms came through. Many fruit trees also grew on the property like guava, papaya, and mango. They ate everything and lived off the fruits that grew in the area. Uncle Wayne remembered that Uncle Ralph’s father had a Japanese friend who lived up *mauka* (mountain-side) who would bring down fruits to trade for fish. “He would bring fruits and then the old man, [Uncle Ralph’s] father, used to be a good fisherman so they would trade,” remembered Uncle Wayne.

Uncle Ralph added the following:

> Yah. Trade. He [would] bring all the vegetables, fruits, oranges. They’d come down, they wanna learn how to throw net, so my dad take ‘um, teach ‘em and when my dad catch a lot of fish, they trade.

Uncle Ralph’s father would fish along the shoreline fronting the project area which they described as once having “so much fish” such as *manini, uouo*, and *maiko*. “The parrot fish,” says Uncle Ralph, was “choke.” Uncle Wayne added that back then, parrotfish was considered junk fish.

They explained that each cove along the shoreline had a specific name. Uncle Wayne recalled the place name Imo‘ōhua, where they would go catch the small manini or *‘ōhua*:

> RA: In the months of February, March April, the small kind *manini*, we used to go catch the small *manini*. The ones you can see through, then take home. Salt. Dry. That and hot rice and *poi*. Now you don’t see like how before.
>
> WK: Usually they come out when the whales come.
>
> RA: We used to set net before. Kapai. At evening time right before dusk. Right in front of the hotel. We get small area over there. Set net. Come with my mother. She used to come all the time before. Then we just set the net then the small *manini*, they come up to sleep in the ponds in front of the hotel in the evening. They come and just lay against the net.
>
> WK: Still get. We used to come up in the evening time. Set the net. Three quarters, half a bag. Burlap bag, half of it all *manini, kapai* kind. *Kakala manini*. By 8 o’clock, go home. Dry ‘em. Everybody had fish for eat.

Fish was dried by leaving them out on the rocks or placed on top of coconut leaves on the rocks. “Never had flies before,” said Uncle Wayne. The black lava rock would absorb heat from the sun and add to the drying process. Depending on how soft one liked one’s dried fish, drying usually would take a day and a half to two days. With salt, the fish could be preserved for a long time which was important in those days because there were no refrigerators or freezers. They used *‘alae* salt and ocean salt. Uncle Ralph explained how salt would dry along the shoreline of the project area:

> Before, you used to have over here. Now, I don’t see how like before. All the small ponds, the salt water all in front here. The sun dries up and that’s how they got salt before. Right here. That’s the kind salt they had before . . . before along

> Ali‘i Drive, you could just go pick salt, put in a bag. All the way to Hōlualoa Beach, get plenny.

Uncle Wayne added, “In those days, Hawaiian salt was so cheap. Now it’s gold.” He admitted that he would be afraid to collect salt from the ocean nowadays because the shoreline is not clean and is often used as a bathroom.

He‘e (octopus) also used to be abundant in nearby Kahalu‘u Bay. The cousins reminisced about cross netting in the bay, a method of fishing called *‘upena ku‘u* where nets would be set strategically in the bay for catching fish. They explained how the nets were set:

> WK: Cross net. We’d get plenny *ku‘una* in there. The kine where you can set the fish . . . I think we had over 30 inside that bay. Set this way, go that way. They knew how it ran and all you do, the old people, you just help them. They knew the marks. The rocks. You get the landmarks. They never touched the water. Line up this rock with that formation over there, that break water, they line them up with the church, all the old houses, coconut trees . . .
>
> RA: That’s how it was before. [When it was time to bring in the fish], you could walk in there. Shallow. It’s only about five feet, six feet in some places . . . So when you get all the fish in the net, just grab the lead, throw over the *ekoi*—that’s the floater— throw over and bring ‘em all together and . . . if you get one tub, better yet, throw ‘em on the tub [laughter]. Before days, they had galvanized tubs. Just throw ‘em inside . . . Actually, before days, the fish taste better than now because before had all the *limu*—the seaweed they eat. Now, there’s hardly any seaweed so the taste is kinda different.
>
> WK: And you could eat the *manini* guts. Now you won’t even chance ‘um. [laughs] It was the best! It’s all *limu* they eat.
>
> RA: *Pulehu* that. Yah. They only eat the *limu* eh? Before, they used to *pulehu*. Like before days, the half-size one, that’s the best kine. Plenny fat.
>
> Also plentiful were *limu* and *‘opihi* (limpets). Uncle Ralph recounts eating a lot of *limu* and an abundance of *ogo, limu kala*, and cabbage *limu*. Uncle Wayne and Uncle Ralph explained:
>
> WK: We became instant fishermen because we had to depend on fish . . . when you hungry, you just eat them [*‘opihi*] from the rocks. By the time you go home, you stay full . . . [We had] *limu kala*. Everything. Now you don’t see *limu kala* too much.
>
> RA: Yeah, not too much. Even the *ogo* . . . Those days was good because we ate a lot of iodine with all the *limu*. [But] food everywhere. Oh! You never had to worry . . . So you decide what you like eat, you go make what you like eat, then take home. Was the best life we had when we were young and I’m glad.

While the ocean was once abundant with many resources in earlier times, the cousins lamented about the changes they’ve seen over time. They still come down once in a while to throw net, drink beer, and have a good time, but they aren’t as dependent on the ocean now as they once were. Uncle Ralph admitted:

> That’s it mostly now ‘cause you don’t see the fish like before. Now, you just come. Come with your beer, throw net, pair of goggles, one spear if you’re lucky . . . for *he‘e*.

The discussion turns to the commercial activities along the shoreline of the southwestern portion of the project area. Uncle Ralph explained that tour companies bring people through the Kona Surf and Racquet Club to surf and kayak but their activities often disrupt their fishing, “Kinda hard when you’re standing on the beach with your net in your hand and . . . [laughs] wow . . . they don’t care. They just come up on the side.”

At the time they lived in Mākole‘ā, there were only a handful of families on the *makai* side of Kahalu‘u Ahupua‘a. These included the Kelekuli family who lived in the project area, the Upchurch family, the Haunio family in Keauhou, the Jimmy Asia house, and another house along Kahalu‘u Bay belonging to a man named Kinikā or the Kā house. They remembered the house that was once the house of King Kalākaua and that someone was living in that house when they were growing up. They recalled that the Nāhale family was part of that settlement and later a nightclub was there. They also remembered Tūtū Naluwāhine who lived near them in Mākole‘ā and who used to carry his wife and bathe her in freshwater ponds near his house. They remembered a brackish water pond near his house that was salty but they used it for bathing. They fondly recounted memories of him:

> WK: You have to remember him. If he whacked you with his *koko‘o*, you’d remember him! [laughs]
>
> RA: You have to remember him. Everything he talked is Hawaiian. That time we were young. We don’t understand Hawaiian. So every time I come home from school and stay down here, he’d yell for somebody to come down and help him. My older brother, them, they understand Hawaiian little bit. My mother would tell them: ‘Go down there see what the old man like. When he talk to you in Hawaiian, you just nod your head.’ [Laughs] He’d start talking to me in Hawaiian, I’d nod my head but he’d jab me in my gut with the bottom of the *koko‘o*. I’d turn around, I’d dig, run back home . . . You see him, you gotta hide!
>
> WK: The only English word he knew was, Oh my! [laughs]

They discussed the house site of Lonoikamakahiki and remembered many walls there prior to the construction of the existing condominiums. “They [had] all walls,” said Uncle Ralph. The cousins were young when the Keauhou hotel was built. Uncle Ralph had just started driving and became a truck driver, operating the first concrete truck for building the hotel. Uncle Wayne helped build Kona Lagoon hotel so the hotels provided construction jobs. Uncle Wayne pointed out that at that time no laws existed to protect cultural resources. “In those days, never had studies done. In those days, they just went for it. Never had laws. ”

Regarding burials, Uncle Ralph and Uncle Wayne remembered seeing plenty of *iwi* (bones) in the sand, especially when the surf was high, particularly in the sandy areas of the beach around Mākole‘ā. Before, there was a lot more sand along the shoreline and the cousins remembered the beach being about a 100 ft more than it is now. They shared their recollections of *iwi*:

> RA: Still get. I’m pretty sure because when we were small, sometimes, we’d go play in the sand and dig eh? Before, we’d find the head but not the body . . . When have high surf, all the bones start coming out.
>
> WK: High surf would dig ‘em [*iwi*] up. When sand moves, become all exposed . . . the old man would come down and he’d just move them more *mauka*.

Uncle Ralph also remembered a grave pit in the area near the tennis courts:

> I think there’s one here. The Asia house had one grave pit. I don’t know if they took that out. It was on this side somewhere. There used to be this big monkeypod tree. The road used to come in through by the building. When you come out, used to get one rock wall with the house on top and there used to be a trail right here. There used to be a rock wall with a coconut grove but they took the wall down. I think it was around here [near the tennis courts].

The cousins shared that there are many caves in Kahalu‘u which were used for burials and also for shelter previously. Some of the caves also had many fishbone hooks, poi pounders, and many nice things but collectors would take them. They pointed out a cave system on the *mauka* side of Ali‘i Drive by the old church, as well as one just opposite the southern portion of the project area:

> RA: Before, used to get two holes go under there [referring to area by the church].
>
> WK: Yeah, [it would] come down and then go *mauka* and come up here by Kam [III Road]. They put something on top. The old road used to go there. We used to go in the cave. All the caves. They shut it down. Then get one *mauka* here by the houses. We used to call it the Blonde Cave and it used to have one blonde *wāhine* with different hair. Blond hair. She had reddish blond hair.
>
> RA: In a coffin. Small box. Only the hair. One of those missionaries probably.
>
> WK: There’s plenny [of caves]. There’s one way up in the bushes. All Kam III coming down. Plenny. All down where the golf course was.

Several *heiau* exist on the property but according to Uncle Ralph and Uncle Wayne, only Hāpaiali‘i Heiau was intact when they were growing up and the rest were all “buss up.”

Māhealani Pai of Kamehameha Schools pointed out that the last two storms in Kona blew down the tents on the property that were used to house education programs so he was interested in the winds that blow in and around the project area. He shared two wind names for the area that he had come across in his research: Maakualapu—the wind that makes you bend, and Maihi. Uncle Ralph nodded his head saying, “When it comes, one side might be blowing stronger than the other. One from north, one from the south. ”

The discussion concluded with both cousins supporting the overall purpose of the proposed Heritage Center. They agreed that it is an asset and a positive initiative for Kona, particularly for young children to learn their culture.

> RA: I’m for it. This is good for our grandkids coming up. Our great-great grandkids. Learn the culture of how people lived before . . . This is where I learned how to throw net. My mom taught me. I was five years old. Before, we

> used to make the nets with gillian. Yeah. I'm good with it. [Kamehameha Schools should] continue what they're doing with the school. They should make a big school were they could use the *makai* side for planting. It's better to have a school in the open—have clean air to breathe. That's the best thing you can breathe is the ocean air. The ocean air.
>
> WK: I'm for it . . . and not just [for] this island.

Both Uncle Ralph and Uncle Wayne indicated they support the education program and would like to be called upon if their help is needed. "That's why we're here," said Uncle Wayne.

7.4 Interview with Ms. Nicole Lui

CSH interviewed Ms. Nicole Kealohaokalanikeakaonaali‘i Lui on 21 January 2014 in Kona, Hawai‘i. Her mother is Agnes Kaelemakule Lui and her father is Raymond "Joe" Lui. She is an active cultural practitioner who identifies her interests and skills in the areas of history, *mo‘olelo*, and genealogy. Although the family are recognized descendants of Pawai and Keahuolū, they are also connected to the project area through her mother's ancestors, from the Ma‘a line.

Ms. Lui shared her genealogy, detailing the Kaua and Ma‘a side of her family, who are the maternal ancestors of her mother, Agnes Kaelemakule. Starting with the Ma‘a side, Ms. Lui noted the following in Hawaiian:

> *‘O Ma‘a ke kāne ‘O Pili ka wahine noho pu laua a hanau ia ‘O Malaka Ma‘a;*
>
> *‘O Malaka Ma‘a ka wahine ‘O Ewaliko Kaihe ke kāne noho pu laua a hanau*
>
> *ia ‘O Luika Kaihe;*
>
> *‘O Luika Kaihe ka wahine ‘O Kaua Kaihemakawalu ke kāne noho pu laua a hanau ia ‘O Malia Kaua Kaihemakawalu;*
>
> *‘O Malia Kaua ka wahine ‘O Kapahu ‘Samson’ Pelekane noho pu laua a hanau ia ‘O Margaret Pelekane*.

Ms. Lui translated her statement in English:

> Ma‘a married Pili and they had Malaka Ma‘a. Malaka Ma‘a is a woman and she married Ewaliko Kaihe and they had a daughter named Luika Kaihe. Luika Kaihe married Kaua Kaihemakawalu and they had Malia Kaua Kaihemakawalu. Malia Kaua Kaihemakawalu married Samson Pelekane and they had Margaret Pelekane, who is my grandmother, the mother of my mother, Agnes Kaelemakule.

According to Ms. Lui, the wedding of Kapahu "Samson" Pelekane and Malia Kaua Kaihemakawalu took place at Helani church at Kahalu'u in 1916. Naluahine Kaopua was present as a witness to the marriage. The name "Kauakaihemakawalu" was translated by Ms. Lui's grandmother, Margaret Pelekane, to mean the "sacred war spear."

That Ms. Lui's *‘ohana* is connected to the Kahulu‘u *makai* project area through her mother's side of the family is borne out from her research on her family history. While she was doing genealogy work and interviewing *kūpuna*, an elderly woman in her *‘ohana* who lives on Moloka‘i stated that the *heiau* referred to as Hāpaiali‘i was called "Kapaealii" by the elders in

the family, and it was passed down that the *heiau* was built by the first Ma‘a, an ancient ancestor. The alternative name of "Kapaealii" to refer to what is commonly known as Hāpaiali‘i could also be included in reports and historical documents, stated Ms. Lui.

Ms. Lui noted that one of her ancestors, Kaua Kaihemakawalu, was also a *kahuna* for Kawaluna Heiau at the Pawai end of Maka‘eo (Old Kona Airport) located in Lae ‘O Ke‘ohu‘olu or Keahuolū. Kaua Kaihemakawalu was husband to Luika Kaihe, who was the granddaughter of the more recent ancestor named Ma‘a. Ms. Lui noted that sometimes it made sense in some families to keep the *mana* (supernatural or divine power) in the line by marrying into another family with the same status. In addition, Ms. Lui related that it was the grandparents of Ma‘a (*elua*, or second Ma‘a ancestor) who planted the large coconut grove at Waikilohi near Pawai for the chiefess Keouawahine, the wife of Kuakini who was the governor of Hawai‘i at the time. Ma‘a's grandparents were the caretakers and continued as such until the time of Keohokalole up to the overthrow of Ali‘i Nui Lili‘uokalani. Ms. Lui stated, "In those days, *kahuna* families all stuck together. They would marry each other, marry into each other. So they keep the power between the families."

She related that even though people were from another area, they also had connections to other areas. A search for descendants of a place should also include those who live away from the place, stressed Ms. Lui. She had shared this information about Ma‘a being the builder of Hāpaiali‘i and that Kapaealii as another name for the *heiau* with a Kamehameha Schools representative.

Ms. Lui's research on the Hāpaiali‘i Heiau has resulted in her understanding that the *heiau* was built around AD 1400 and that it was definitely before the time of Kamehameha I (1758-1819). "So that *heiau* was around for a long time," she stated.

Referring to previous studies by Stokes and Thrum on Hāpaiali‘i, Ms. Lui related that Stokes was informed by a local resident named Malanui that the Hāpaiali‘i Heiau was built by a Maui priest named Maa:

> Stokes' informant Malanui indicated that the temple of Hāpaiali‘i was built by a Maui priest named Maa, sometime later than the time of Paao [Stokes n.d.], but before Ke‘eku . . . by genealogical count, sometime between A.D. 1200 to 1400. [Tuggle 1990:53-55]

She also pointed to the following reference, where Thrum later reported that Kamehameha may have built or "rebuilt" the *heiau* in 1782:

> Kamehameha built (rebuilt?) this temple, with Hewahewa as its priest, after the battle of Mokuohai near Honaunau, about 1782, the first major battle for the control of Hawai‘i after the death of Kalaniopu‘u. There is no corroboration that this dedication took place at Hapaiali‘i, but it is quite likely that Kamehameha would have rededicated one of the Kahalu‘u temples because of the importance of Ke‘eaumoku‘s role at Mokuohai. [Tuggle 1990:53-55]

Based on the genealogical ties she uncovered, Ms. Lui would also like her family to be included in the list of descendants to the project area. When asked about what she thinks of the project, Ms. Lui gave her approval:

> It’s good. So long as they don’t keep out the old oral history, teach everything so the children, all the beneficiaries of that learning center can come away with deciding what they want to take and learn from. And then how they can do further research on either topic. Some say Kamehameha built it, Ma‘a may have built it. As a student, I want to be able to have a choice . . . ‘Oh wow, I have two things to choose from. Maybe I am going to take this one and find out more information about it.’ Do research on it and have a more broader *mana‘o* of the whole picture.

She would like for the proposed Heritage Center to include all sources of information so people have a fuller picture of the area, without one particular source being privileged so students can be exposed to different *mo‘olelo* and *mana‘o*.

As for her *mana‘o* of other cultural resources in the area, Ms. Lui shared that in the 1970s, her Papa toured the project area with a *kupuna* by the name of Kanakala Springer who was knowledgeable about the Kona coast, from Keauhou all the way to ‘Anaeho‘omalu. Mr. Springer informed Mr. Lui that there were springs with “sweet tasting water” and he knew this because he drank from those springs that now are underneath the old Kona Lagoon parking lot.

When asked about the importance of genealogy to Hawaiian people, Ms. Lui stressed that it definitely is important to the culture. She noted the following:

> Genealogy is very powerful. The ancestors play a vital role in our life because you can always call on them when you need help or inspiration. They are always there. I know they are there. And knowing who your ancestors are and their past, whatever fragments you can find and piece together is rewarding.

When combined with the work that her mother, Agnes, had done along with her own work, Ms. Lui estimated that the two of them have about 50 years’ worth of combined genealogical research on their family and they also know the genealogies of other families as well. Stated Ms. Lui, “You can have that help from them, just knowing the genealogy. Bring back some of the old ways, because that is what they did.”

Wherever she goes, Ms. Lui is asked the question of who is her family. “A lot of times, I am always asked that question, ‘Who is your family?’ . . . . All these little things play a vital role in how we perceive ourselves as Hawaiian people.”

Ms. Lui shared her thoughts about the proposed project, saying that “it is wonderful what is happening with the awakening of becoming true stewards of the land.” What is important to her is that she can share her *mana‘o* and the connection that her family has with the project area.

Section 8 Cultural Landscape

Discussions of specific aspects of traditional Hawaiian culture as they may relate to the project area are presented below. This section integrates information from Sections 3–7 in order to examine cultural resources and practices identified within or in proximity to the project area in the broader context of the encompassing landscape of Kahalu‘u. Excerpts from consultations are incorporated throughout this section where applicable.

8.1 Hawaiian Habitation and Agriculture

Based on radiocarbon data, Burtchard et al. (1996:54) suggest the earliest settlement in Kona began around AD 900. The earliest settlement most likely was located around Kahalu‘u Bay with all its marine resources. Archaeological evidence and community consultation also confirm the use of caves near the project area as a place of refuge and habitation during times of war and instability.

As for agriculture, the beginning of the Kona Field System is believed to have taken place by the mid-1300s. It was a system of planting unique to Kona which involved cultivating crops such as sweet potatoes, breadfruit, and dryland taro in narrow fields that ran from near the sea to the uplands. In the project area, coconut trees and crops such as sweet potatoes where grown and higher up away from the shoreline were trees like mai‘a (bananas) and mango trees that gave both fruit and shade for travelers using the trails. Taro, plantains, sugar, and *‘ulu* also grew further upland.

8.2 *Wahi Pana* and *Mo‘olelo*

Kahalu‘u, both the *ahupua‘a* and particularly the project area, is part of a storied landscape teeming with natural and cultural resources which have been enjoyed by both the *ali‘i* and *maka‘āinana*, including the *kama‘āina* and *kūpuna* of today. Beginning with numerous names for resources such as ponds, surf waves, caves and lava tubes, coastal points, and hills, and abundance of historic and cultural properties such as *heiau* and petroglyphs, Kahalu‘u is one of the most significant places in all of Hawai‘i.

The project area is called Kahalu‘u according to Mr. Fujisaka, and he suggested the meaning of the name has to do with diving. The boundary between Kahalu‘u and Keauhou is Paniau, while the name Mākole‘ā refers to the *heiau* (south of Hale ‘Ike), as well as the whole beach.

Place name research and community consultation reveal a profusion of names to describe the storied cultural landscape, with Mr. Fujisaka noting that the names for places have gotten lost through time and improper usage. Ke‘ali‘ali‘a once referred to a sandy pond, and Kilohana to a large pond that he and others regularly cleaned when called by Tūtū Naluahine. Mr. Fujisaka also shared that groves of *‘ōhai* trees once existed, and one grove (located where there are condos now) was called Ulumoi, and in the lower end, where Tūtū Naluahine’s house was located, the grove of *‘ōhai* there was called Umi.

Mo‘olelo about the project area include that of the *mo‘o* pond (Keawehala Pond), which Mrs. Kauahi shared was located in front of the current coconut trees seen from Hale ‘Ike. The story

involved two sisters, one who was evil and one who was good. They would travel to and from the pond. The pond was taken care of by Tūtū Naluahine and her father.

The proper name for the wall in Kahalu‘u Bay is not Menehune wall, as it known today, but Kala‘auokali‘ikini, stated Mr. Fujisaka. Relating that he learned about the Menehune wall in school, he narrated the legend which involved the *menehune* abandoning their work which left the wall incomplete and enabled surf to come in.

Other *mo‘olelo* associate the project area with the spirits of *ali‘i* who were there, such as sixteenth century Maui ruler Kamalālāwalu and his two faithful *‘ilio*, Kapapako and Kauakahi‘oka‘oka. Mr. Fujisaka shared that Mrs. Kauahi’s father saw a “big man, standing on the heiau with a dog.”

8.3 *Heiau*

Along with the numerous *mo‘olelo* regarding *wahi pana* in the area, the sheer number of *heiau* near and within the project area is indicative of the spiritual importance of this special place. There are five *heiau* contained within the project area, and three of them have been restored: Hāpaiali‘i, located south of Kahalu‘u Beach Park; Ke‘ekū, situated 150 ft southwest of Hāpaiali‘i Heiau; and Mākole‘ā southeast of Ke‘ekū Heiau. Another possible name for Hāpaiali‘i was “Kapaealii,” according to Ms. Nicole Lui who traced her genealogy to the Ma‘a line.

Community consultation indicates that Kahalu‘u *makai* was and is a sacred place, with each site having its own prayer. Mr. Fujisaka recalled that during the 1950s, when he assisted Henry Kekahuna, Theodore Kelsey, and Tūtū Naluahine with measuring the *heiau*, each time they measured a particular *heiau*, it had a different prayer. Places like the pond also had their own prayer. “So, if that was done then, when we did it, they [the early Hawaiians] were doing it before. It was sacred. So you have to ask permission to do what you want to do.”

The majority of the community participants emphasized the sacred nature of the *heiau* and how they grew up being taught by their elders to respect the *heiau* and that it was *kapu* or forbidden to step on it. They always had to go around and avoid the *heiau*, although they did not know until seeing Kekahuna’s map the full significance of the area. When Mr. Alapai and Mr. Kahulamu were growing up, only Hāpaiali‘i Heiau was intact. There are a total of three *heiau* that have since been restored by KS in the project area: Hāpaiali‘i, Ke‘ekū, and Mākole‘ā.

8.4 Burials (*Ilina*)

Sand dunes in the project area may contain burials according to archaeological research and community consultation.

Iwi were found in certain areas of the project area, especially around the sand dunes. After a storm or big waves, *iwi* would pop up in the sand and simply be put back where they came from, according to Mr. Fujisaka. When the Keauhou Golf Club was being built in 1966, lots of sand was taken from Kahalu‘u to be placed in the golf course, stated Mr. Kahalioumi. Bones were found in the sand that was hauled up by machines. He pointed out that burials in the sand were common, especially in Kona, where people buried wherever they could dig.

Caves as well as lava tubes were also utilized as burial sites because tools that can dig through stones were not available. No markers were used and the grave location was committed to memory. There are three types of burials, sand, earth and cave, noted Mr. Fujisaka, and whatever was convenient determined the type of burial that occurred.

Mr. Ralph Alapai and Mr. Wayne Kahulamu also described seeing plenty of *iwi* in the sand, especially when the surf was high, particularly in the sandy areas of the beach around Mākole‘ā. Before, there was a lot more sand along the shoreline and the cousins remembered the beach being about a 100 ft more than it is now. There was a grave pit in the area near the tennis courts of the Keauhou resort, according to Mr. Alapai.

Mrs. Hamm stressed that there is a family cemetery close to the project area that is still being maintained by the family. Mr. Fujisaka related that his father was trained to be the caretaker for the burial cave of the Kahalu‘u area when cave burials were still being done. The cultural practice of preparing the dead included washing the body with ashes and salt, and then wrapping it with cloth or tapa to be tied to carrying poles. Only a designated group of family members, no more than eight, were chosen to accompany the body along the trail to be buried in the cave. Other family members stayed behind to mourn the deceased. Mrs. Hamm confirmed the training of the designated members to take care of the deceased, and that the ceremonies of carefully cleaning the dead and preparing them for burial was part of honoring the physical body of individuals, which was valued by Hawaiians along with the spiritual and mental bodies.

8.5 Caves

Near the project area are a number of caves that were used for refuge and/or habitation purposes during times of instability, as well as for burials. Archaeological studies, place name research, and community consultation confirm the presence of caves including the well-studied ‘Ōhi‘a Cave, a large lava tube entered below ‘Ōhi‘amukumuku Heiau that goes up *mauka*.

There are no caves in the project area itself, according to Mr. Fujisaka. But there are many along the hillside near the project area. Both Mr. Alapai and Mr. Kahulamu shared that there are many caves in Kahalu‘u which were used as burials and also for shelter. Some of the caves also had many fishbone hooks and poi pounders which were taken by collectors. They pointed out a cave system on the *mauka* side of Ali‘i Drive by the old church, as well as one just opposite the southern portion of the project area. There are also many caves along Kamehameha III Highway down to where the Keauhou Golf Course is located.

8.6 Marine and Freshwater Resources

Kahalu‘u *makai* was teeming with abundant water resources, brackish as well as fresh. The water came from underground and would bubble to the surface, shared Mr. Fujisaka. Study participants knew ponds that can be used for bathing and for drinking purposes. There were also ponds that were off limits and reserved for *ali‘i*, such as Po‘o Hawai‘i.

As for daily drinking water, study participants used freshwater catchment; water for the cisterns came from rain. Mrs. Hamm related that they would minimize using the water from their cisterns as much as possible by taking baths and washing their laundry at the beach.

Mr. Kahalamu and Mr. Alapai had a catchment tank for their needs but they needed to supplement by hauling water from a brackish pond near their house as well as several freshwater ponds. The salty water was used to make rice taste better and to help preserve it.

Anchialine ponds teeming with *‘ōpae ‘ula* were and still are in the project area, and Mr. Fujisaka recalled a big pond in particular called Kilohana, which he and others cleaned whenever Tūtū Naluahine called for the overgrown *ēkoa* bush to be cut back. The cleaning of invasive plants like *ēkoa* is still an ongoing cultural practice.

‘Ōpae ‘ula was used as bait for *‘ōpelu* fishing. But the *‘ōpae ‘ula* that grew in Kilohana was not as small as the regular *‘ōpae ‘ula*. Mr. Fujisaka described the *‘ōpae ‘ula* as hardy survivors who find a way to live no matter where they may be, while Mr. Alapai explained that the little red shrimp filtered the water and kept the pond clean.

Because the project area was primarily a fishing area, just about every fish variety associated with the shoreline could be found, including *manini,‘ū‘ū*, and *hinalea*, to name just a few. There was plenty of *limu* of all kinds, including *limu ele‘ele*, *limu waina*, *limu lipoa* (for use with *‘ōpihi*), and *limu kala*. There was no *limu kohu* in the Kahalu‘u *makai* area, so those who lived in Kahalu‘u would ask permission from the residents of Keauhou to pick *limu kohu* there. *Limu kala* was used for medicinal purposes as well.

8.7 Fishing Practices

Kahalu‘u Bay was teeming with all kinds of fish. Mr. Fujisaka recalled being four years old and being taken by his elders around the bay to learn all the locations of *ku‘una* or places where and how to set net. The *ku‘una* were in shallow waters and had their own names such as Ko‘omea or Pokowa‘a, which had big flat boulders on the bottom close to where the net is set. Cousins Mr. Alapai and Mr. Kahulamu noted there were at least 30 *ku‘una* in the bay, and they shared their method of cross netting which set the nets along the marks, or lined them up using landmarks. Once it was time to bring in the fish, one simply walked up to the shallow area, grabbed the lead, and brought the net together to catch the fish, which Mr. Alapai noted as tasting better back then because of all the *limu* that the fish ate. Even the guts of *manini* would be eaten, when now it is not advisable, and little fish like that would be roasted or *pulehu*. *Limu* is not as available now as it was before, which limits the amount fish can eat, thereby changing its taste.

Each family also had a specific kind of fish that was taboo for them to eat. For Mr. Kahalioumi, a little dark fish that was used for medicine by his family was forbidden to be eaten. For Mr. Fujisaka, the fish that was *kapu* was the one that was used to lure others. There was *‘ōpelu* fishing outside Keauhou, and there was also *‘ōpelu* caught outside of La‘aloa. *He‘e* (octopus) also used to be abundant in Kahalu‘u Bay.

8.8 *Limu* Gathering

According to Mrs. Hamm, women were the *limu* gatherers, while men were the fishermen. The women from her *‘ohana* frequented special places to gather *limu* and she learned to do it by watching her mother who also fished in the water for small fish using her *mu‘umu‘u*. She also

gathered limpets or *‘ōpihi*. Mr. Alapai described the different kinds of *limu*, such as ogo, *limu kala*, and cabbage *limu*.

8.9 Salt Gathering

Salt was found and gathered all along the shoreline of the project area. It was used to dry fish that would then be left out on the black lava rocks or placed on top of coconut leaves on the rocks. Mr. Alapai noted that there were plenty of small salt water ponds that were dried by the sun, leaving salt. However, the salt is not so clean now as before due to the ocean being used as a bathroom, according to Mr. Kahalamū.

8.10 Trails

There were four main trails that went *mauka-makai* in Kahalu‘u, according to Mr. Fujisaka. Those trails were Paniau, Mākole‘ā, Kaholele, and Kapa‘ala‘alaia. Other nearby trails include Kahalu‘u, La‘aloa, Pāhoehoe which was a flat trail, Hōlualoa, Kamalumalu (a big trail), Judd trail, and Puapua‘a. In addition, there were smaller trails that interconnected with the larger ones.

One travelled up and down the trails on old *kēkake*,or donkeys that were used to carry packs and wooden saddles, related Mrs. Hamm who described riding on the hard wooden saddles. All along the trail, she and her family would visit other families and pay their respects along the way to their destination.

The main road that is now known as Ali‘i Drive was a trail before; residents referred to the trail as either going to Kailua or Keauhou, described Mr. Fujisaka.

8.11 Surfing

Ku‘emanu Heiau was a surfing *heiau* attesting to the ancient practice of surfing enjoyed by *ali‘i*. Near Ku‘emanu Heiau were specific wave breaks called Kehau and Kapua, with Kapua being inside and Kehau located outside according to Mr. Mitchell Fujisaka. There was also a third surf wave there. Pu‘u Pu‘u was the surf by Ohi‘o, because it was the highest peak.

Mr. Fujisaka described surfing the way it was practiced in the 1950s, stating it was he and others in his group who started so-called “modern surfing.” He used a “big, hollow paddle board” that was about 13 ft long and knew all the surf spots and their names before they were called the names that are currently being used. The names were sometimes related to the people who lived nearby including Tommy Whites and Hinds (before it was known as Banyan’s). Other spots were Moa, Kamoamoa, and Kahalu‘u.

8.12 Educational and Cultural Programs

The project area is currently being used for educational purposes by Kamehameha Schools’ Keauhou-Kahalu‘u Education Group which teaches students using place-based learning. Students are brought on-site to learn topics such as plane table mapping techniques and math, which is being used in the restoration of the *heiau* located in the project area. Mrs. Hamm pointed to the use of genealogy to teach history to the children. Her grandchildren along with Mr. Kahalioumi’s grandchildren and those of Mrs. Vel Kauahi are already benefitting from the

program, which teaches them important aspects of Hawaiian culture including chants and ceremonies.

Section 9 Summary and Recommendations

CSH undertook this CIA at the request of Helber Hastert & Fee Planners, Inc. and Kamehameha Schools (KS). The cultural survey broadly included the entire study area and more specifically the project area.

9.1 Results of Background Research

Background research for this study yielded the following results, presented in approximate chronological order:

1. The project area is located on the *makai* (seaward) side of Ali‘i Drive in the *māno wai* (water source or headwaters) of Kahalu‘u Ahupua‘a. Kahalu‘u literally translates to “diving place,” and is one of the most important places in all of the Hawaiian Islands. The project area with its productive fishing grounds, access to the Kona field system and other resources, is home to no less than five *heiau* (place of worship), all of highest spiritual importance historically and in recent times, to Hawaiians.

2. Archaeological research shows the project area contains numerous culturally and historically significant sites and features including *heiau* (Hāpaiali‘i Heiau, Ke‘ekū Heiau, Mākole‘ā Heiau, Kapuanoni Heiau), Keawehala Pond, petroglyphs, fishponds, freshwater springs, and a residential complex associated with *ali‘i* (Po‘o Hawai‘i).

3. Based on radiocarbon dating (Burtchard et al. 1996:54), the earliest settlement in Kona began around AD 900. The earliest settlement most likely was located around Kahalu‘u Bay with its abundant marine resources.

4. The project area is also associated with a number of ruling chiefs who made Kahalu‘u their place of residence, including Lono-i-ka-makahiki, Alapa‘inui, Kalani‘ōpu’u, and Kamehameha (Tuggle 1989:10) as well as a famous and beautiful chiefess by the name of “Makolea” (Reinecke 1930:6).

5. The project area is associated with specific *mo‘olelo* (oral history) including, but not limited to Pāokamenehune, or the Menehune breakwall created by the *menehune* (legendary race of small people who worked only at night); the famous king sharks Kehau and Laenui, who controlled the lesser sharks to ensure no one was attacked in the waters of Kahulu‘u; Keawehala Pond (Site # Ha-D4-52) as the home of two twin *mo‘o* (lizard) sisters; “Kaao Hooniua Puuwai no Ka-Miki” (“The Heart-stirring Story of Ka-Miki”) which tells the story of Ka-Miki, the quick or adept one, and his brother Maka‘iole (“rat or squinting eyes”), who traveled around the island to participate in competitions ca. the thirteenth century when Pili-a-Ka‘aiea was the chief of Kona; “Makolea,” a beautiful chiefess who was the wife of Chief Ke-paka-‘ili-‘ula” and who resided in the *heiau* that bears her name (Kekahuna 1952) and Lono-i-ka-makahiki who was the ruler of Hawai‘i Island during the sixteenth or seventeenth centuries and was involved in several famous battles with the chiefs of Maui (including Kama-lala-walu) who is said to have been put to death on Ke‘ekū Heiau and mourned by his two faithful dogs, whose spirits still guard his body even today (Stokes and Dye 1991).

9.2 Results of Community Consultation

A total of 26 people were contacted for the purposes of this CIA; seven people responded and were interviewed for more in-depth contributions.

Community consultation indicates:

1. The project area and its environs, from *mauka*-to-*makai* (upland to the sea) has a long history of use by *ali‘i* and *Kānaka Maoli* (Native Hawaiians) for a variety of past and present cultural activities and gathering practices including fishing, *limu* (seaweed) gathering, and spiritual worship. Community participants stress the sacred nature of the place and convey their deep aloha for the project area’s cultural and natural resources.

2. Participants discussed natural and cultural resources including freshwater springs and anchialine ponds teeming with *‘ōpae ‘ula* (small endemic shrimp) which were used as bait; the existence of at least 30 *ku‘una* (place where a net is set in sea) in shallow waters, and *‘ōpelu ko‘a* (*Decapterus macarellus*, mackerel scad fishing grounds) in deep water; the consumption and enjoyment of many kinds of fish such as *manini*, *uouo*, *maiko*, and *he‘e* (octopus) during a time when fish like parrot fish was so “choke” that it was considered a “junkfish.” They gathered marine resources such as *‘opihi* (limpets), and a large variety of *limu* (seaweed, algae) used for subsistence as well as medicinal purposes and also gathered salt used to dry fish. Community interviewees shared the traditional manner of handling the dead and other burial customs, the protocol and respect accorded to *heiau* in the project area, and gender-based cultural beliefs associated with fishing and gathering. They shared place names for cultural and natural resources including Kilohana for a large pond which once existed, place names for each cove along the shoreline such as Imo‘ōhua, where small *manini* or *‘ōhua* were caught, and told *mo‘olelo* about surfing in the 1950s, and what it was like to grow up in an area with *heiau* of extreme importance.

3. All of the community participants expressed their support for the proposed project and the importance of cultural education for the younger generation, with Mrs. Hamm suggesting that all children, not just Hawaiian children, should be able to take advantage of this learning opportunity.

4. They approved the restoration of the *heiau* and stressed the continuing need to teach visitors the right protocol and proper respect in approaching the *heiau*. They called for proper signage that can teach the history of the site as well as communicate the need for respecting the area.

5. The majority of the study participants agreed to limiting public access and called for customary fishing rights to be part of the practice of the heritage center. Those living outside the *ahupua‘a* must first ask for permission to fish, and the same should be done for use of the project area for funeral services.

6. The study participants would like to continue to participate in maintaining the *heiau* and expressed their willingness to be involved in future operation of the heritage center, emphasizing their aloha for the place and their desire to perpetuate Native Hawaiian culture.

9.3 Recommendations

The following recommendations are based on a synthesis of all the information gathered during preparation of this CIA. Faithful attention to these recommendations, and efforts to develop appropriate measures to address these concerns, will help mitigate the adverse impacts of the proposed action on Hawaiian cultural beliefs, practices, and resources by the project.

1. In light of statements made by the majority of the participants in this study that there may be burial sites or *iwi kūpuna* (ancestral remains) in the *makai* (seaward) portion of the project area, it is recommended that:

   a. Lineal and cultural descendants will be identified and consulted in accordance with applicable laws.

   b. Personnel involved in development activities in the project area should be informed of the possibility of inadvertent cultural finds, including human remains.

   c. Any development of the *makai* area should be limited and the sand dunes and beach area should be left alone.

   d. Any potential development should be limited to minimally invasive infrastructure.

   e. Should cultural or burial sites be identified during ground disturbance, all work should immediately cease, and the appropriate agencies notified pursuant to applicable law.

2. Community members affiliated with the area both genealogically and culturally should be consulted regarding the preservation, restoration, and interpretation of cultural resources including archaeological sites, caves, petroglyphs, trails, possible burials, and other features.

3. As part of active management, visitor/resident education should be provided to encourage proper behavior and protocol to assist in the protection, appreciation, and enjoyment of natural and cultural features.

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Appendix A Glossary

To highlight the various and complex meanings of Hawaiian words, the complete translations from Pukui and Elbert (1986) are used unless otherwise noted. In some cases, alternate translations may resonate stronger with Hawaiians today; these are placed prior to the Pukui and Elbert (1986) translations and marked with “(common).”

Diacritical markings used in the Hawaiian words are the *‘okina* and the *kahakō*. The *‘okina*, or glottal stop, is only found between two vowels or at the beginning of a word that starts with a vowel. A break in speech is created between the sounds of the two vowels. The pronunciation of the *‘okina* is similar to saying “oh-oh.” The *‘okina* is written as a backwards apostrophe. The *kahakō* is only found above a vowel. It stresses or elongates a vowel sound from one beat to two beats. The *kahakō* is written as a line above a vowel.

Hawaiian Word	English Translation
ahupua‘a	Land division usually extending from the uplands to the sea, so called because the boundary was marked by a heap (*ahu*) of stones surmounted by an image of a pig (*pua‘a*), or because a pig or other tribute was laid on the altar as tax to the chief
akua	God, goddess, spirit, ghost, devil, image, idol, corpse; divine, supernatural, godly
ali‘i	Chief, chiefess, officer, ruler, monarch, peer, headman, noble, aristocrat, king, queen, commander
‘āpana	Piece, slice, portion, fragment, section, land parcel
‘aumakua	Family of personal gods, deified ancestors who might assume the shape of sharks, owls, hawks, etc.; a symbiotic relationship existed; mortals did not harm or eat *‘aumakua*, and *‘aumakua* warned and reprimanded mortals in dreams, visions, and calls; *‘aumākua*—plural of *‘aumakua*
heiau	Pre-Christian place of worship, shrine; some *heiau* were elaborately constructed stone platforms, others simple earth terraces; many are preserved today
‘ili	Land section, next in importance to an *ahupua‘a* and usually a subdivision of an *ahupua‘a*
‘ili ‘āina	Land area; an *‘ili* land division whose chief pays tribute to the chief of the *ahupua‘a* of which it is a part, rather than directly to the king
‘ili kū	Short for *‘ili kūpono*; a nearly independent *‘ili* land division within an *ahupua‘a*, paying tribute to the ruling chief and not to the chief of the *ahupua‘a*
iwi	Bone; the bones of the dead, considered the most cherished possession, were hidden

Hawaiian Word	English Translation
kama‘āina	Native-born, one born in a place, host; native plant; acquainted, familiar, *Lit.*, land child
kapu	Taboo, prohibition; special privilege or exemption from ordinary taboo
konohiki	Headman of an *ahupua‘a* land division under the chief
kua‘āina	Country, countryside; person from the country, Lit., back land
kula	Plain, field, open country, pasture; an act of 1884 distinguished dry or *kula* land from wet or taro land
kuleana	Native Hawaiian land rights (common); right, privilege, concern, responsibility, title, business, property, estate, portion, jurisdiction, authority, liability, interest, claim, ownership, tenure, affair, province
kupua	Demigod or culture hero, especially a supernatural being possessing several forms; one possessing *mana*; to possess *kupua* (magic) powers
kupuna	Grandparent, ancestor, relative or close friend of the grandparent’s generation
kūpuna	Plural of *kupuna*
lo‘i	Irrigated terrace, especially for taro, but also for rice; paddy
loko	Pond, lake, pool
Māhele	Land division of 1848
maka‘āinana	Commoner, populace, people in general
makai	Seaward
manele	Sedan chair, palanquin
mauka	Inland
moku	District, island, islet, section
mo‘o	Narrow strip of land, smaller than an *‘ili*
mo‘olelo	Story, tale, myth, history, tradition, literature, legend, journal, log, yarn, fable, essay, chronicle, record, article; minutes, as of a meeting (from *mo‘o ‘ōlelo*, succession of talk; all stories were oral, not written)
nī‘aupi‘o	Offspring of the marriage of a high-born brother and sister, or half-brother and half-sister; bent coconut mid-rib, i.e., of the same stalk
nuku pu‘u	Group of Hawaiian honey creepers, possibly *Hemignathus lucidus lucidus*, *Hemignathus lucidus hanapepe*, and/or *Hemignathus lucidus affinis*
pa‘akai	Salt
pāhale	House lot
pīkoi	A tripping club, as of wood or stone, with a rope attached

Hawaiian Word	English Translation
pōhaku	Rock, stone, mineral, tablet
wahi pana	Storied place (common); legendary place

Appendix B Authorization and Release Form

Cultural Surveys Hawai‘i, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 Kailua, Hawai‘i 96734 Ph: (808) 262-9972 Fax: (808) 262-4950
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AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawai‘i (CSH) appreciates the generosity of the *kūpuna* and *kama‘āina* who are sharing their knowledge of cultural and historic resources, beliefs and past and present cultural practices and historic events in Kahalu‘u Ahupua‘a, (TMK) parcels: (3) 7-08-013: 042, (3) 7-08-013: 002, (3) 7-08-013: 013, and (3) 7-08-013: 043 for the Cultural Impact Assessment (CIA) CSH is preparing for Helber Hastert & Fee Planners, Inc. and Kamehameha Schools (KS).

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. The interview will not be tape-recorded without your knowledge and explicit permission.
2. You will have the opportunity to review the written transcript or notes of our interview with you. At that time you may make any additions, deletions or corrections you wish.
3. You will be given a copy of the interview transcript or notes for your records.
4. You will be given a copy of this release form for your records.
5. You will be given any photographs taken of you during the interview.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, _____, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview and/or photograph to be used as specified.

_____
(Signature)

_____
(Date)

Appendix I

PRELIMINARY ENGINEERING REPORT

KAHALU'U MA KAI

PRELIMINARY ENGINEERING REPORT

Prepared by:

Belt Collins Hawaii LLC
2153 North King Street, Suite 200
Honolulu, Hawaii 96819

January 2014

ERIC H. TAMASHIRO
LICENSED PROFESSIONAL ENGINEER
No.9787-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION

April 30, 2014
EXPIRATION DATE OF THE LICENSE

1. Purpose

The purpose of this Preliminary Engineering Report (PER) is to assess existing utility (sewer, water, drainage, electrical, telephone, and communication) services, necessary improvements, and the potential impacts and mitigations to accommodate the Kahalu'u Ma Kai project (Project).

2. Project Description

The Project includes the redevelopment of the Keauhou Beach Resort (KBR) and adjacent former Kona Lagoon Hotel property, approximately 22.6 acres in area, from resort use to an educational complex and cultural center. The conceptual site plan considered in this PER is shown on Figure 2.1 below.

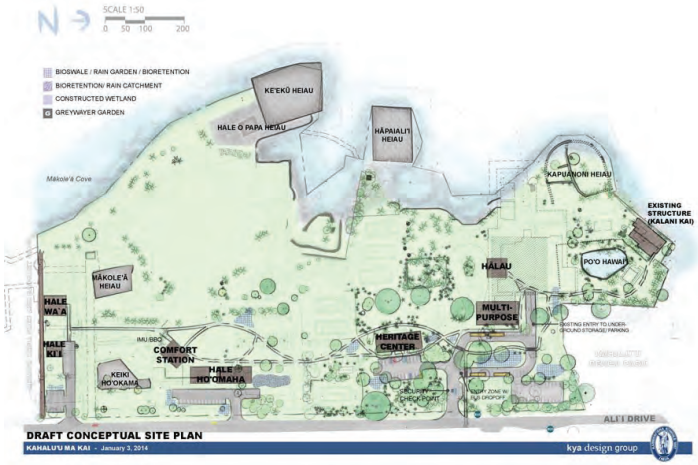

Figure 2.1 – Draft Conceptual Site Plan

From a site development perspective, the main components of the Project include the demolition and removal of the existing KBR Hotel including supporting buildings and parking areas and the construction of an educational complex and cultural center. Primary facilities supporting the Project's educational complex and cultural center include the Heritage Center, multi-purpose building with *hālau*, Hale Ho'omaha (camping area), maintenance building, comfort station and storage buildings, reuse of the existing Kalani Kai structure, and facilities supporting existing canoe (*wa'a*) and tiki (*ki'i*) making activities.

Site improvements will also include driveways, parking areas, concrete walkways, and “soft” reinforced vehicular/pedestrian paths. Low Impact Design (LID) such as constructed wetlands, greywater gardens, bioswales, rain gardens, bioretention areas, rain catchment systems, and seepage pits (shallow sumps) will be incorporated into the Project.

3. Wastewater

3.1. Existing Conditions

Wastewater at the project site currently collects in three small sewage pump stations (SPSs). A SPS located in the basement of the existing KBR Hotel conveys wastewater to a SPS located adjacent to the hotel on the southeast side. The other SPS is at the existing Tennis Center Building. Force mains from the SPSs convey wastewater to an existing 12-inch diameter sewer main within the Ali‘i Drive right-of-way. The 12-inch diameter sewer main conveys wastewater by gravity from the project site and nearby properties to the existing Kahalu‘u SPS.

The Kahalu‘u SPS is located in the VE flood zone near the southwestern corner of the property and adjacent to the Mākole‘ā Heiau. Because of its proximity to the coastline, the Kahalu‘u SPS experiences limited flooding during high tide or high surf conditions.

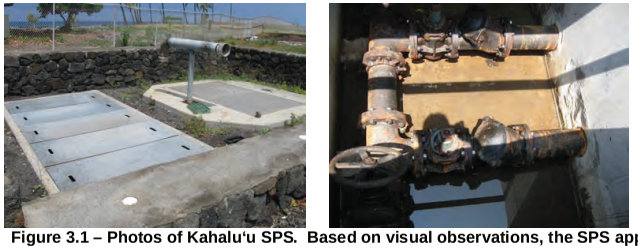

Figure 3.1 – Photos of Kahalu‘u SPS. Based on visual observations, the SPS appears to be well maintained and in satisfactory condition.

The Kahalu‘u SPS is owned by Kamehameha Schools and operated by a private firm. The original pumping facilities consisted of a dry well and wet well. However, in 2005 the SPS was modified with the demolition of the dry well and addition of two submersible pumps in the wet well.

The pump controls and emergency generator are installed separately from the SPS in the southeastern corner of the property outside the flood zone. The circuit breakers of the pumps trip periodically due to the long distance from the pump controls. The pumps operate in a lead-lag configuration

according to the level in the wet well. The lead pump will start first. The lag pump will operate only if the level in the wet well continues to rise. Each submersible pump is rated to operate at 1,037 gallons per minute (gpm) (1.5 million gallons per day [mgd]) at a head of 73.4 feet. With two pumps in operation, the Kahalu‘u SPS capacity is about 3 mgd.

The Kahalu‘u SPS pumps wastewater in a 10-inch diameter force main to the He‘eia Wastewater Treatment Plant (WWTP). The treatment plant is operated by the same private firm that operates the Kahalu‘u SPS. The current capacity of the treatment plant is 1.8 mgd. The treatment plant capacity can be expanded up to 3.6 mgd (LUC 2005).

Wastewater at the treatment plant receives pretreatment followed by primary and secondary treatment. The wastewater is treated to R-2 quality with approximately 0.5 mgd of reclaimed water produced (Limtiaco).

3.2. Existing Tributary Area and Wastewater Design Flows

The wastewater tributary area of the Kahalu‘u SPS is approximately 400 acres and includes existing and planned development for the Keauhou Kona Resort Development. Information on the tributary area and tributary population was obtained from the 1980 Keauhou master plan, 1990 Ali‘i Drive Sewer Improvement project, and the August 2013 Draft Environmental Assessment, Parcel 26 at Kahalu‘u. A general site map with the Kahalu‘u SPS tributary area is shown on Figure 1 in Appendix A.

The Kahalu‘u SPS receives flow from the KBR Hotel, Tennis Center Building, and Kalani Kai Grill as well as the following surrounding properties: the Keauhou Kona Surf and Racquet Club, HHA Rental Apartments, Na Hale Keauhou Townhouses located mauka of the racquet club, Kahalu‘u Beach Park SPS, Beach Villas at Kahalu‘u, and several single-family and multi-family residences.

In addition to the properties cited above, the tributary area also includes the grounds of the former Kona Lagoon Hotel and large undeveloped areas planned for future residential and multi-family development.

Wastewater from the racquet club and mauka townhouses is conveyed to the Kahalu‘u SPS via a gravity line directly from the racquet club property. A 4-inch diameter force main from the Kahalu‘u Beach Park SPS conveys wastewater to the 12-inch diameter gravity sewer main in the Ali‘i Drive right-of-way.

Preliminary wastewater flow calculations based on the tributary area and population described above are provided on Table A-1 in Appendix A. Preliminary wastewater flow calculations based on existing wastewater flow

conditions without KBR Hotel and Kona Lagoon Hotel in service are provided on Table A-2 in Appendix A. The wastewater flows were estimated based on the methodology in the *Design Standards of the Department of Wastewater Management* (City 1993).

Based on the preliminary wastewater flow calculations, the estimated design average, design maximum, and design peak flows to the Kahalu'u SPS are 0.81 mgd, 3.59 mgd, and 4.14 mgd, respectively. Under existing conditions, the estimated average, maximum, and peak flows to the Kahalu'u SPS are 0.16 mgd, 0.77 mgd, and 0.86 mgd, respectively. Based on the current developments discharging to the SPS, the existing pumps are oversized for the flows received.

3.3. Proposed Improvements

To facilitate construction of the proposed improvements, the existing sewer lines will be demolished and removed or abandoned in place and backfilled with grout. New sewer lines connecting to the Kahalu'u SPS and existing 12-inch diameter sewer line in Ali'i Drive will be incorporated into the Project to provide service to Kalani Kai Grill as well as occasional events, such as life celebrations, makahiki, hō'ike, seasonal ceremonies, and educational workshops.

Average daily wastewater flow for Kalani Kai Grill is anticipated to be less than 4,000 gallons per day based on 40 users per day. The wastewater flow rate for occasional events will be determined during the Project design. However, for preliminary purposes, the average daily wastewater flow is estimated to be 5,000 gpd based on 1,000 visitors at 5 gallons per person per day based on Table 1 in Appendix F of the Hawai'i Administrative Rules (HAR) 11-62 "Wastewater Systems" for the State Department of Health (DOH).

For new facilities, the Project will utilize an on-site wastewater collection and treatment system (on-site wastewater system) and greywater gardens. Information on the on-site wastewater system and greywater gardens is provided in a report prepared by Roth Ecological Design International (REDI). The report is provided in Appendix B and summarized as follows:

The projected wastewater flow from the new facilities is based on HAR 11-62. The population that contributes to the wastewater generation at the Project site will vary daily and will consist of students, tourists, campers, lineal descendents, and facility personnel. Based on the above uses, the average daily wastewater flow is projected to be 5,450 gpd (REDI), see Appendix B.

The on-site wastewater system will consist of septic tanks, pump stations, equalization tanks, small diameter collection pipe, a constructed wetland,

turbidity filters, and an ultraviolet (UV) disinfection system. The treatment system will produce R-2 water for irrigation at the Project site. The intent of the proposed treatment system is to reuse all wastewater on-site with zero discharge of wastewater.

As noted above, the on-site wastewater system will not be designed to treat wastewater during occasional events due to the large number of visitors. During these events, wastewater from the septic tanks will discharge from the on-site wastewater system to the existing 12-inch diameter gravity main within the Ali'i Drive right-of-way and discharge to the Kahalu'u SPS. The overflow system and its operation will be designed under the Project.

Primary treatment tanks with a total capacity of 13,000 gallons will be located near individual buildings or groups of buildings (REDI). The septic tank system will provide primary treatment of the raw wastewater and will consist of two chambers. The first chamber will provide solids and floatables separation. The second chamber will include a duplex pump system and effluent filters to pump the septic tank effluent to the constructed wetland. The locations and total number of septic tanks still need to be determined.

Small diameter discharge pipe (2 inches to 4 inches in diameter) will convey wastewater from the septic tanks to the equalization tanks and constructed wetland (REDI). A pumped system does not require manholes. Pipes will be installed 24 to 60 inches below grade (REDI).

Equalization tanks with a total capacity of 6,500 gallons will be installed downstream of the septic tanks and upstream of the constructed wetland to dampen peak flows (REDI). The locations and total number of equalization tanks still need to be determined and will depend on the total number of septic tank zones at the project site.

Secondary treatment of the primary effluent will be accomplished with a subsurface-flow constructed wetland. Primary effluent will flow beneath the ground surface into wetland cells with native Hawaiian plants treating the primary effluent. Discharge from the wetland cells or secondary effluent will then flow to tertiary treatment consisting of 5-micron cartridge filters and UV disinfection. The filtration and disinfection unit processes will produce R-2 water for on-site landscape irrigation reuse.

An irrigation pump station will distribute the R-2 water to non-edible native Hawaiian or Polynesian plants suitable for the coastal environment at the property. The irrigation distribution system will consist of drip tubing and a root zone watering system with a subsurface bubbler sprinkler.

Greywater from outdoor showers will be treated with planted, shallow absorption beds before ground infiltration. The beds will be planted with

native Hawaiian plants. The greywater gardens will be sized to accommodate up to 100 visitors per day or 500 gpd based on the requirements of HAR 11-62 (REDI). The locations of the showers still need to be determined.

As indicated above, the Kahalu'u SPS will receive wastewater from the Kalani Kai Grill and occasional on-site events. In the event of a power outage or temporary shutdown of the on-site wastewater system, wastewater flows will be diverted directly into the Kahalu'u SPS via the 12-inch diameter sewer line in Ali'i Drive. The overflow system and its operation will be designed under the Project.

The Kahalu'u SPS can accommodate the estimated peak wastewater flows associated with the Kalani Kai Grill, on-site occasional events, and temporary shutdown of the on-site wastewater system.

Preliminary wastewater flow calculations under future conditions are provided on Table A-3 in Appendix A. Under future conditions, the estimated average, maximum, and peak flows to the Kahalu'u SPS are 0.53 mgd, 2.43 mgd, and 2.98 mgd, respectively.

As shown on Table A-3, the design peak flow from the Project will be on the order of 0.11 mgd, which is lower than the design peak flow from the KBR and Kona Lagoon Hotels (Table A-1) of about 1.3 mgd.

3.4. Potential Impacts and Mitigations

The Project is located in the critical wastewater disposal area as determined by the Hawai'i County Wastewater Advisory Committee. However, there is no existing public sanitary sewer connection available. The on-site wastewater system will be designed, constructed, operated, and maintained in accordance with HAR 11-62. The existing privately owned regional wastewater system will provide 100 percent backup capacity.

The removal of design flows from the KBR Hotel and Kona Lagoon Hotel and construction of the on-site wastewater system will result in lower wastewater demands. Based on the Project's wastewater discharging to the Kahalu'u SPS and removal of the design flows from the hotels, the average, maximum, and peak flows will be reduced by 0.27 mgd, 1.16 mgd, and 1.16 mgd, respectively.

The Kahalu'u SPS is located in the VE flood zone and experiences limited flooding during high tide or high surf conditions. The VE zone is a coastal high hazard area subject to a one percent or greater annual chance of flooding in any given year that includes additional hazards associated with high velocity waves, including tsunamis. Potential impacts from flooding and water infiltration have been reduced with the following measures:

- Upgrades made to the SPS in 2005 including the demolition of the dry well and addition of two submersible pumps in the wet well.
- Low lying concrete rubble masonry (CRM) wall surrounding the SPS.
- Solid manhole covers located over the SPS.

4. Water

4.1 Existing Conditions

Water service to the site is provided by the County of Hawaii Department of Water Supply (DWS) from its 324.5-foot elevation Keauhou system. A 12-inch diameter ductile iron water line extends from the Keauhou Reservoir to Ali'i Drive. Record drawings indicate that the water line was constructed in the late 1960's or early 1970's. A map with the layout of the existing 12-inch diameter water line is shown on Figure 4.1 below.

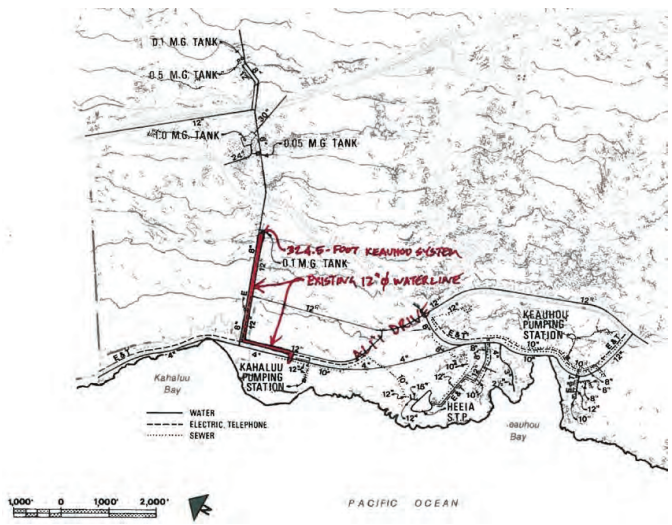

Figure 4.1 – Existing Water System

Domestic water service to KBR is provided by a 6-inch by 4-inch Hersey compound meter (meter no. 4933781) located near the KBR main entrance. A 4-inch diameter water line extends from the meter to the hotel. Smaller service laterals extend from the hotel to the Tennis Center Building and

Kalani Kai structure. Irrigation lines are also tapped off the 4-inch diameter water line.

The existing water system was sized to accommodate 317 hotel rooms. Based on a previous due diligence study completed for KBR around 1998, water pressure was determined to be adequate for the 7-story hotel and support buildings.

Fire protection service to KBR is provided by a 6-inch Hersey detector check meter (meter no. 4965517), which is located adjacent to the service meter. Building fire protection was provided by a 4-way Siamese wet standpipe connection located in front of the hotel and a 2-way Siamese dry standpipe connection located near the southeast corner of the building. There are no on-site fire hydrants in the building area.

Domestic water and fire protection services to the former Kona Lagoon Hotel parcel are provided by a 4-inch Hersey compound meter (meter no. unknown) and 6-inch Hersey detector check meter (meter no. 05017439). The water meters are located within the property near the Ali‘i Drive shoulder area. DWS indicated that as-built drawings of the water system for this property are not available. However, the existing water system was sized to accommodate 462 hotel rooms.

Based on a water agreement with an effective date of October 20, 2011, the Kona Lagoon Hotel parcel has an allocation from DWS of 235 equivalent units of water. Each equivalent unit is equal to 600 gallons per maximum day. As a result, the available maximum daily usage for the Project site is 141,000 gpd.

Average daily water usage at KBR, based upon DWS monthly water usage data from November 2011 to November 2012 was approximately 46,000 gpd. Monthly water usage data from January 2013 to July 2013 indicates an average daily demand on the order of 20,000 gallons per day. The 56-percent reduction in water usage is due to the KBR Hotel closure.

Average daily water usage at the Kona Lagoon Hotel, based upon DWS monthly water usage data from October 1997 to October 1981, was approximately 94,000 gpd. Monthly water usage data from December 2012 to August 2013 following the demolition of the Kona Lagoon Hotel indicates an average daily demand of about 4,000 gpd, or less than 95-percent of the previous demand.

4.2 Proposed Water System

Based on the water agreement and projected water demands, adequate water service is available for the Project. DWS indicated in a phone

conversation on September 26, 2013 that it is not aware of any issues with the existing 12-inch diameter water line in Ali‘i Drive, and water line improvements or upgrades are not planned in the near future.

The projected water demands for the Project were provided by REDI as part of its evaluation of the proposed on-site wastewater system design. The average daily demand is anticipated to be on the order of 5,450 gpd.

Based on the domestic consumption guidelines provided in the DWS Water System Standards, the average daily demand for school and park areas is 4,000 gallons per acre. Assuming similar water demands for the educational complex and cultural center, the projected average daily demand for the 22.6 acre parcel is 90,400 gpd. Maximum daily demand is anticipated to be on the order of 135,600 gpd, which is less than the 141,000 gpd per the water agreement for the Kona Lagoon Hotel parcel. Due to the Project’s implementation of sustainable water management practices, water usage is expected be closer to the projected water demand provided by REDI.

The Project’s design for the on-site water system will include down-sizing the service meters and installing new laterals off of the 12-inch diameter water line in Ali‘i Drive. Fire protection services will also be designed for the Project in accordance with applicable building and fire codes.

The Project will result in a lower water demand than that occurring when the KBR and Kona Lagoon Hotels were in service. An additional reduction in water demand is expected with the Project’s use of reclaimed water.

4.3 Potential Impacts and Mitigations

Potential impacts to the water system are not expected due to the reduction in water use. No mitigation is required.

5. Grading and Drainage

5.1. Existing Conditions

The project site is bordered by Kahalu‘u Beach Park to the northeast, Ali‘i Drive to the east, Kona Surf and Racquet Club to the south, and the ocean along the northwest and west. The site generally slopes from Ali‘i Drive toward the shoreline. Several lower lying areas are located throughout the property, including the Keawehala Pond located between the Ke‘ekū and Hāpaiali‘i Heiaus, Po‘o Hawai‘i Pond located to the north of the hotel, and a small spring located to the south of the hotel. The site consists of areas developed for KBR and the former Kona Lagoon Hotel and includes the existing hotel and support buildings, asphalt concrete paved driveway and

parking areas, and grass and landscaped surfaces. An existing conditions plan is provided on Figure 2 in Appendix C.

Surface waters surrounding the property are classified and regulated by the State of Hawai'i under Title 11 Hawaii Administrative Rules, Department of Heath, Chapter 54 Water Quality Standards. The waters along the west coast of the Island of Hawai'i are designated Class AA marine waters, designated to remain in a natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused source or action.

Storm water runoff generated on the site generally sheet flows to lower lying areas, infiltrates into the ground in some locations, and eventually discharges into the ocean at the shoreline. Three existing drain inlets and a 16-inch diameter drain line collect storm water runoff from portions of the KBR parking lot and cul-de-sac located adjacent to the hotel. The drain line discharges into a seepage pit located within a landscape area to the south of the hotel. The existing drainage conditions are shown on Figure 2.

5.2. Proposed Improvements

Storm water runoff design criteria for the Project will be based on the County of Hawaii Department of Public Works (DPW), Storm Drainage Standard. However, the Project's design civil engineer, Okahara & Associates, Inc. indicated that DPW requested that storm water runoff for developed conditions be reduced to pre-developed conditions, i.e., prior to the development of the existing hotel and parking areas. [Telephone conversation with Bruce Meyers of Okahara & Associates, Inc. on September 24, 2013]

The storm water runoff generated on-site will decrease with the Project's implementation of LID, increase in green space, and removal of the hotel, support buildings, and parking areas. Preliminary drainage basin areas and storm water runoff quantities are provided on Figure 3 in Appendix C. The following table provides a summary of the total runoff quantity for pre-developed and developed conditions:

Drain Basin	Total Area	Runoff Quantity in cubic feet per second (cfs)
Pre-developed	5.3 acres	4.1 cfs
Developed	5.3 acres	10.2 cfs

As shown in the summary above, there will be an increase in storm water runoff quantity from 4.1 to 10.2 cubic feet per second (cfs) from pre-developed to developed conditions. To limit storm water runoff to pre-

developed conditions, the storm water runoff quantity for developed conditions would have to be reduced by 6.1 cfs.

To accommodate the reduction in storm water runoff, LID concepts are planned for the Project. The following provides a summary of the proposed LID concepts that will be utilized:

- Seepage Pits (Shallow Sumps) – Seepage pits will be incorporated into the Project's design to infiltrate excess storm water runoff into the ground. The infiltration rate of the seepage pits will be determined during design with percolation tests. However, it is anticipated that each seepage pit will have a capacity of one to two cfs.
- Rain Gardens – Rain gardens, also referred as bioretention basins, are engineered shallow depressions that collect and filter storm water runoff using vegetation and conditioned planting soil beds. The filtered runoff gradually infiltrates through the basin invert and into the soil matrix. The estimated bioretention basin surface areas are provided in the report prepared by REDI in Appendix B.
- Bioretention Swales – Bioretention swales are shallow linear channels with a planting bed and covered with turf or other surface material (other than mulch or plants). Runoff filters through the planting bed, is collected in an underdrain system and discharged at the downstream end of the swale.
- Rainwater Harvesting – Rainwater harvesting is the collection and temporary storage of roof runoff in rain barrels or cisterns for subsequent landscape irrigation. Rainwater harvesting will be utilized at the Multi-Purpose Building, Heritage Center, Hale Ho'omaha, and comfort station. The estimated storage volumes for selected buildings are provided in the report by REDI in Appendix B.

Infiltration facilities, such as the seepage pits and rain gardens, are highly susceptible to clogging and premature failure from sediment, trash, and other materials. To extend the service life of the infiltration facilities, pretreatment using vegetated swales, filter strips, sedimentation basins, and manufactured treatment devices may also be included in the Project's design.

The proposed improvements would not significantly alter the existing topography of the site. However, grading would be required to provide level building pad areas. Additionally, the site will be graded such that surface storm water runoff is directed into rain gardens, bioretention areas, bioretention swales, and grass swales. Seepage pits (shallow sumps) will be incorporated into the Project as needed to control storm water runoff.

5.3. Potential Impacts and Mitigations

Potential impacts to the project site and near shore waters are not expected due to the application of LID practices and reduction in impervious areas. No mitigation is required.

During demolition and construction activities Best Management Practices (BMPs) will be utilized for both land based areas and areas within the ocean. The procedures and BMP details will be verified with the selected contractor, but are expected to include the following:

- BMPs for the landside work
  - Installing a perimeter construction fence.
  - Using controlled watering to allay dust during the demolition work.
  - Collecting and placing building debris, as it is created, into roll-off bins or trucks for hauling and removal from the site.
  - Installing silt fences, snake bags or other means to mitigate silt laden runoff from leaving the site.
  - Installing netting or another form of barrier along the exterior of the KBR Hotel to prevent debris from falling down from the upper floors. Such BMPs will be needed for protection of Po‘o Hawai’i and shoreline areas.
  - Installing stabilized construction entrances, tire wash areas, and concrete washout areas.
- BMPs for work over the lagoon
  - Installing a floating boom outside of the “fall zone” for dust and particle control.
  - Installing silt curtains in the ocean as needed.
  - Installing a platform that serves as a debris catchment system, plywood, or netting with a filter cloth beneath the work area.
- Procedures for work in the ocean
  - Work will be done at low tide and when winds are calm.
  - Install floating booms and silt curtains as needed.
  - Large debris will be removed as soon as possible.
  - Waste hauling will follow the shortest and most direct path to the shoreline.
  - Water contaminated with fine particles will be removed by bailing within the work area barrier and disposed in an area similar to a construction site concrete washout area.

6. Flood Hazards

The Federal Emergency Management Agency's (FEMA) Preliminary Digital Flood Insurance Rate Map (DFIRM), July 2011, indicates that the majority of the project site is in Flood Zone AE (100-year flood with base flood elevations determined) and Flood Zone VE. The remainder of the site is located in Flood Zone X, outside of the 500-year floodplain.

Based on the draft conceptual site plan and DFIRM, the Project will include structures located within the flood zones. New construction and substantial improvement will comply with the Hawai‘i County Code Chapter 27, Floodplain Management.

The project will include the demolition of the existing KBR Hotel basement, site stabilization of the excavated area, and construction of a future basement structure. Because the Gutter Line (boundary of the AE and VE Zones) is not well defined relative to the existing topographic survey map, the County of Hawaii National Flood Insurance Coordinator was contacted via a conference call on October 3, 2013 with a follow-up phone conversation on October 15, 2013 to discuss the proposed demolition and future basement concept. The conference call and phone conversation were summarized via e-mail on October 17, 2013. The following provides a summary of the discussions:

- Existing Conditions
  1. Base Flood Elevation = 12 feet
  2. Gutter Line = 8 feet
  3. The existing gutter line is not well defined; interpretation of the map will be acceptable per Section 27-16c of the Hawai‘i County Code.
- Interim Site Improvements Following Basement Demolition
  1. A level basement pad area with a finish grade elevation of about +2 will be provided.
  2. To accommodate the grade change, cut and fill slopes with a slope gradient of 2 horizontal to 1 vertical will be utilized (subject to recommendations from the Geotechnical Engineer).
  3. New fills located within the existing building area, but outside of the future basement area will either maintain pre-construction elevations, i.e. original grades prior to construction of the KBR Hotel or extend below pre-construction elevations.
  4. The original grades prior to the construction of the KBR Hotel are based on the existing topographic survey ground elevations and range from +4.0 on the west side of the hotel near the shoreline to +9.2 on the east side and +6.1 on the north side near Po‘o Hawai‘i to +11.9 on the south side.
  5. A No Rise Certification (NRC) will be required for the interim site improvements. The supporting data for the NRC will be based

on Items 3 and 4 above. A detailed flood elevation study is not required.

6. A Conditional Letter of Map Revision is not anticipated.
7. FEMA review and approval is not anticipated.

- Future Basement Structure
  1. Because the interim finish grades surrounding the future basement area will range in elevation from +8.3 to +11.9, the interim site conditions will be located outside of the VE Zone and within the AE Zone.
  2. Due to the AE Zone, flood proofing of the future basement will be required.
  3. Upon completion of the basement construction, backfill will be placed along the basement walls and extend no higher than preconstruction elevations. If additional fill height is required, then new fill within the AE Zone will be placed in accordance with Chapter 27 of the Hawai‘i County Code.

The preliminary footprint of the future basement with interim grading concept and two cross-sections are provided on Figures 4 and 5 in Appendix D. A copy of the October 17, 2013 e-mail summary is also provided in Appendix D.

7. Electrical and Communication Facilities

Electrical power service to this area is provided by Hawaii Electric Light Company (HELCO), a privately owned utility company regulated by the State Public Utilities Commission, via distribution lines routed primarily along major roadways. HELCO Keahole generating plant, along with generating facilities in East Hawai‘i, provides electrical capacity to West Hawai‘i (LUC August 2005). North of the project site, overhead sub-transmission lines located on utility poles are routed along Ali‘i Drive. At the Project site and south into Keauhou Resort area, utility lines are distributed underground. Power availability in the Keauhou Resort area is comfortably sufficient to feed proposed new HELCO padmount transformers necessary for the planned redevelopment of the site. HELCO will, at the appropriate time, extend existing primary circuits to the proposed padmount transformers.

Hawaiian Telcom (HT) provides voice, CATV and other telecommunications services to Keauhou as well as to the rest of the island. HT provides services for the region from their switching facilities in Kailua-Kona (LUC August 2005). Availability of telecommunication services to the site by HT is sufficient for the proposed redevelopment and planned use. At the appropriate time, HT will extend the requested services to a demarcation point via customer provided facilities.

Oceanic Time Warner Cable (OTWC) provides CATV, voice and other telecommunication services to Keauhou as well as to the rest of the island.

Availability of telecommunication services to the site by OTWC is sufficient for the proposed redevelopment and planned use. At the appropriate time, OTWC will extend the requested services to a demarcation point via customer provided facilities.

The Project should have a positive effect by reducing the total amount of electrical power required to service planned buildings and operations associated with the educational complex and cultural center. The project should have minimal effect on voice, CATV and telecommunication services serving the site.

8. References

Belt Collins & Associates (BCA). 1990. *Construction Plans of: Keauhou Improvement Project Phase 2A Ali‘i Drive Sewer Improvements for: Keauhou Kona Resort Development*.

Land Use Commission (LUC). August 2005. Docket No. A04-747; Findings of Fact, Conclusions of Law, and Decision and Order. In the Matter of the Petition of Kamehameha Investment Corporation to Amend the Agricultural Land Use District Boundary into the Rural Land Use District for Approximately 487.246 Acres of Land at Keauhou I and II, and Kahalu‘u, North Kona, Hawai‘i.

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County of Hawaii, Department of Public Works. October 1970. *Storm Drainage Standard*.

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The Limtiaco Consulting Group (Limtiaco). July 2013. *2013 Update of the Hawaii Water Reuse Survey and Report.*

Roth Ecological Design International, LLC (REDI). 2014. *KS – Kahalu‘u Redevelopment – PER for EA*.

Appendix A – Wastewater

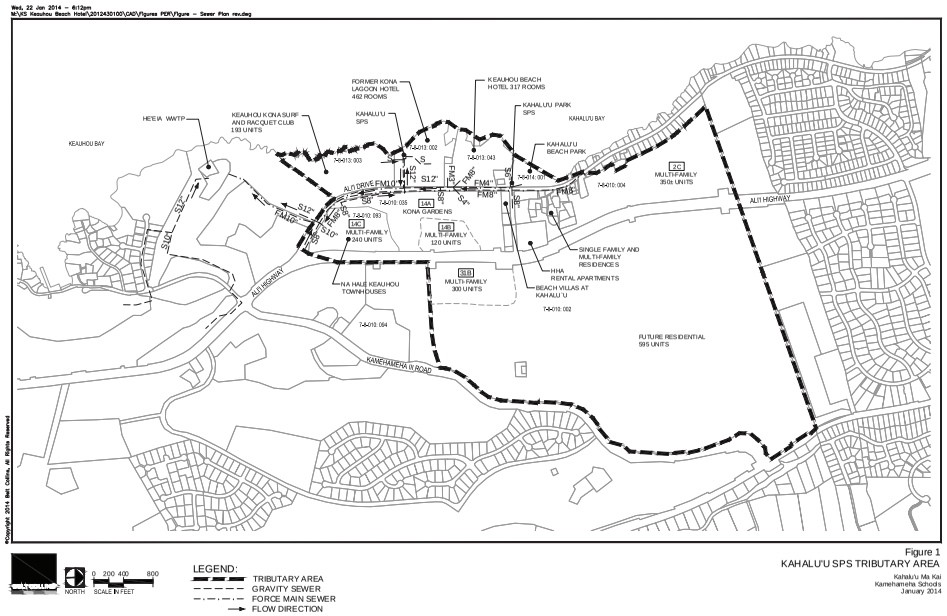


Figure 1
KAHALU'U SPS TRIBUTARY AREA

Kahalu'u Ma Kai
Kamehameha Schools
January 2014

WASTEWATER FLOW ESTIMATES - DESIGN CONDITION

TABLE A-1

	TRIBUTARY AREA	TRIBUTARY POPULATION			WASTEWATER FLOW COMPUTATION[1]								
		Units[2]	Other Users		Average Daily Flow	Total Equivalent Population	Max Flow Factor	Max Flow	Dry Weather I/I (at 5 gpcd)	Design Avg Flow	Design Max Flow	Wet Weather I/I (at 1,250 gpcd)	Design Peak Flow
	(Acres)		Density (cpa)	Capita [3]	Occupants (at X gpcd)[4]			(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)
Keauhou Beach Hotel (13A)	11.0	317		1030	0.111	1387	4.683	0.520	0.007	0.118	0.527	0.014	0.540
Kona Lagoon Hotel (13B)	11.6	462		1502	0.162	2021	4.344	0.702	0.010	0.172	0.712	0.015	0.727
Total Hotel	**22.6**	**779**		**2,532**	**0.273**	**3408**		**1.222**		**0.290**	**1.239**		**1.267**
Na Hale Keauhou Townhouses (14C)	12.0	240		672	0.054	672	5.000	0.269	0.003	0.057	0.272	0.015	0.287
Multi-Family (14B)	4.6	120		336	0.027	336	5.000	0.134	0.002	0.029	0.136	0.058	0.194
Multi-Family (2C)	42.0	350		980	0.078	980	5.000	0.392	0.005	0.083	0.397	0.053	0.449
Multi-Family (31B)	11.0	300		840	0.067	840	5.000	0.336	0.004	0.071	0.340	0.014	0.354
Future Residential	261.0	505		2,020	0.162	2020	4.344	0.702	0.010	0.172	0.712	0.326	1.038
Keauhou Kona Surf & Racket Club[5]	15.9	193		636	0.008	97	5.000	0.039	0.0005	0.008	0.039	0.020	0.059
Kona Gardens (14A)	14.3			800	0.004	50	5.000	0.020	0.0003	0.004	0.020	0.018	0.038
Kahaluu Park	3.7			400	0.002	25	5.000	0.010	0.0001	0.002	0.010	0.005	0.015
Beach Villas at Kahaluu and Single-/Multi-Family Residences	10.0	150		420	0.060	750	5.000	0.300	0.0038	0.064	0.304	0.013	0.316
HHA Rental Apartments	3.3	60		168	0.024	300	5.000	0.120	0.0015	0.026	0.122	0.004	0.126
Total Residential	**377.8**	**1918**		**7,272**	**0.49**	**6070**		**2.322**		**0.52**	**2.35**		**2.88**
Kahaluu SPS TOTAL	**400.4**	**2697**		**9804**	**0.76**	**9477.63**		**3.54**		**0.81**	**3.59**		**4.14**

Footnotes:

1 Design methodology based on the Design Standards of the Department of Wastewater Management, City and County of Honolulu.

2 The hotels have units in terms of "rooms" while the residential section has units in terms of residential occupancy. The Multi-Family housing units are considered to be apartment style units with 2.8 persons per apartment.

3 The capita for the hotels was considered to be the number of units (rooms) multiplied by 3.25 persons per room, which includes guests and employees. This information was taken from the Maui Wastewater Reclamation Division: http://www.co.maui.hi.us/documents/11/28/Wastewater%20Flow%20Standards.PDF The capita for the residential units was taken from the Honolulu Department of Wastewater Management Standards, as 2.8 capita per unit where the unit is considered apartment style.

4 Wastewater flow for hotels were estimated from the number of rooms and the gpd/room as stated in the Maui Wastewater Reclamation Division http://www.co.maui.hi.us/documents/11/28/Wastewater%20Flow%20Standards.PDF Wastewater flows for residential units were based on an average of 80 gpcd as stated in the Honolulu Department of Wastewater Management Standards. Flows for Kona Gardens were assumed to be 5gpcd with 800 persons while flows for Kahalu'u Beach Park were assumed to be 5 gpcd with 400 persons. The HHA Rental Facility wastewater flows were assumed to be 400 gpd/unit with 60 units.

5 The capita for the surf and racket club was calculated as 40 cpa (capita per acre), while the average daily flow was estimated as 40 gal/unit/d where a unit was taken as a member present at the club. Source: Davis, Mackenzie L. Water and Wastewater Engineering: Design Principles and Practice. McGraw-Hill, 2010.

WASTEWATER FLOW ESTIMATES - EXISTING CONDITIONS

TABLE A-2

	TRIBUTARY AREA	TRIBUTARY POPULATION			WASTEWATER FLOW COMPUTATION[1]								
		Units[2]	Other Users		Average Daily Flow	Total Equivalent Population	Max Flow Factor	Max Flow	Dry Weather I/I (at 5 gpcd)	Design Avg Flow	Design Max Flow	Wet Weather I/I (at 1,250 gpcd)	Design Peak Flow
	(Acres)		Density (cpa)	Capita [3]	Occupants (at X gpcd)[4]			(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)
Keauhou Beach Hotel (13A)	11.0			10	0.001	13	5.000	0.005	0.000	0.001	0.005	0.014	0.019
Na Hale Keauhou Townhouses (14C)	12.0	240		672	0.054	672	5.000	0.269	0.003	0.057	0.272	0.015	0.287
Keauhou Kona Surf & Racket Club[5]	15.9	193		636	0.008	97	5.000	0.039	0.0005	0.008	0.039	0.020	0.059
Kona Gardens (14A)	14.3			800	0.004	50	5.000	0.020	0.0003	0.004	0.020	0.018	0.038
Kahaluu Park	3.7			400	0.002	25	5.000	0.010	0.0001	0.002	0.010	0.005	0.015
Beach Villas at Kahaluu and Single-/Multi-Family Residences	10.0	150		420	0.060	750	5.000	0.300	0.0038	0.064	0.304	0.013	0.316
HHA Rental Apartments	3.3	60		168	0.024	300	5.000	0.120	0.0015	0.026	0.122	0.004	0.126
Kahaluu SPS TOTAL	**70.2**	**643**		**3,106**	**0.15**	**1906.00**		**0.76**		**0.16**	**0.77**		**0.86**

Footnotes:

1 Design methodology based on the Design Standards of the Department of Wastewater Management, City and County of Honolulu.

2 The hotels have units in terms of "rooms" while the residential section has units in terms of residential occupancy. The Multi-Family housing units are considered to be apartment style units with 2.8 persons per apartment.

3 The capita for the hotels was considered to be the number of units (rooms) multiplied by 3.25 persons per room, which includes guests and employees. This information was taken from the Maui Wastewater Reclamation Division: http://www.co.maui.hi.us/documents/11/28/Wastewater%20Flow%20Standards.PDF The capita for the residential units was taken from the Honolulu Department of Wastewater Management Standards, as 2.8 capita per unit where the unit is considered apartment style.

4 Wastewater flow for hotels were estimated from the number of rooms and the gpd/room as stated in the Maui Wastewater Reclamation Division http://www.co.maui.hi.us/documents/11/28/Wastewater%20Flow%20Standards.PDF Wastewater flows for residential units were based on an average of 80 gpcd as stated in the Honolulu Department of Wastewater Management Standards. Flows for Kona Gardens were assumed to be 5gpcd with 800 persons while flows for Kahalu'u Beach Park were assumed to be 5 gpcd with 400 persons. The HHA Rental Facility wastewater flows were assumed to be 400 gpd/unit with 60 units. The Keauhou Beach Hotel flows were assumed to be 100 gpcd with 10 security personnel and workers onsite.

5 The capita for the surf and racket club was calculated as 40 cpa (capita per acre), while the average daily flow was estimated as 40 gal/unit/d where a unit was taken as a member present at the club. Source: Davis, Mackenzie L. Water and Wastewater Engineering: Design Principles and Practice. McGraw-Hill, 2010.

WASTEWATER FLOW ESTIMATES - FUTURE CONDITIONS

TABLE A-3

	TRIBUTARY AREA	TRIBUTARY POPULATION			WASTEWATER FLOW COMPUTATION[1]								
		Units[2]	Other Users		Average Daily Flow	Total Equivalent Population	Max Flow Factor	Max Flow	Dry Weather I/I (at 5 gpcd)	Design Avg Flow	Design Max Flow	Wet Weather I/I (at 1,250 gpcd)	Design Peak Flow
			Density	Capita[3]	Occupants								
	(Acres)		(cpa)		(at X gpcd)[4]			(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)
Kahaluu Ma Kai	22.6			1,454	0.015	190	5.000	0.076	0.001	0.016	0.077	0.028	0.105
Na Hale Keauhou Townhouses (14C)	12.0	240		672	0.054	672	5.000	0.269	0.003	0.057	0.272	0.015	0.287
Multi-Family (14B)	4.6	120		336	0.027	336	5.000	0.134	0.002	0.029	0.136	0.058	0.194
Multi-Family (2C)	42.0	350		980	0.078	980	5.000	0.392	0.005	0.083	0.397	0.053	0.449
Multi-Family (31B)	11.0	300		840	0.067	840	5.000	0.336	0.004	0.071	0.340	0.014	0.354
Future Residential	261.0	505		2,020	0.162	2020	4.344	0.702	0.010	0.172	0.712	0.326	1.038
Keauhou Kona Surf & Racket Club[5]	15.9	193		636	0.008	97	5.000	0.039	0.0005	0.008	0.039	0.020	0.059
Kona Gardens (14A)	14.3			800	0.004	50	5.000	0.020	0.0003	0.004	0.020	0.018	0.038
Kahaluu Park	3.7			400	0.002	25	5.000	0.010	0.0001	0.002	0.010	0.005	0.015
Beach Villas at Kahaluu and Single-/Multi-Family Residences	10.0	150		420	0.060	750	5.000	0.300	0.0038	0.064	0.304	0.013	0.316
HHA Rental Apartments	3.3	60		168	0.024	300	5.000	0.120	0.0015	0.026	0.122	0.004	0.126
Kahaluu SPS TOTAL	**400.4**	**1,918**		**8,726**	**0.50**	**6259.63**		**2.40**		**0.53**	**2.43**		**2.98**

Footnotes:

1 Design methodology based on the Design Standards of the Department of Wastewater Management, City and County of Honolulu.

2 The hotels have units in terms of "rooms" while the residential section has units in terms of residential occupancy. The Multi-Family housing units are considered to be apartment style units with 2.8 persons per apartment.

3 The capita for the hotels was considered to be the number of units (rooms) multiplied by 3.25 persons per room, which includes guests and employees. This information was taken from the Maui Wastewater Reclamation Division: http://www.co.maui.hi.us/documents/11/28/Wastewater%20Flow%20Standards.PDF The capita for the residential units was taken from the Honolulu Department of Wastewater Management Standards, as 2.8 capita per unit where the unit is considered apartment style.

4 Wastewater flow for hotels were estimated from the number of rooms and the gpd/room as stated in the Maui Wastewater Reclamation Division http://www.co.maui.hi.us/documents/11/28/Wastewater%20Flow%20Standards.PDF Wastewater flows for residential units were based on an average of 80 gpcd as stated in the Honolulu Department of Wastewater Management Standards. Flows for Kona Gardens were assumed to be 5gpcd with 800 persons while flows for Kahaluu Beach Park were assumed to be 5 gpcd with 400 persons. The HHA Rental Facility wastewater flows were assumed to be 400 gpd/unit with 60 units. The Kahaluu Ma Kai flows were assumed to be 5 gpcd for 1,000 visitors, 100 gpcd for 40 users at Kalani Kai Grill, and 15 gpcd for 414 visitors.

5 The capita for the surf and racket club was calculated as 40 cpa (capita per acre), while the average daily flow was estimated as 40 gal/unit/d where a unit was taken as a member present at the club. Source: Davis, Mackenzie L. Water and Wastewater Engineering: Design Principles and Practice. McGraw-Hill, 2010.

Appendix B

Preliminary Engineering Report

Onsite Wastewater Treatment

by

Roth Ecological Design International, LLC

A. EXECUTIVE SUMMARY

The *Kahalu'u Mai Kai Development, Phase 1* (Kahalu'u) Preliminary Engineering Report produced by Roth Ecological Design Int. (REDI) for the Environmental Assessment outlines the following:

1. Design Flow
2. Onsite Wastewater Treatment Description
3. Water Reuse Landscape;
4. Backup Power and Backup Disposal
5. Operations & Maintenance (O&M) discussion
6. Onsite greywater treatment for the showers.
7. Educational Opportunities

Kamehameha Schools (KS) is taking a proactive approach to managing their water resources at Kahalu'u by proposing the installation of an onsite wastewater treatment system to serve the proposed new facilities and reuse the treated water for onsite irrigation. The Kahalu'u (re)development is striving to achieve restorative and regenerative design goals. Achieving sustainable water management practices towards *Net-Zero Water* is a critical component offering both ecological and educational value. As part of this strategy both greywater gardens for the treatment and reuse of the outdoor shower effluent and an onsite natural systems wastewater treatment system to treat effluent from the facilities to tertiary standards (10mg/l TSS and 10mg/l BOD) for onsite reuse for irrigation is being proposed.

There is no existing **public** sanitary sewer system at the property. Rather the property is currently served by pump stations that discharge to a private wastewater treatment works offsite. The onsite natural systems treatment works will be installed in accordance with Hawaii Administrative Rules, Chapter 11-62 and the Guidelines for the Treatment and Use of Recycled Water dated May 15, 2002 to meet R-2 effluent standards. In addition, the R-2 treatment works will use the existing privately owned sewer/pumping station as the "backup" disposal system in the event flows exceed the design standards such as when there are the occasional larger events, water reuse is not warranted, and/or if maintenance is required of the onsite system. The greywater gardens, however would be stand alone systems and not connected to the backup existing sewer line.

Implementing onsite wastewater treatment systems for reuse will highlight the KS's sustainability goals, add to the landscape design and provide educational and public outreach opportunities for KS.

B. ONSITE WASTEWATER TREATMENT

i. DESIGN FLOW

The following is a list of the facilities that will contribute wastewater to the onsite natural systems wastewater treatment system

Hale Ho'omaha
Comfort Station
Heritage Center
Multi-purpose Building

Other buildings onsite that do not have facilities contributing wastewater include:

Hale Wa'a
Hale Ki'i
Kalani Kai (Existing Structure)

The projected wastewater flow rate was determined by REDI based on the program numbers provided by KYA and then the estimated gallons per day (gpd) of wastewater were calculated following the Department of Health (DOH) Hawaii Administrative Rules (HAR) 11-62. The estimated population is expected to vary throughout the week with a Full Time Equivalent (FTE) of 100/day students visiting Monday-Friday; a FTE of 200/day non-student visitors to the site occurring Tuesday-Saturday; FTE of 24 (each) of staff and a total of no more than 90 campers including Lineal Descendants Monday-Sunday.

Average Design Wastewater Flows for the proposed new facilities = 5,451 gpd
Peak Average Design Flow = 6,360 gpd

There is also the occurrence of occasional events planned for the site including the following:

Life Celebrations (4 yearly)
Makahiki (2 yearly)
Hoike (3 yearly)
Enrichment/Special Functions (4 yearly)
Seasonal Ceremonies (8 yearly)
Educational Institutes/Workshops (6 yearly)

During these events there are expected to be a large number of visitors and the onsite wastewater treatment primary tanks would discharge into the existing sewer to flow to the offsite private wastewater treatment plant located in Keauhou (WWTP) instead of going through the onsite system.

Table 1: Estimated Design Flow Following DOH HAR 11-62 guidelines (Appendix A)

VISITORS	FREQUENCY	TIME (Hrs/day)	# (FTE) /day	Gal/day/person
Students (Cafeteria)	M-F	24	100	20
Tourists	T-Sat	6	200	5
Staff	M-Sun	24	24	20
Campers & Lineal Descendents	M-Sun	24	90	32

VISITORS/DAY OF WEEK			# (FTE) /day	GPD
Monday			214	5360
Tuesday			414	6360
Wednesday			414	6360
Thursday			414	6360
Friday			414	6360
Saturday			200	4000
Sunday			114	3360
TOTAL/WK			**2184**	**38160**
WEEKLY AVG			**312**	**5451**

The Greywater Treatment System is designed for the outdoor showers only. The design flow makes the assumption that these showers would only be used by students as per the programmatic direction (limited to 100 people). The design flow therefore for the greywater garden is 500 gpd following the DOH HAR 11-62.

ii. WASTEWATER TREATMENT SYSTEM OVERVIEW

The proposed onsite wastewater treatment system would include primary, secondary and tertiary treatment stages with effluent that would meet or exceed R-2 standards. The proposed system incorporates primary treatment tanks, an equalization tank, subsurface flow constructed wetland(s), turbidity filters and UV disinfection. The "Water Reuse Landscape" would be sized and designed to meet the DOH Water Reuse Guidelines for drip irrigation.

The design standard of the effluent from the treatment system is designed to meet the requirements of DOH R-2 water quality standards (Disinfection with BOD and TSS to less than or equal to10 mg/L). The treatment system elements include:

- Primary Treatment Tanks at each building or group of buildings producing wastewater (septic tanks)
- Small Diameter Collection System from tanks to the secondary treatment site
- Subsurface Flow Constructed Wetlands
- Turbidity Filters
- UV disinfection for all irrigation-reuse

- Reuse on the Campus via drip irrigation of (non-edible) native Hawaiian plant landscape

PRIMARY TREATMENT TANKS WITH EFFLUENT FILTERS

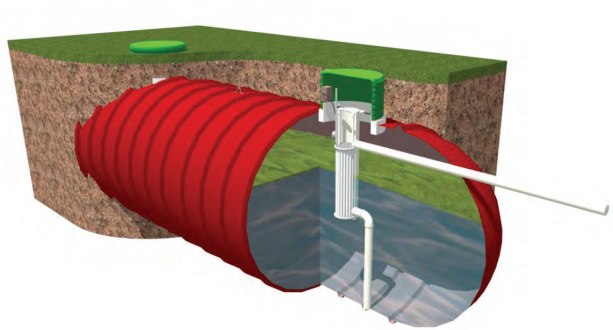
Primary treatment tanks will be located at each building or group of buildings, with a total capacity of 13,000 gal. In addition to handle peak flows an Equalization tanks (6500 gal) would be required.

Likely the depth of burial of the septic tank systems will not permit gravity flow to the constructed wetland secondary treatment system. A Septic Tank Effluent Pump (STEP) system is proposed for each of the septic tank zones. Following solids settling in the primary septic tank chamber, a duplex pump system will be located in the secondary tank/chamber within a screened effluent vault with filter.

The Glide, Oregon septic-tank effluent system (operating since 1980) introduced the idea of using in-tank pump vault screens, also called effluent filters. The use of tanks with screens, with or without pumps, has been documented to reduce raw wastewater BOD5 by more than 64% and total suspended solids by more than 90% (Bounds, 1997).

Effluent filters permit the use of turbine-effluent pumps if the effluent must be pumped. Use of a single-model pump for collection and treatment greatly reduces pump maintenance and replacement costs. Screens clog occasionally, requiring system oversight. Clogged screens lead to higher water levels in the tank, which activates a high-water alarm and a remote alert to the operator. Clogging prevents material that would cause difficulties in the treatment system from reaching the collection lines. This feature enables the operator to solve the problem as inexpensively as possible by pumping out the tank and cleaning the screen, rather than repairing treatment works or compromising treatment efficiency.

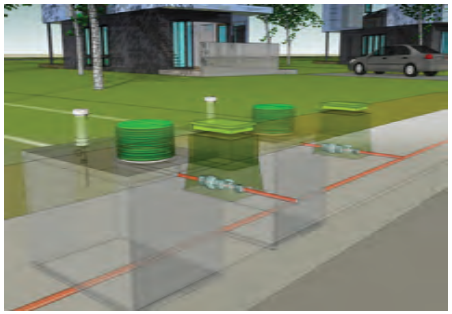
Figure 1: Primary treatment tank with effluent-filter



SMALL DIAMETER COLLECTION SYSTEM

The STEP system from each of the septic tanks will connect into singular small (2 inch to 4 inch) diameter pipe collection system to transport the water from the primary treatment tanks to the constructed wetland treatment system. Because of the ease with which small diameter collection systems can be installed, smaller pipe size and their ability to be buried at shallow depths below grade, they are significantly less expensive than conventional systems sewer systems. Unlike conventional systems, maintenance costs are 5-10% of the costs of conventional sewers, primarily because only liquid is transported.

Figure 2: Small Diameter Collection System



The sewer lines from the pumped systems do not require manholes. Hence, gases are kept dissolved in the wastewater in the closed pipe conveyance system. Materials for piping are acid resistant and will not corrode. Depending on the soil conditions, these small diameter sewer pipes can be set in the road with a ditch witch trencher at the rate of up to 2000 feet a day.

Shoring of trenches is not necessary because the small diameter sewer line is generally set at 24 to 60 inches below grade and follows the profile of the road.

Since 2/3 to 3/4 of the total costs of providing wastewater collection and treatment are in the costs of the collection system, significant capital savings can be realized with the use of small diameter sewer systems. In addition to allowing the use of small diameter systems, effluent pumping removes the constraints imposed on development by gravity and conventional sewer system designs.

CONSTRUCTED WETLAND TECHNOLOGY

Pollution is just a resource out of place. Engineered wetland technologies mimic the natural 'composting' abilities of marshes found in nature by transforming 'pollution' into food for the wetland organisms. The living engine driving this technology employs the food web structure found in natural marshes including: microorganisms, zooplankton, algae, and higher plants. The technologies have been successfully designed and engineered to treat wastes generated by anthropogenically derived pollution including mine and landfill leachate, airport runoff, and municipal and industrial wastewater for over thirty years.

Subsurface flow constructed wetlands are a passive, aesthetically pleasing option for onsite wastewater treatment meeting effluent quality suitable for water reuse. They are typically planted with native wetland plants from the region and since all water flows **beneath** the surface odors are minimized since the noxious gases are filtered through the media and organic layers. A HDPE (high density polyethylene) or PPE (polypropylene) liner will be used to provide a water-tight cell. A geotextile fabric will be laid underneath and often above to protect the liner. Once the liner is installed, the cell(s) will be filled with media and be planted with native Hawaiian wetlands species to demonstrate a 'Hawaiian' garden

Primary treated effluent from the Equalization tank will enter the front of the wetland cells and be distributed through a row of 'half-chambers' and be collected at the opposite end of the cell in a collection header. A level adjustment sump placed on the outside of each of the wetland cells is connected to the collection header and maintains the water level below the surface, serving much like a standpipe.

All surrounding site grading from the treatment works will be such that stormwater runoff is diverted away from the constructed wetland treatment systems. Therefore only the rain that falls within the wetland cells themselves will need to be accounted for and managed. To account for the potential excess water in the open treatment systems (wetlands) during large storm events, the berms/free board of the constructed wetlands will be sized minimally for the 100yr/24hr storm (approximated at 7.7'' over 24 hrs for the site by NOAA) to temporarily hold the excess water, allow for continued operations and prevent overflows during these events.

Treated effluent from the constructed wetland will flow into the tertiary treatment components (5 micron turbidity filter cartridges and disinfection) before entering the irrigation pumping station to be distributed in the Water Reuse Landscape.

Figure 3: Image of a Constructed Wetland

WATER REUSE LANDSCAPE DESIGN NARRATIVE

The landscape for the proposed site will include native and adaptive trees, shrub, and groundcover plantings. The water reuse irrigation system will utilize R-2 water source from the onsite wastewater treatment facility and possibly additional potable water during the first year of operations to allow for plant establishment if the initial plant water demand exceeds the design flows.

The planted landscape will blend in with the surrounding lava field and the unique ecosystems of the site by restoring native flora.

Xeriscape (Native and Adoptive landscape)
All plants used for the Water Reuse Garden are proposed to be non-edible Native Hawaiian or Polynesian Plants that are commonly found in native low land, dryland, and coastal areas in the island. These selections were made based on their drought tolerance, ecological and educational values, and aesthetics.

Signs
Each irrigation zone (or cluster of zones if small in area and next to one another) will have a 'warning' sign notifying the public that the irrigation water is of non-potable sources/reclaimed effluent as required by HAR 11-62. All irrigation piping will be coded purple (stripe or painted), and valve box lids or other access points will be labeled as 'non potable water'.

Irrigation
The irrigation system will apply water via a combination of water-efficient drip tubing and root zone watering system with subsurface bubbler sprinkler. The irrigation specifications will be designed and built to use reclaimed water as specified by the manufacturers.

iii. BACK-UP POWER & BACK UP DISPOSAL

An onsite backup generator will be required to provide backup power in the event of a HELCO failure. The onsite wastewater system will continue to operate during power outages. Once power goes off the generator would automatically turn on and be sized to power each of the mechanical components of the systems for a given time period based on the facilities plan for closure during these loss of power events. Another option is to use the onsite, existing sewer as the backup system in the event of power loss. The system could be designed such that effluent from the tanks gravity flows into the existing sewer line instead of being pumped to the treatment pad. The existing pump stations would then need to rely on their own backup power supply to take the effluent to the offsite WWTP for disposal.

The same existing sewer line would also be used for the occasional large events, during periods when water reuse is not warranted and/or during system maintenance. Any effluent that flows into the existing sewer to be disposed of offsite would be metered using magnetic meters connected to the disposal conveyance pipes such that the operating offsite WWTP could record these additional flows and bill KS accordingly.

iv. WASTEWATER SYSTEMS OPERATIONS AND MAINTENANCE

Operation and maintenance (O&M) tasks are crucial for the proper and safe function of wastewater collection, treatment, and dispersal. Typically, maintenance staff should be able to perform or supervise all required tasks for a successful system including water quality sampling, compiling operation logs, and regulatory permit compliance reports. Standard activities may include periodic adjustment of pump timers, pump dosing schedules, review and analysis of water quality testing, basic maintenance tasks and system troubleshooting (in the event of pump or equipment failure). The Engineer of the system should provide onsite operator training, an O&M Manual, and offer technical support (via phone, internet and/or email). In addition, remote monitoring could be added into the systems components via telemetry such that the operator, the Engineer and KS would all have access to knowing the operational performance of any given mechanical component in the system at any time, which will help coordinate and streamline operations for the lifetime of the project and could also play into educational opportunities for KS.

General O&M Tasks are the following:

Primary and Equalization Tanks - Annual inspection should include:

- Inspection of effluent filter, sludge and scum depths and general condition; clean effluent filters.
- Pump out solids as required (typically 1-4 years).
- Check and ensure proper operation of floats and pumps (for tanks with effluent pumps).

Constructed Wetland
- Adjusting water level
- Checking and removing solids as necessary
- Clearing of dead vegetation
- Leveling the gravel

Mechanical Filters and UV
- Clean UV bulb as needed
- Replace UV bulb (typically annually or semi-annually, depending upon use)
- Change bag filters as needed
- Calibrate NTU meter

Dosing/Storage Tank(s)
- Maintain berms and landscape condition. Ensure that lids are secure and watertight.
- Inspect level monitoring equipment to ensure proper operation.
- Check pump operation, adjust timers as needed.

Irrigation System
- Inspect dispersal system. Detect and repair leaks. Adjust zone valves as necessary.
- Ensure control timer is providing adequate line flushing (Water Reuse System).

Testing
- Collect and deliver grab and/or composite samples as needed to a certified laboratory.
- Maintain data logs and monitor long-term performance.
- Record flow meter readings.

Provide written reports to appropriate regulators as required by permit. The proposed natural treatment system is low-energy and mechanically simple. The most complicated pieces of equipment are pumps and control panels. Pumps are easily replaceable in the case of failure. The control panel can be designed to be accessible remotely by the system operator to assist in troubleshooting and response to alarm conditions.

C. GREYWATER TREATMENT

A greywater treatment system is proposed for the outdoor showers. The greywater treatment design flow is proposed to be 500 gpd, sized according to the DOH HAR 11-62 guidelines to based on the program information provided by KS to accommodate up to 100 students using it per day. These will not be considered public showers according to KS and will not be available for other 'visitors.' The system would comprise of a planted, shallow absorption bed where the water would be treated before infiltrating into the ground. It would be planted with appropriate native Hawaiian plants as part of the restorative efforts of the project and also serve as part of the overall, sustainable water management educational experience at the site.

D. EDUCATIONAL OPPORTUNITIES

Historically Hawaiian culture especially valued water, *wai,* and the socio-environmental constructs of managing this natural resource within a watershed, *ahupua'a,* reflected these values. The water systems being proposed would be part of the site's restoration that the story of *wai,* told both within this traditional construct, but also importantly, demonstrate it through 21st century water management practices. Traditionally in native Hawaiian culture water was held sacred; this resource was vital for life to survive on the islands and, therefore, its management was central to all socio-political and environmental activities. Due to the sacred nature of this resource, it is important to educate visitors both of its historical significance as well as bridging this to a modern day context. To undergo this, it is proposed that the site becomes a place that demonstrates a 21st century *ahupua'a*, holding traditional values at its core and reflecting modern day methods for sustainable water resource management. Fundamentally, this means that the site demonstrates that its practices are appropriate within an ecological context and that its water management displays practices that maximize its efficient use and management without impairing neighboring downstream ecosystems or communities. To bridge the *ahupua'a* concept into a 21st century model, it is proposed that Kahalu'u demonstrate sustainable water management strategies that minimize its ecological (and hydrological) footprint through best management practices and green infrastructure that also be part of the visitor experience.

The basic building blocks for 21st century water management include the following principles: Reduce, Reuse, Recharge, and Regenerate (ecosystem services). (1) *Reduce*. Reducing potable water consumption can be done both behaviorally and physically. Behavioral changes relate to one's personal actions and choices, while physical alterations include a diversity of both technological upgrades such as installing high efficiency low-flow devices and/or supplementing non-potable water where possible such as using rainwater and reclaimed water. (2) *Reuse*, is necessary for making the most out of the resource. Examples of reuse include both the direct reuse of greywater and/or onsite treatment of wastewater to produce clean, reclaimed water for non-potable purposes such as for irrigation. Once water is used by the plants, it is then recharged back into the ground. (3) *Recharge*, places (treated) water back into the ground locally to support subterranean, groundwater flows that service other ecosystems, communities or cultural needs instead of being wasted or being the vehicle for pollution through sewer conveyance systems, ocean outfalls, leachfields, cell pools, injection wells and/or as storm water runoff. Green Infrastructure methods and Low Impact Development Best Management Practices offer an array of tools to achieve both recharge and regeneration of life. (4) *Regenerate*, refers to protecting and restoring the surrounding ecosystems through the regeneration of life. Coupling this practice with water conservation efforts such as 'Reuse' and 'Recharge' may include implementing rain gardens, bioswales, and constructed wetlands.

The Kahalu'u Ma Kai Development would demonstrates these principles of sustainable water management through evaluating and elevating best management practices that also could offer

educational experiences for both KS students and local, national, and international visitors alike bridging the traditional values of respecting water and ecological resources with modern day approaches and technologies. Importantly not just implementing these practices, but telling their stories through site through signage, walking tours, as well as other educational informational tools, students and visitors could leave the site with knowledge of both traditional and modern applications of sustainable water management to take back the classroom and or their communities. The onsite wastewater treatment and reuse system along with the Low Impact Development Best Management Practices for onsite stormwater management would serve as the physical tools and building blocks for this educational experience.

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APPENDIX A

TABLE 1
April 15, 1997

Type of Establishment	Gallons Per Person Per Day (Unless Otherwise Noted)
Airports (per passenger)	5
Camps:	
Campground with central comfort stations	32
With flush toilets, no showers	25
Construction camps (semi-permanent)	50
Day camps (no meals served)	15
Resort camps (night and day) with limited plumbing	50
Luxury camps	100
Church	
With kitchen	10
Without kitchen	5
Cottages and small dwellings with seasonal occupancy (2 persons per bedroom minimum)	100
Country clubs (per resident member)	100
Country clubs (per non-resident member present)	25
Dentist per chair	200
Doctor per patient	5
Dwelling (2 persons per bedroom minimum)	100
Factories (gallons per person, per shift, exclusive of industrial waste)	35
Hair salon, including barber shops and beauty salons	150
Hospitals (per bed space)	250+
Hotels with private baths (2 person per bedroom minimum)	100
Hotels without private baths	50
Institutions other than hospitals (per bed space)	125
Laundries, self-service (per machine)	300
Mobile home parks (per space)	250
Motels with bath, toilet, and kitchen waste (per bed space)	50
Motels (bed space)	60
Picnic parks (toilets wastes only) (per picnicker)	5
Picnic parks with bathhouses, showers, and flush toilets	10
Restaurants	
Average, per seat	80
Fast food, per seat	100
Additional kitchen wastes per take out meals	3
Additional for bars and cocktail lounges, per seat	15
Schools:	
Boarding	100
Day, without gyms, cafeteria, or showers	15
Day, with gyms, cafeteria, and showers	25
Day, with cafeteria, but without gyms or showers	20
Service station (per vehicle served)	10
Swimming pools and bathhouses	10
Theaters:	
Movie (per auditorium seat)	5
Drive-in (per car space)	5
Workers (in addition to above):	
Construction (at semi-permanent camps)	50
Day, at schools and offices (per shift)	20
Employee (per shift)	20

APPENDIX B

Appendix B.

Low Impact Development Preliminary Sizes for Kahalu'u Redevelopment
Prepared by: Roth Ecological Design Int.

BUILDINGS	Impervious Area (sqft)	Potential rain captured/yr (gal)	1"/24hr rainfall (gal/event)	Estimated Bioretention (sqft - Surface Area)
Wa'a	3,600	61,482	2,244	450
Ki'i	1,600	27,325	997	200
Comfort Station	1,800	30,741	1,122	224
Camping	3,500	59,774	2,182	440
Storage	625	10,674	390	80
Heritage Center	800	13,663	499	100
Halau	2,600	44,404	1,621	330
Kalani Kai	4,950	84,538	3,085	620
Subtotal Buildings	**19,475**	**332,602**	**12,139**	**2,444**
PATHS				
Hard	14,400	245,929	8,976	1,000
	Impervious Area (sqft)	**Potential rain captured/yr (gal)**	**2"/24hr WQV rainfall (gal/event)**	**Estimated Bioretention (sqft - Surface Area)**
Entry Road	31,200	532,847	38,894	4,000
Parking	9,500	162,245	11,843	1,200
Maintenance Yard	5,800	99,055	7,230	735
Subtotal roads & paths	**60,900**	**1,040,076**	**66,942**	**6,200**
Total	**80,375**	**1,372,678**	**79,081**	**11,088**

RAIN CATCHMENT FOR BUILDINGS (AS A POTENTIAL ALTERNATE CHOICE INSTEAD OF BIORETENTION)

BUILDINGS	Catchment storage (gallons)
Wa'a	5000
Ki'i	2500
Comfort Station	2500
Camping	5000
Storage	1000
Heritage Center	2500
Halau	5000
Multi-Purpose	5000
Kalani Kai	7500

Appendix C – Drainage

Wed, 22 Jan 2014 – 4:14pm
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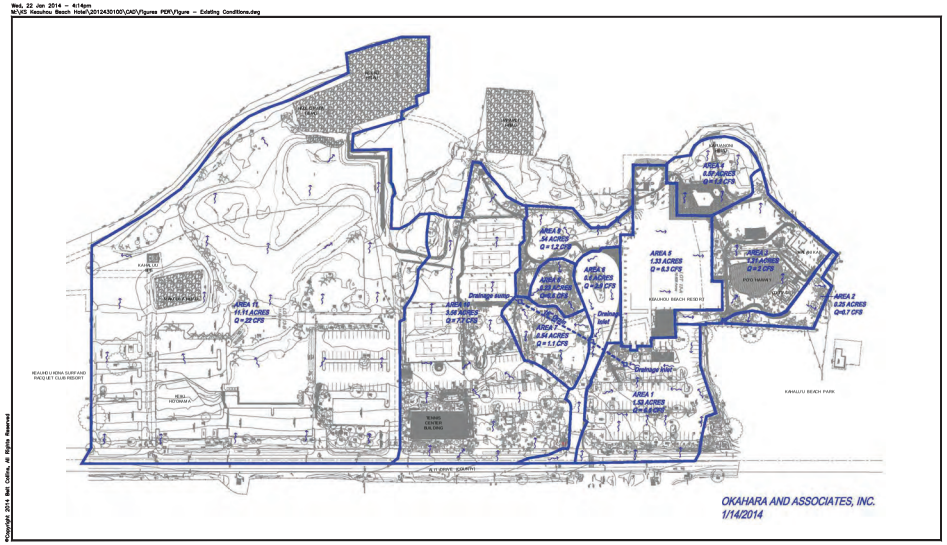

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NORTH NOT TO SCALE

Figure 2
EXISTING CONDITIONS PLAN

Kahalu'u Ma Kai
Kamehameha Schools
January 2014

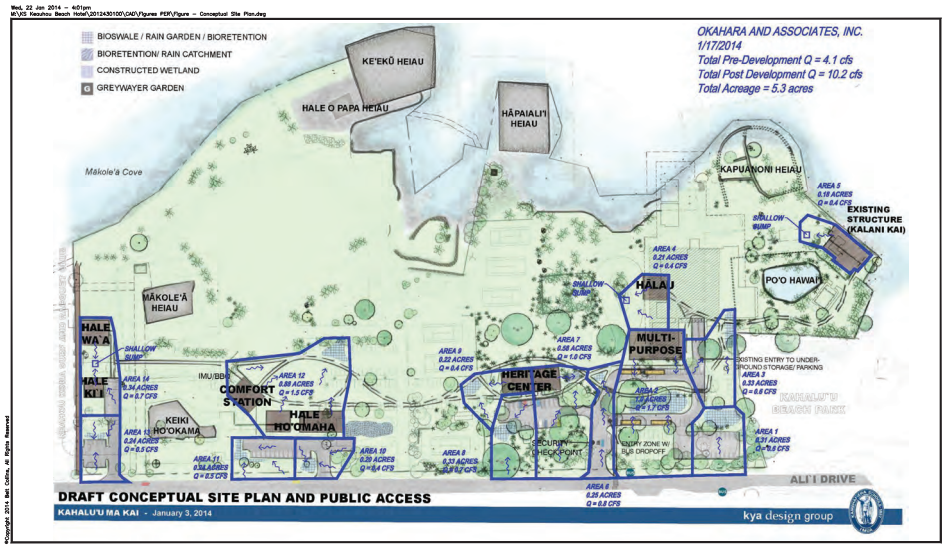

Figure 3
PRELIMINARY DRAINAGE BASINS AND STORM WATER RUNOFF QUANTITIES

Kahalu'u Ma Kai
Kamehameha Schools
January 2014

NORTH NOT TO SCALE

Appendix D

Preliminary Future Basement with Interim Grading Concept

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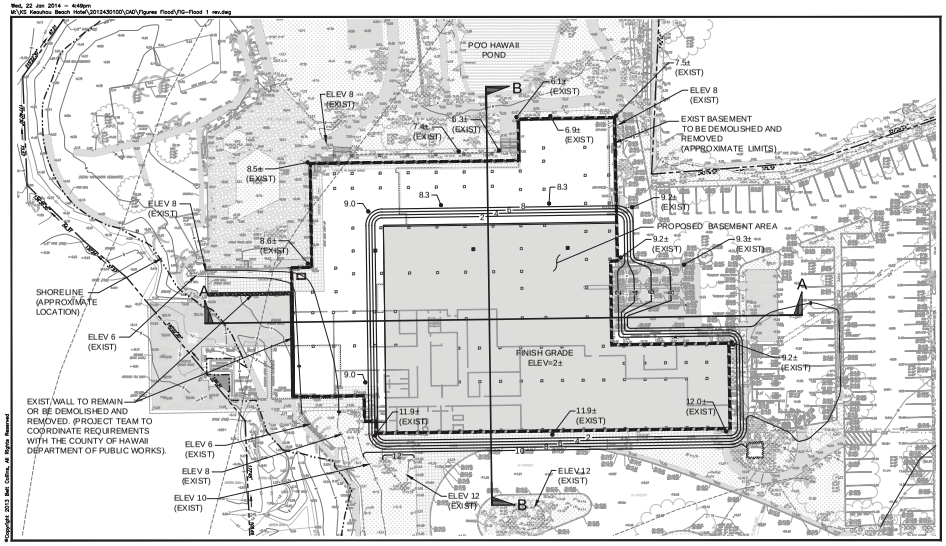

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NOTE:
SEE FIGURE 5 FOR CROSS SECTIONS.

Figure 4
GRADING PLAN FOR FUTURE BASEMENT

Kahalu'u Ma Kai
Kamehameha Schools
October 2013

Wed, 22 Jan 2014 – 4:55pm
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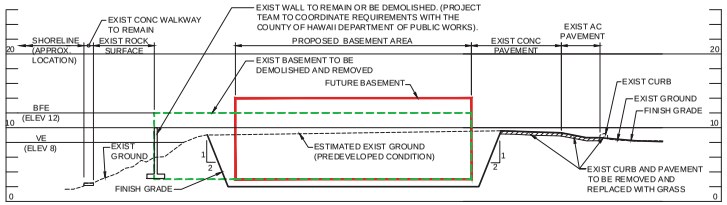
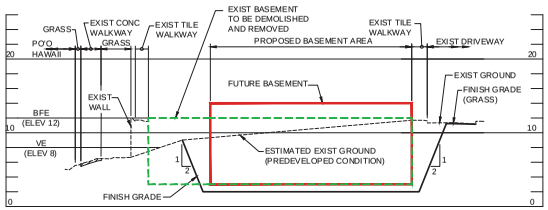


SECTION A

SCALE: HORIZ 1"=40'
VERT 1"=8'



SECTION B

SCALE: HORIZ 1"=40'
VERT 1"=8'

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0 10 20 40
SCALE IN FEET
0 2 4 8
SCALE IN FEET

Figure 5
SECTIONS

Kahalu'u Ma Kai
Kamehameha Schools
October 2013

From: Frank DeMarco [mailto:fdemarco@co.hawaii.hi.us]
Sent: Thursday, October 17, 2013 1:42 PM
To: Eric Tamashiro
Cc: 'Laura Takahashi'; Cheryl Palesh
Subject: RE: Keauhou Beach Hotel Demolition and Kahaluu Ma Kai Future Basement

Hi Eric,

With the exception of item 6 under "Interim Site Improvements Following Basement Demolition," I concur that your summary below reflects our October 3 and 15 discussions.

Thanks,

Frank DeMarco, P.E., CFM
County of Hawaii
Department of Public Works
Engineering Division
101 Pauahi St., Ste. 7
Hilo, HI 96720-4224

(808) 961-8042

From: Eric Tamashiro [mailto:etamashiro@beltcollins.com]
Sent: Thursday, October 17, 2013 10:12 AM
To: FDemarco@co.hawaii.hi.us
Cc: Laura Takahashi; Cheryl Palesh
Subject: Keauhou Beach Hotel Demolition and Kahaluu Ma Kai Future Basement

Hi Frank,

Attached for your review please find a pdf showing the site layout of the existing Keauhou Beach Hotel basement and grading concept that will follow the demolition of the basement. The preliminary footprint of the future basement with two cross sections is also shown in the attached pdf.

The proposed concept to demolish the existing basement, stabilize the excavated area, and construction of the future basement structure is based on the project team's October 3rd conference call and our phone conversation on October 15, 2013 and summarized as follows:

Existing Conditions

1. Base Flood Elevation = 12 feet.
2. Gutter Line (VE and AE boundary) is at 8 feet.
3. Because the existing gutter line is not well defined, interpretation of the map would be

acceptable per Section 27-16c of the Hawai`i County Code.
4. Based on the topographic survey map, the existing exterior hotel adjacent ground elevations are approximately +6.1, +4.0, +11.9, and +9.2 feet on the north, west, south, and east sides, respectively.

Interim Site Improvements Following Basement Demolition

1. A level basement pad area with a finish grade elevation of approximately +2 will be provided in the south and east portions of the existing basement area.
2. To accommodate the grade change, cut and fill slopes with a slope gradient of 2 horizontal to 1 vertical will be utilized. The existing basement ramp area will have a 20 percent slope and be utilized for access purposes onto the newly graded basement pad area.
3. New fills located within the existing building area, but outside of the future basement area will either maintain pre-construction elevations, ie, original grades prior to the construction of the hotel or extend below pre-construction elevations.
4. The original grades prior to the construction of the hotel is based on the existing topographic survey ground elevations and range from +4.0 on the west side of the hotel near the shoreline to +9.2 on the east side and +6.1 on the north side of the hotel near Po`o Hawaii Pond and +11.9 on the south side.
5. A No Rise Certification (NRC) will be required for the interim site improvements. The supporting data for the NRC would be based on Items 3 and 4 above. A detailed flood elevation study is not required.
6. A new CRM wall will replace the existing hotel wall on the west side of the site. The intent of the wall would be to limit potential future shoreline loss.
7. Conditional Letter of Map Revision is not anticipated.
8. Federal Emergency Management Agency review and approval is not anticipated.

Future Basement

1. Because the interim finish grades surrounding the future basement area will range in elevation from +8.3 to +11.9, the interim site conditions will be located outside of the VE Zone and within the AE Zone.
2. Due to the AE Zone, dry flood proofing of the future basement will be required.
3. Upon completion of the basement construction, backfill will be placed along the basement walls and extend no higher than preconstruction elevations. If additional fill height is required, then new fill within the AE Zone will be placed in accordance with Chapter 27 of the Hawai`i County Code.

Please review the proposed concept with attachments and provide us your feedback. If you have any questions or need additional information for your review, please let us know.

Thank you,
Eric Tamashiro

Appendix J

TRAFFIC IMPACT ANALYSIS STUDY

TRAFFIC IMPACT ANALYSIS REPORT
KAHALU‘U MA KAI REDEVELOPMENT
KAHALU‘U-KEAUHOU, HAWAI‘I

March 18, 2014

Prepared for:

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TRAFFIC IMPACT ANALYSIS REPORT
KAHALU‘U MA KAI REDEVELOPMENT
Kahalu‘u-Keauhou, Hawai‘I

Prepared for

Helber, Hastert & Fee Planners, Inc.

Prepared by
Austin, Tsutsumi & Associates, Inc.
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March 18, 2014

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A. TRAFFIC COUNT DATA

B. LEVEL OF SERVICE CRITERIA

C. LEVEL OF SERVICE CALCULATIONS

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

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DRAFT

TRAFFIC IMPACT ANALYSIS REPORT

KAHALU'U MA KAI REDEVELOPMENT

Kahalu'u-Keauhou, Hawai'i

I. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi & Associates, Inc. (ATA) to evaluate the potential traffic impacts resulting from the proposed Kahalu'u Ma Kai Redevelopment (hereinafter referred to as the 'Project'). The Project proposes to demolish the existing 309-room Keauhou Beach Hotel on a 22.5-acre project site to establish an educational complex and cultural center in Kahalu'u-Keauhou, Hawai'i.

A. Project Description

This Project will demolish the existing hotel, and establish an educational complex and cultural center on a 22.5-acre project site fronting Ali'i Drive. The Project will include the construction of a heritage center, outdoor classrooms, a multi-purpose building, interpretation areas, cultural halau, and camping accommodations. The heritage center and parking area will accommodate visits by the general public to the site with the majority of the project site reserved for cultural and educational purposes.

Shoreline parking will be accessed via a driveway on the south end of the site, while all heritage center, outdoor classroom, interpretation area, cultural halau, cultural site, and camping areas will be accessed though the main entrance driveway. A service entrance will also be provided, but it was assumed that this access would not be used during the peak hours of traffic.

REPLY TO:
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HONOLULU, HAWAII
WAILUKU, MAUI, HAWAII
HILO, HAWAII

Figure 1 illustrates the location and study intersections for the Project. The Project Site Map is included as Figure 2.

B. Location

The Project is located in the Ahupua'a of Kahalu'u, on the island of Hawai'i. The project site is located along the west side of Ali'i Drive with Kahalu'u Beach Park to the north, developed parcels to the south, and the Pacific Ocean to the west. The Project site is more specifically identified as TMK: (3) 7-8-013:002, 013, and 043.

C. Study Methodology

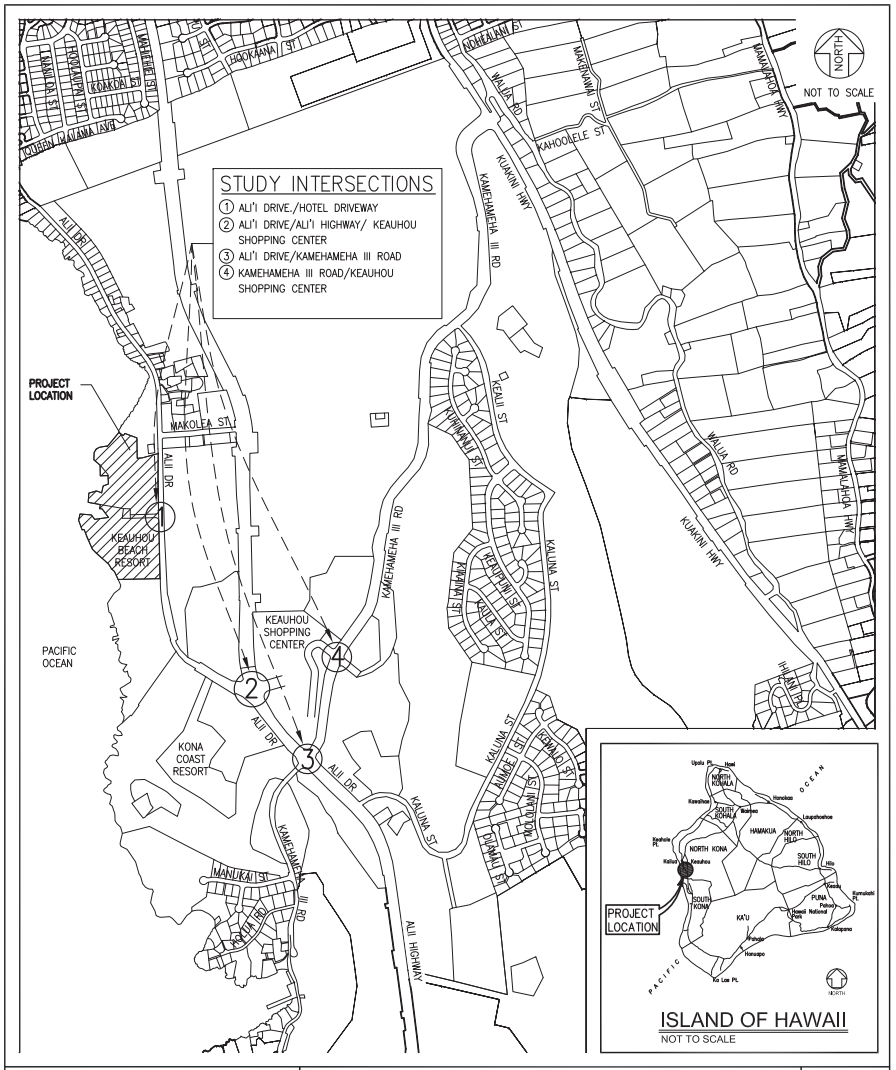
This study will address the following:

1. Existing traffic operations at key locations within the study area during the AM and PM peak hours of traffic.
2. Traffic projections for Base Year 2023 (without the Project) including traffic generated by an annual defacto growth rate and other known developments in the vicinity of the Project. These other known developments in consideration are projects that are currently under construction as well as known new/future developments that are anticipated to affect traffic demand and operations within the study area.
3. Identification of potential traffic conditions for the Base Year 2023.
4. Trip generation and traffic conditions for the proposed Project.
5. Determination of the impact of Project-generated traffic.
6. Recommendations for roadway improvements or other traffic mitigative measures, as appropriate, to reduce or eliminate the adverse impacts resulting from traffic generated by the Project.

D. Analysis Methodology

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The Highway Capacity Manual – Special Report 209 (HCM), dated 2000, includes methods for calculating volume to capacity ratios, delays, and corresponding Levels of

Service that were utilized in this study. LOS definitions for signalized and unsignalized intersections are provided in Appendix B.

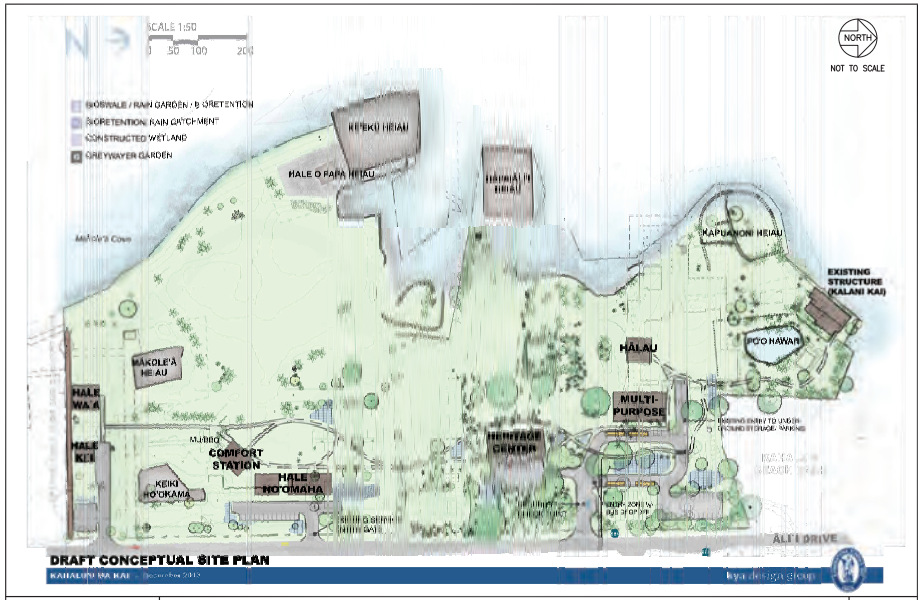


KAHALU'U MA KAI

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS,SURVEYORS • HONOLULU,HAWAII

FIGURE 1

PROJECT LOCATION



KAHALU'U MA KAI

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FIGURE 2

PROJECT SITE MAP

II. EXISTING CONDITIONS

A. Roadway System

The following are brief descriptions of the existing roadways in the vicinity of the Project:

Ali‘i Drive is generally a north-south, two-lane, undivided two-way County collector roadway. This roadway begins to the south at its intersection with Ali‘i Highway, and terminates to the north at its intersection with Ka‘ahumanu Place and Palani Road in downtown Kailua-Kona. The posted speed limit is 30 miles per hour (mph) in the vicinity of the Project, with a reduced speed limit of 15 mph north of Walua Road near downtown Kailua-Kona. Pedestrian crosswalks and numerous all-way stop controlled intersections are provided along Ali’i Drive.

Ali’i Highway is a north-south, two-lane, two-way undivided County roadway, also referred to as County Highway 187, with a posted speed limit of 35 mph. This roadway begins to the south at its intersection with Mamalahoa Bypass Road and terminates to the north at its intersection with Ali‘i Drive. This roadway is currently planned to be extended beyond Ali‘i Drive for approximately 4.5 miles into downtown Kailua-Kona, with no specific start date for construction.

Kamehameha III Road is a generally east-west, two-lane, two-way undivided County roadway that connects Ali‘i Drive with Kuakini Highway. This roadway begins at Keauhou Bay and extends to the northeast with a posted speed limit of 25 mph until its intersection with Ali‘i Drive. After its intersection with Ali’i Drive, the roadway continues with a posted speed limit of 35 mph. Kamehameha III Road terminates at its intersection with Kuakini Highway where it becomes Walua Road.

B. Existing Traffic Volumes

Due to their proximity to the Project, the following intersections were studied:

- Ali‘i Drive and Hotel Driveway (unsignalized)
- Ali‘i Drive and Keauhou Shopping Center SC) Driveway (signalized)
- Ali‘i Driveand Kamehameha III Road (signalized)

- Kamehameha III Road and Keauhou SC Driveway (signalized)

The Weekday Morning (AM) and Evening (PM) peak hour turning movement data utilized in this report was collected on Tuesday, October 1, 2013. Based on this traffic count data, the weekday AM peak hour of traffic was determined to be from 7:15 AM to 8:15 AM and the PM peak hour of traffic was determined to be from 3:30 PM to 4:30 PM. The traffic count data is provided in Appendix A.

C. Methodology

Analysis for the Project intersections peak hour counts was performed using the traffic analysis software Synchro, which is able to prepare Highway Capacity Manual (HCM) reports. The reports contain quantitative delay results, as based on intersection lane geometry, signal timing, and hourly traffic volume. In addition, Synchro was used to estimate queue lengths at some intersections.

Based on vehicular delay, reserve capacity and critical gaps at the intersection, a LOS is assigned (see Appendix B) as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis of the recommendations outlined in this report.

D. Results of Existing Intersection Analysis

Ali’i Drive and Hotel Driveway

The existing two-way, stop-controlled Ali‘i Drive and Hotel Driveway intersection provides single-lane approaches and a marked crosswalk on the north leg. All approaches currently operate at LOS B or better during the AM and PM peak hours of traffic.

Ali’i Drive and Keauhou Shopping Center Driveway

The Ali‘i Drive and Keauhou SC Driveway signalized “T”-intersection operates at LOS B or better for all approaches during both the AM and PM peak hours of traffic.

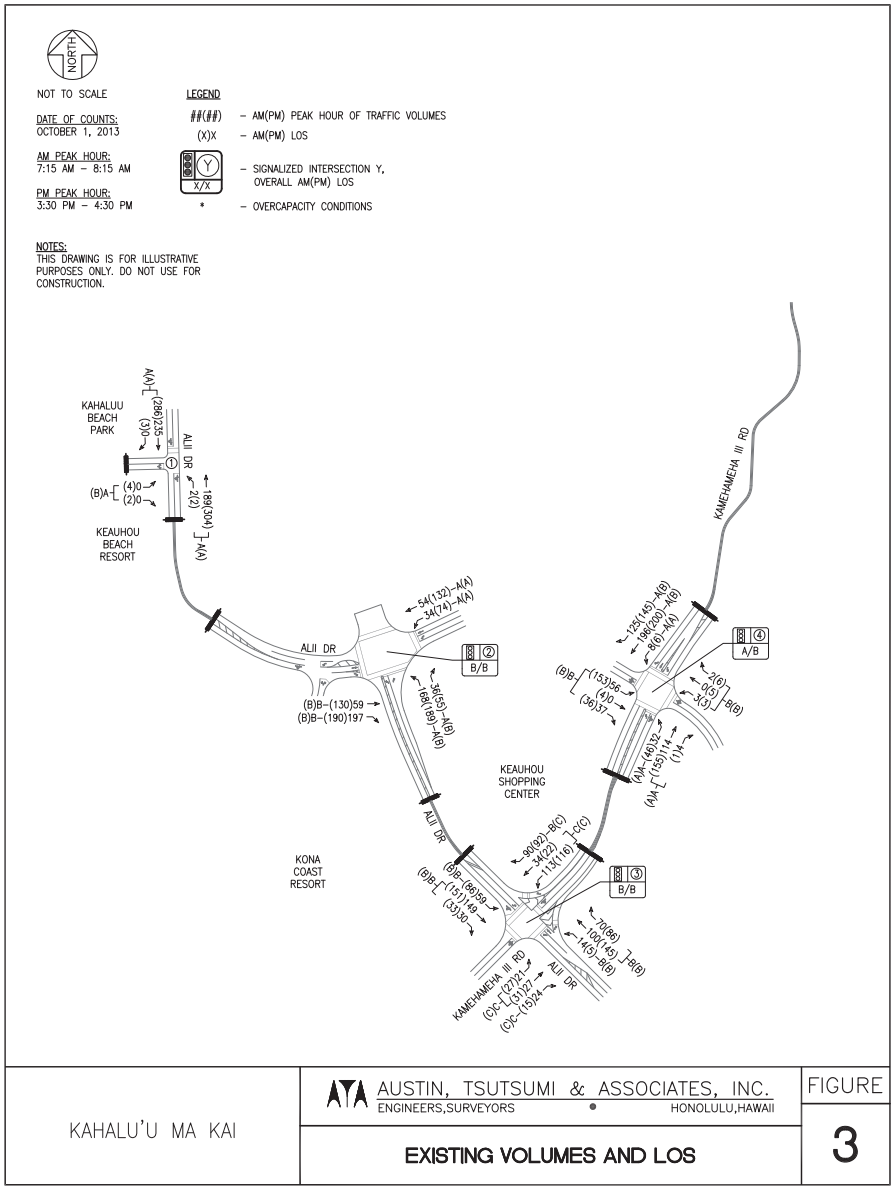
Ali'i Drive and Kamehameha III Road

The Ali'i Drive and Kamehameha III Road signalized intersection was observed to operate at LOS C or better for all approaches during both the AM and PM peak hours of traffic.

Kamehameha III Road and Keauhou Shopping Center Driveway

The Kamehameha III Road and Keauhou SC Driveway signalized intersection was observed to operate at LOS B or better for all approaches during both the AM and PM peak hours of traffic.

Existing traffic volumes, lane configuration and movement LOS are illustrated in Figure 3. Table 1 shows the existing delay, volume-to-capacity ratio (V/C), and LOS for the study intersections, with the full LOS summary tables provided in Appendix C.



KAHALU'U MA KAI

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ENGINEERS,SURVEYORS • HONOLULU,HAWAII

EXISTING VOLUMES AND LOS

FIGURE 3

Table 1: Existing 2013 Level of Service Summary

Intersection	Existing Conditions					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Alii Drive & Hotel Driveway						
EB LT/RT	0.0	0.00	A	12.6	0.01	B
NB LT/TH	0.1	0.00	A	0.6	0.02	A
SB TH/RT	0.0	0.15	A	0.0	0.18	A
2: Alii Drive & Keauhou Shopping Ctr.						
EB TH	11.3	0.18	B	12.7	0.36	B
EB RT	11.2	0.14	B	12.3	0.24	B
WB LT	8.0	0.13	A	7.6	0.20	A
WB TH	7.7	0.10	A	7.5	0.20	A
NB LT	9.9	0.38	A	12.1	0.46	B
NB RT	8.8	0.03	A	10.6	0.04	B
Overall	10.1	0.30	B	10.9	0.40	B
3: Alii Drive & Kamehameha III Road						
EB LT/TH	24.3	0.33	C	26.9	0.39	C
EB RT	23.3	0.02	C	25.5	0.01	C
WB LT/TH	20.7	0.48	C	22.8	0.46	C
WB RT	18.7	0.06	B	20.8	0.07	C
NB LT	14.8	0.05	B	14.9	0.01	B
NB TH/RT	17.1	0.38	B	18.0	0.47	B
SB LT	10.8	0.15	B	10.7	0.21	B
SB TH/RT	14.5	0.33	B	14.2	0.30	B
Overall	17.5	0.38	B	18.3	0.43	B
4: Private DW/Keauhou SC & Kamehameha III Road						
EB LT	6.1	0.07	A	7.6	0.11	A
EB TH/RT	6.8	0.17	A	9.8	0.26	A
WB LT	5.8	0.02	A	9.6	0.02	A
WB TH	7.0	0.27	A	11.4	0.37	B
WB RT	6.4	0.09	A	10.3	0.10	B
NB LT/TH/RT	13.7	0.00	B	11.8	0.02	B
SB LT/TH/RT	14.5	0.28	B	15.2	0.57	B
Overall	8.0	0.27	A	11.6	0.43	B

III. BASE YEAR 2023 TRAFFIC ANALYSIS WITHOUT THE PROJECT

The year 2023 was selected as the base year to reflect the anticipated completion year and full occupancy of the Project.

A. Defacto Growth Rate

Defacto growth rates derived from the Model, which takes into account island wide projects and generates and distributes the generated trips though out the roadway network, were used to generate Base Year 2023 traffic projections. The growth rate was derived linearly due to the uncertainty of each project's timing. Note that the most recent traffic counts within the Project area indicate a reduction in vehicle traffic during the AM and PM peak hours.

B. Other Known Developments

The future developments in the area that are anticipated to have a direct transportation impact on the study intersections are the following:

- Parcel 26 at Kahalu'u: A Residential Project for Towne Development of Hawai'i – 321 multi-family time-share units and 17 single-family detached units to be located on the mauka side of Ali'i drive. The Traffic Impact Assessment Report for KIC Land Area 26 by Phillip Rowell and Associates was used to determine the number of trips that would be generated by this project. The number of trips generated by this project was applied to the background projections

C. Results of Intersection Analysis and Recommended Mitigation

Ali'i Drive and Hotel Driveway

The two-way stop-controlled Ali'i Drive and Hotel Driveway intersection is forecast to operate at LOS C or better for all approaches during both the AM and PM peak hours of traffic.

Ali'i Driveway and Keauhou Shopping Center Driveway

The Ali'i Drive and Keauhou SC Driveway signalized "T"-intersection is forecast to operate at LOS B or better for all approaches during the AM and PM peak hours of traffic.

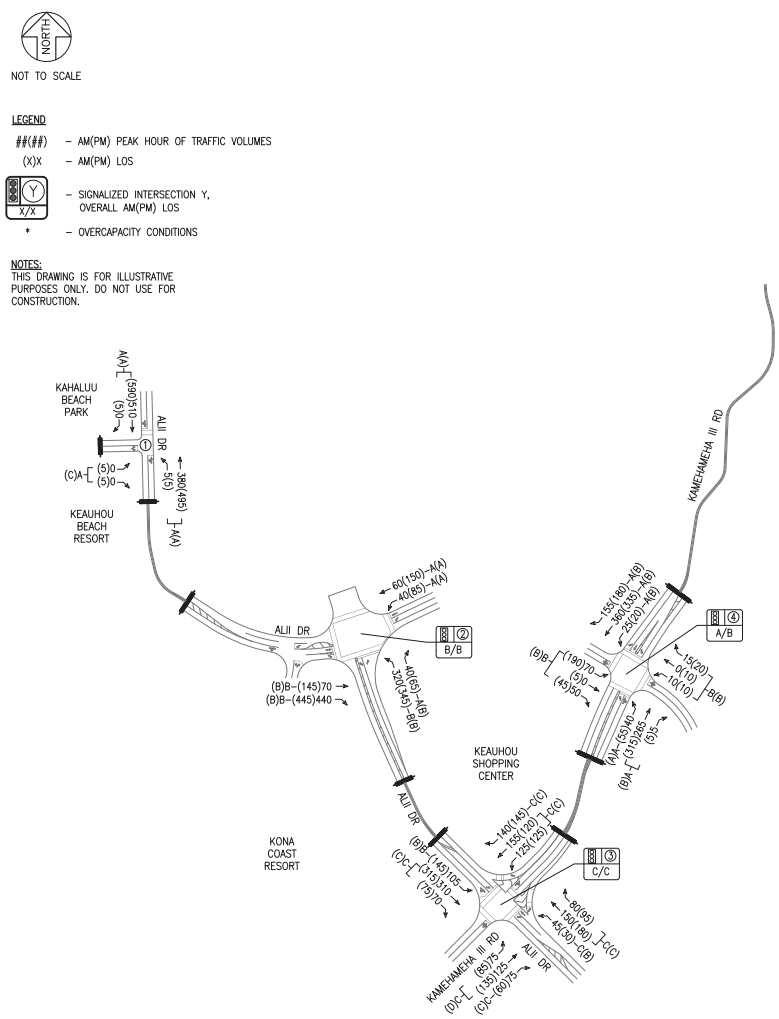
Ali'i Drive and Kamehameha III Road

The Ali'i Drive and Kamehameha III Road signalized intersection is forecast to operate at LOS D or better for all approaches during both the AM and PM peak hour of traffic.

Kamehameha III Road and Keauhou Shopping Center Driveway

The Kamehameha III Road and Keauhou SC Driveway signalized intersection is forecast to continue operating at LOS B or better for all approaches during both the AM and PM peak hours of traffic.

Figure 4 illustrates the forecast traffic volumes, lane configuration and movement LOS for Base Year 2023 conditions. Table 2 shows the Base Year 2023 LOS at the study intersections, with the full LOS summary tables provided in Appendix C.



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BASE YEAR 2023 VOLUMES AND LOS

FIGURE 4

Table 2: Base Year 2023 Level of Service Summary

Intersection	Base Year 2023					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Alii Drive & Hotel Driveway						
EB LT/RT	0.0	0.00	A	18.1	0.04	C
NB LT/TH	0.2	0.01	A	0.2	0.01	A
SB TH/RT	0.0	0.33	A	0.0	0.38	A
2: Alii Drive & Keauhou Shopping Ctr.						
EB TH	13.4	0.21	B	16.2	0.33	B
EB RT	13.8	0.31	B	18.7	0.58	B
WB LT	9.2	0.13	A	9.7	0.19	A
WB TH	9.0	0.10	A	9.8	0.21	A
NB LT	12.4	0.60	B	17.1	0.64	B
NB RT	9.1	0.04	A	12.3	0.08	B
Overall	12.6	0.47	B	15.9	0.57	B
3: Alii Drive & Kamehameha III Road						
EB LT/TH	33.8	0.66	C	35.6	0.70	D
EB RT	26.9	0.05	C	26.9	0.04	C
WB LT/TH	32.0	0.70	C	34.4	0.70	C
WB RT	23.7	0.10	C	25.9	0.10	C
NB LT	20.0	0.22	C	19.8	0.13	B
NB TH/RT	24.4	0.49	C	26.3	0.58	C
SB LT	17.4	0.31	B	16.1	0.42	B
SB TH/RT	29.9	0.75	C	26.1	0.70	C
Overall	28.0	0.70	C	27.8	0.70	C
4: Private DW/Keauhou SC & Kamehameha III Road						
EB LT	6.9	0.10	A	9.6	0.16	A
EB TH/RT	9.1	0.39	A	13.4	0.52	B
WB LT	6.5	0.05	A	10.5	0.06	B
WB TH	9.5	0.51	A	14.8	0.57	B
WB RT	7.7	0.11	A	11.8	0.12	B
NB LT/TH/RT	14.1	0.02	B	12.8	0.06	B
SB LT/TH/RT	15.2	0.33	B	17.4	0.62	B
Overall	9.7	0.44	A	14.1	0.57	B

IV. FUTURE YEAR 2023 TRAFFIC ANALYSIS WITH THE PROJECT

A. Project Trip Generation

The Institute of Transportation Engineers (ITE) publishes a book based on empirical data compiled from a body of more than 4,250 trip generation studies submitted by public agencies, developers, consulting firms, and associations. This publication, titled Trip Generation Manual, 9th Edition, provides trip rates and/or formulae based on graphs that correlate vehicular trips with independent variables. The independent variables can range from Dwelling Units (DU) for single-family attached homes to Gross Floor Area (GFA) for commercial or office development to Acres for recreational park spaces. These trip rates/formulae and their associated directional distributions were used to estimate the increase in the number of vehicular trips generated by the Project heritage center. The ITE code 580 – Museum, was used to generate trips for the heritage center as it is anticipated to provide similar information as a museum.

As described in the introduction, the Project plans to demolish the existing hotel, and establish an educational complex and cultural center including camping facilities. In addition to the educational site, a heritage center providing cultural and historical information and shoreline access will be provided to the public. The volume of trips generated by the Project is projected to be less than the hotel when it was in use.

In general, it is anticipated that approximately 125 students and staff could be conducting activities at any one time on the site. Camping facilities would accommodate up to 80 students in addition to teachers and other support staff. It is planned that as an educational complex and campsite, students and teachers would be shuttled to and from the site via bus. It is assumed that conservatively approximately five (5) buses in and out during the AM and PM peak hours of traffic would be shuttling students for the daytime educational programs and five (5) other buses would be shuttling campsite users. Ten (10) trips during the AM and PM peak hours of traffic were anticipated to account for the ground staff needed to care for all project facilities. Also, ten (10) trips during the AM and PM peak hours of traffic were assumed to account for people

accessing the shore at the public access driveway located at the south end of the project.

The trip generation rates for the Hotel and Project are shown in Table 3, while the trips generated by the Hotel and Project are shown and compared in Table 4.

Table 3: Generation Rates

Land Use (ITE Code)	Independent Variable	AM Peak Hour of Traffic		AM Peak Hour of Traffic	
		Rate	% Entering	Rate	% Entering
PREVIOUS LAND USE					
Hotel (310)	Rooms	a.	59%	b.	51%
PROPOSED LAND USE					
Museum (580)	kSF	c.	71%	d.	48%

Source: Institute of Transportation Engineers, Trip Generation Handbook, 9th Edition
SF GFA = Square Feet of Gross Floor Area
T = Number of Trip Ends
X = Independent Variable
a. Fitted Curve Equation: Not Given, Average Rate = 0.53
b. T = 0.46(X) + 46.00
c. T = 1.32(X) – 5.84
d. Ln(T) = 0.91*Ln(X) + 2.22

Table 4: Project Generated Traffic

Land Use Designation	Independent Variable	AM Peak Hour			PM Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
PREVIOUS LAND USE							
Hotel (310)	Rooms	97	67	164	95	91	186
TOTAL TRIPS (previous land use)		**97**	**67**	**164**	**95**	**91**	**186**
PROPOSED LAND USE							
Campground (416)	125 Students/Staff	5	5	10	5	5	10
Educational Facilities	125 Students/Staff	5	5	10	5	5	10
Shore-Line Access	10 Stalls	10	10	20	10	10	20
Ground Staff	10 Staff	10	10	20	10	10	20
Museum (580)	7,200 SF	3	1	4	27	29	56
TOTAL NEW TRIPS (proposed land use)		**33**	**31**	**64**	**57**	**59**	**116**
Reduction in trips from hotel land use		**-64**	**-36**	**-100**	**-38**	**-32**	**-70**

As shown in Table 4, the Project is forecast to generate significantly less trips than the previous hotel land use.

B. Trip Distribution/Assignment

Based on the historical traffic data collected by the Hawai‘i State Department of Transportation, it was determined that approximately 60 percent of AM and PM peak hour trips to and from the Project travel south along Ali‘i Drive, with the remaining trips traveling north. No pass-by or internal trip capture were assumed for the Project. Figure 5 illustrates the net trip distribution for the Project.

C. Future Year 2023 Analysis

At full-build of the Project, the study intersections are forecast to operate at conditions similar to the Base Year 2023 with Mitigation scenario. As detailed below, all movements at all intersections are forecast to operate at LOS D or better.

Ali'i Drive and Hotel Driveway

The two-way stop-controlled Ali'i Drive and Hotel Driveway intersection is forecast to operate at LOS C or better on all approaches during both the AM and PM peak hours of traffic.

Ali'i Driveway and Keauhou Shopping Center Driveway

The Ali'i Drive, Ali'i Drive, and Keauhou SC Driveway signalized "T"-intersection is forecast to continue operating at LOS B or better at all approaches during the AM and PM peak hours of traffic.

Ali'i Drive and Kamehameha III Road

The Ali'i Drive and Kamehameha III Road signalized intersection is forecast to continue to operate at LOS D or better at all approaches during both the AM and PM peak hours of traffic.

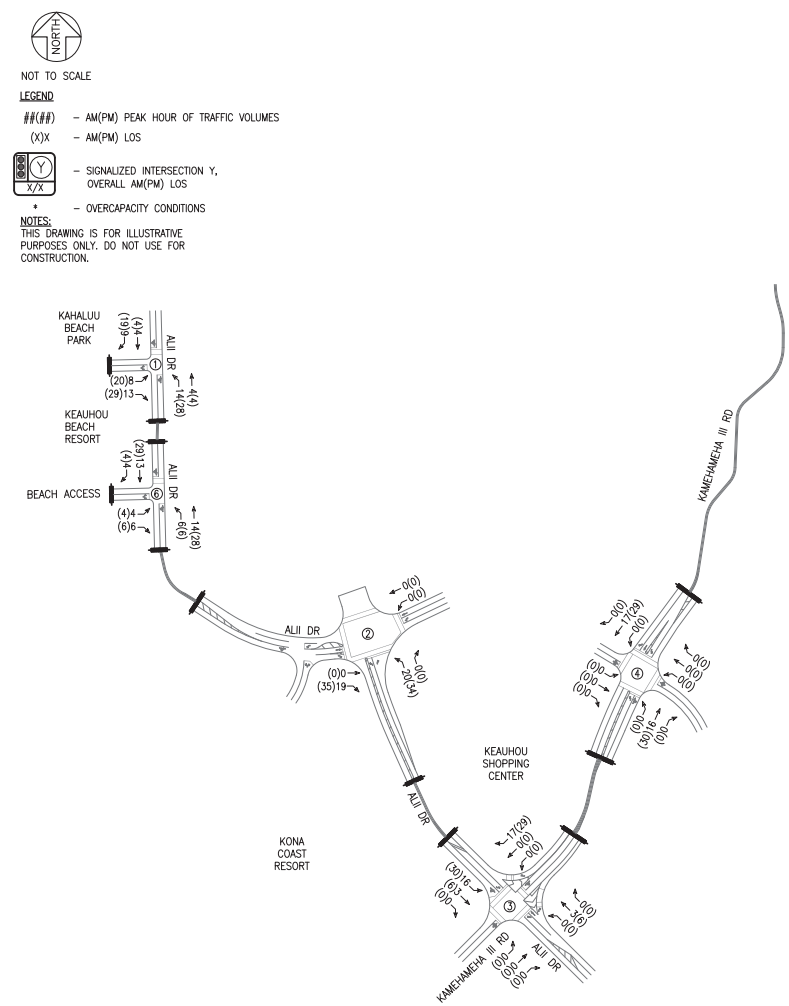
Kamehameha III Road and Keauhou Shopping Center Driveway

The Kamehameha III Road and Keauhou SC Driveway signalized intersection is forecast to continue operating at LOS B or better at all approaches during both the AM and PM peak hours of traffic.

Ali'i Drive and Beach Access

The Ali'i Drive and Beach Access one-way stop-controlled intersection is forecast to operate at LOS C or better during all approaches during both the AM and PM peak hours of traffic.

Figure 6 illustrates the forecast traffic volumes, lane configuration, and LOS for Future Year 2023 conditions. Table 5 summarizes the delay, V/C, and LOS at the study intersections for the Future Year 2023 conditions. Full LOS summary tables are provided in Appendix C.



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TRIP DISTRIBUTION

FIGURE 5

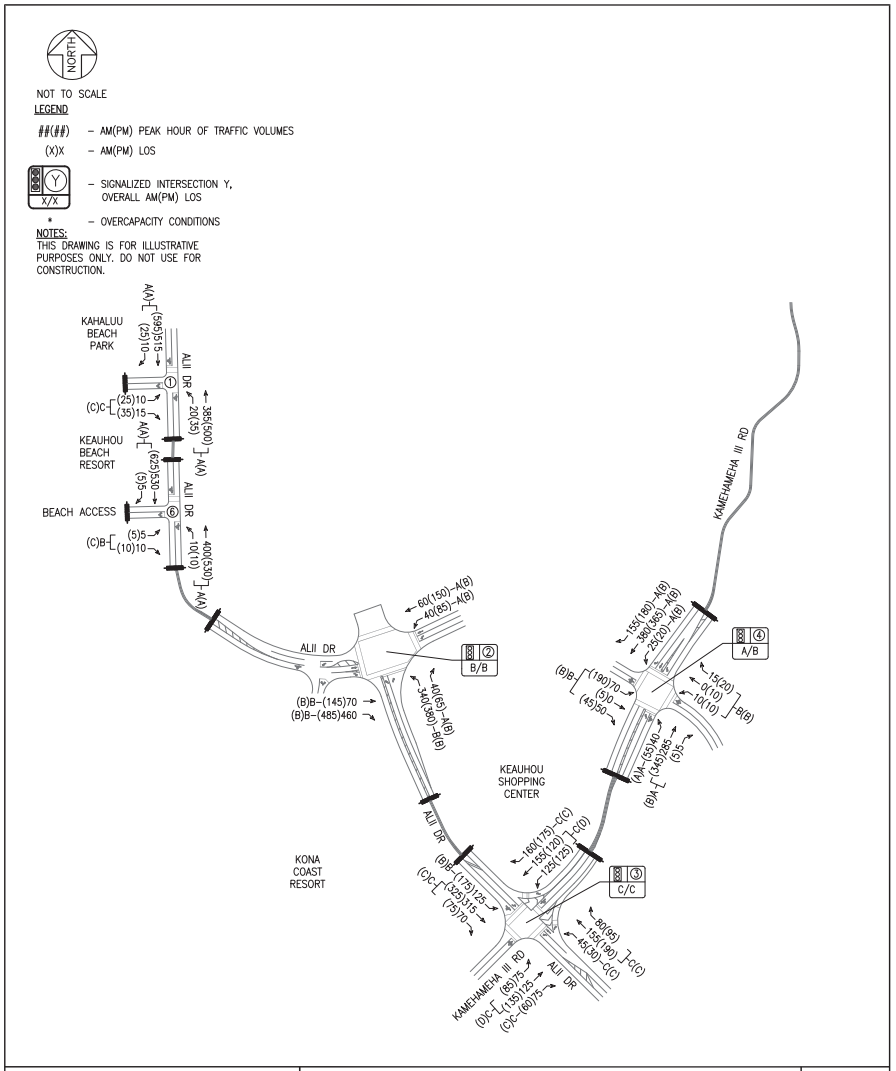

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FIGURE 6

FUTURE YEAR 2023 VOLUMES AND LOS

Table 5: Future Year 2023 Level of Service Summary

Intersection	Future Year 2023					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Alii Drive & Hotel Driveway						
EB LT/RT	15.6	0.07	C	22.1	0.24	C
NB LT/TH	0.7	0.02	A	1.1	0.04	A
SB TH/RT	0.0	0.34	A	0.0	0.40	A
2: Alii Drive & Keauhou Shopping Ctr.						
EB TH	13.7	0.20	B	16.9	0.33	B
EB RT	14.2	0.33	B	19.7	0.59	B
WB LT	9.5	0.13	A	10.2	0.19	B
WB TH	9.4	0.10	A	10.4	0.21	B
NB LT	12.6	0.62	B	18.3	0.68	B
NB RT	9.1	0.04	A	12.5	0.08	B
Overall	12.9	0.48	B	17.0	0.59	B
3: Alii Drive & Kamehameha III Road						
EB LT/TH	34.6	0.67	C	35.5	0.70	D
EB RT	27.0	0.05	C	26.8	0.04	C
WB LT/TH	33.2	0.72	C	35.9	0.72	D
WB RT	24.1	0.11	C	26.3	0.12	C
NB LT	21.6	0.22	C	21.1	0.14	C
NB TH/RT	26.5	0.54	C	28.7	0.64	C
SB LT	16.1	0.35	B	16.3	0.50	B
SB TH/RT	26.6	0.71	C	24.9	0.68	C
Overall	27.6	0.70	C	28.0	0.70	C
4: Private DW/Keauhou SC & Kamehameha III Road						
EB LT	6.8	0.10	A	9.8	0.17	A
EB TH/RT	9.1	0.41	A	13.9	0.55	B
WB LT	6.4	0.05	A	10.5	0.06	B
WB TH	9.6	0.53	A	15.3	0.60	B
WB RT	7.6	0.12	A	11.9	0.13	B
NB LT/TH/RT	14.4	0.02	B	13.3	0.06	B
SB LT/TH/RT	15.5	0.33	B	18.0	0.62	B
Overall	9.8	0.46	A	14.6	0.58	B
6: Alii Drive & Beach Access						
EB LT/RT	14.8	0.04	B	17.7	0.05	C
NB LT/TH	0.3	0.01	A	0.3	0.01	A
SB TH/RT	0.0	0.34	A	0.0	0.40	A

V. CONCLUSION

Existing Conditions

Currently the non-operational Keauhou Beach Hotel is occupying the Project site. All study intersections currently operate at acceptable traffic conditions during the AM and PM peak hours of traffic.

Base Year 2023 WITHOUT the Project

By Base Year 2023, which includes the Parcel 26 project, all study intersections are forecast to continue operating at LOS D or better.

Future Year 2023 WITH the Project

The Project plans to develop a 22.5-acre parcel fronting Ali‘i Drive that will include a heritage center, outdoor classrooms, a multi-purpose building, interpretation areas, cultural halau, and camping accommodations. The project is anticipated to generate approximately 64 AM peak hour trips and 116 PM peak hour trips, which is significantly less trips than the previous hotel was estimated to generate. These trips were assigned to access the Project via two (2) driveways along Ali’i Drive. Analysis of Future Year 2023 with the Project, forecast all study intersections to continue operating at LOS D.

VI. REFERENCES

1. Transportation Research Board, Highway Capacity Manual, 2000.
2. Institute of Transportation Engineers, Trip Generation, 9th Edition, 2012.
3. Phillip Rowell and Associates, Traffic Impact Assessment Report KIC Land Area 26, 2012.

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APPENDICES

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APPENDIX A

TRAFFIC COUNT DATA

Austin Tsutsumi & Associates

501 Sumner Street, Suite 521
Honolulu, HI 96817-5031
Phone: 533-3646 Fax: 526-1267

File Name : AM_Keauhou SC - Kam III
Site Code : 00000000
Start Date : 10/1/2013
Page No : 1

Groups Printed- Unshifted

	KEAUHOU SC From North					KAMEHAMEHA III From East					KEAUHOU SC From South					KAMEHAMEHA III From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:30 AM	6	3	3	0	12	15	13	5	0	33	1	0	0	0	1	5	16	4	0	25	71
06:45 AM	10	0	6	0	16	16	40	3	0	59	2	0	1	0	3	1	10	6	0	17	95
Total	16	3	9	0	28	31	53	8	0	92	3	0	1	0	4	6	26	10	0	42	166
07:00 AM	7	1	9	0	17	23	34	1	1	59	0	0	0	0	0	0	32	3	0	35	111
07:15 AM	8	0	9	0	17	23	44	1	0	68	0	0	1	0	1	1	28	8	0	37	123
07:30 AM	12	0	9	0	21	34	60	1	0	95	0	0	0	0	0	0	33	9	0	42	158
07:45 AM	9	0	13	0	22	41	61	4	0	106	1	0	1	0	2	3	32	6	0	41	171
Total	36	1	40	0	77	121	199	7	1	328	1	0	2	0	3	4	125	26	0	155	563
08:00 AM	8	0	25	1	34	27	31	2	0	60	1	0	1	0	2	0	21	9	0	30	126
08:15 AM	4	0	16	0	20	30	40	1	0	71	0	0	0	3	3	2	33	7	0	42	136
Grand Total	64	4	90	1	159	209	323	18	1	551	5	0	4	3	12	12	205	52	0	269	991
Apprch %	40.3	2.5	56.6	0.6		37.9	58.6	3.3	0.2		41.7	0	33.3	25		4.5	76.2	19.3	0		
Total %	6.5	0.4	9.1	0.1	16	21.1	32.6	1.8	0.1	55.6	0.5	0	0.4	0.3	1.2	1.2	20.7	5.2	0	27.1	

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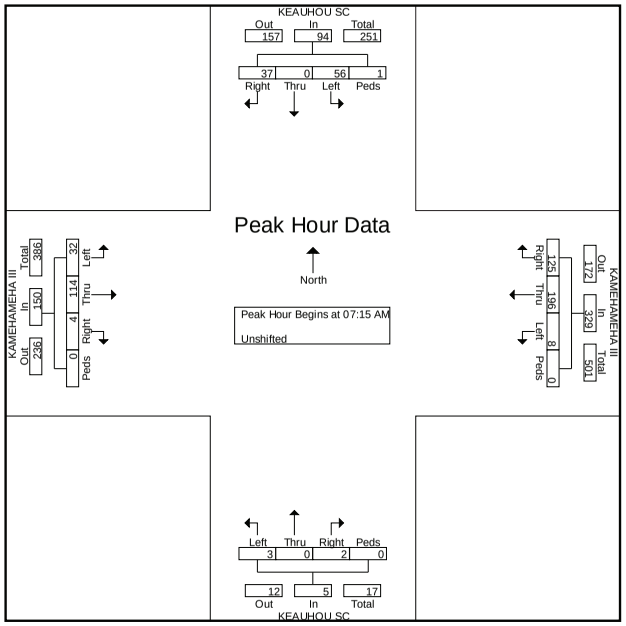
File Name : AM_Keauhou SC - Kam III
Site Code : 00000000
Start Date : 10/1/2013
Page No : 2

	KEAUHOU SC From North					KAMEHAMEHA III From East					KEAUHOU SC From South					KAMEHAMEHA III From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	8	0	9	0	17	23	44	1	0	68	0	0	**1**	0	1	1	28	8	0	37	123
07:30 AM	**12**	0	9	0	21	34	60	1	0	95	0	0	0	0	0	0	**33**	**9**	0	**42**	158
07:45 AM	9	0	13	0	22	**41**	**61**	**4**	0	**106**	**1**	0	1	0	**2**	**3**	32	6	0	41	**171**
08:00 AM	8	0	**25**	**1**	**34**	27	31	2	0	60	1	0	1	0	2	0	21	9	0	30	126
Total Volume	37	0	56	1	94	125	196	8	0	329	2	0	3	0	5	4	114	32	0	150	578
% App. Total	39.4	0	59.6	1.1		38	59.6	2.4	0		40	0	60	0		2.7	76	21.3	0		
PHF	.771	.000	.560	.250	.691	.762	.803	.500	.000	.776	.500	.000	.750	.000	.625	.333	.864	.889	.000	.893	.845



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File Name : AM_Alii - Kam III
Site Code : 00000000
Start Date : 10/1/2013
Page No : 1

Groups Printed- Unshifted

	ALII From North					KAM III From East					ALII From South					KAM III From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:30 AM	2	7	6	0	15	8	1	6	1	16	11	10	1	0	22	3	4	0	0	7	60
06:45 AM	3	9	5	0	17	18	6	27	2	53	8	17	0	2	27	2	4	3	3	12	109
Total	5	16	11	0	32	26	7	33	3	69	19	27	1	2	49	5	8	3	3	19	169
07:00 AM	7	18	15	3	43	18	7	14	5	44	12	34	0	2	48	2	11	5	1	19	154
07:15 AM	7	48	10	0	65	25	9	20	2	56	16	23	1	2	42	8	12	8	7	35	198
07:30 AM	6	43	16	2	67	20	10	34	5	69	23	26	6	4	59	11	7	8	2	28	223
07:45 AM	8	32	20	1	61	33	8	35	0	76	15	22	3	0	40	3	5	3	7	18	195
Total	28	141	61	6	236	96	34	103	12	245	66	105	10	8	189	24	35	24	17	100	770
08:00 AM	9	26	13	0	48	12	7	24	2	45	16	29	4	0	49	2	3	2	8	15	157
08:15 AM	7	30	21	4	62	18	10	16	4	48	15	41	4	1	61	3	5	4	7	19	190
Grand Total	49	213	106	10	378	152	58	176	21	407	116	202	19	11	348	34	51	33	35	153	1286
Apprch %	13	56.3	28	2.6		37.3	14.3	43.2	5.2		33.3	58	5.5	3.2		22.2	33.3	21.6	22.9		
Total %	3.8	16.6	8.2	0.8	29.4	11.8	4.5	13.7	1.6	31.6	9	15.7	1.5	0.9	27.1	2.6	4	2.6	2.7	11.9	

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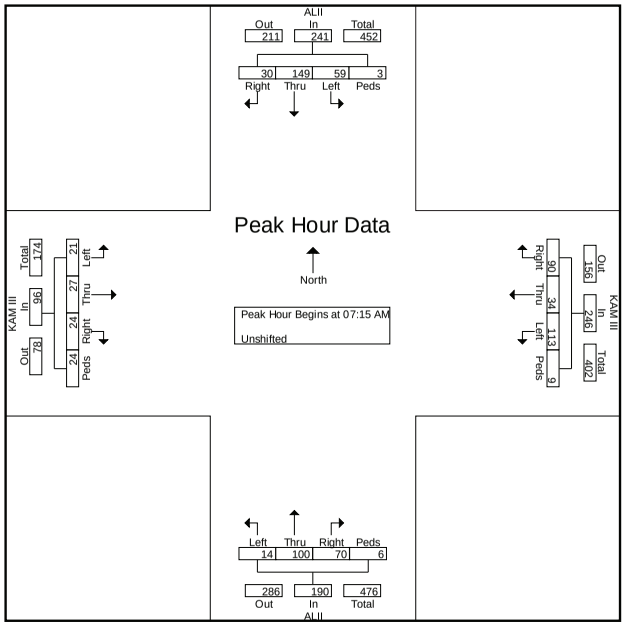
File Name : AM_Alii - Kam III
Site Code : 00000000
Start Date : 10/1/2013
Page No : 2

	ALII From North					KAM III From East					ALII From South					KAM III From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	7	**48**	10	0	65	25	9	20	2	56	16	23	1	2	42	8	**12**	**8**	7	**35**	198
07:30 AM	6	43	16	**2**	**67**	20	**10**	34	**5**	69	**23**	26	**6**	**4**	**59**	**11**	7	8	2	28	**223**
07:45 AM	8	32	**20**	1	61	**33**	8	**35**	0	**76**	15	22	3	0	40	3	5	3	7	18	195
08:00 AM	**9**	26	13	0	48	12	7	24	2	45	16	**29**	4	0	49	2	3	2	**8**	15	157
Total Volume	30	149	59	3	241	90	34	113	9	246	70	100	14	6	190	24	27	21	24	96	773
% App. Total	12.4	61.8	24.5	1.2		36.6	13.8	45.9	3.7		36.8	52.6	7.4	3.2		25	28.1	21.9	25		
PHF	.833	.776	.738	.375	.899	.682	.850	.807	.450	.809	.761	.862	.583	.375	.805	.545	.563	.656	.750	.686	.867



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File Name : AM Alii Hwy - Alii Dr - Keauhou SC West DW
Site Code : 00000000
Start Date : 10/1/2013
Page No : 1

Groups Printed- Unshifted

	ALII From North					KEAUHOU SC From East					ALII From South					KEAUHOU SC From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:30 AM	0	1	1	3	5	0	6	2	1	9	2	1	15	0	18	13	6	0	1	20	52
06:45 AM	0	0	0	1	1	0	6	0	1	7	5	0	35	0	40	17	11	0	1	29	77
Total	0	1	1	4	6	0	12	2	2	16	7	1	50	0	58	30	17	0	2	49	129
07:00 AM	0	0	0	0	0	0	4	6	0	10	6	0	50	2	58	35	16	0	0	51	119
07:15 AM	0	0	0	2	2	0	16	8	0	24	11	0	45	2	58	55	10	0	2	67	151
07:30 AM	0	0	0	3	3	0	16	10	2	28	6	0	44	1	51	51	11	0	1	63	145
07:45 AM	0	0	0	2	2	1	15	6	0	22	10	0	47	0	57	55	19	0	4	78	159
Total	0	0	0	7	7	1	51	30	2	84	33	0	186	5	224	196	56	0	7	259	574
08:00 AM	0	0	0	6	6	0	7	10	1	18	9	0	32	7	48	36	19	0	1	56	128
08:15 AM	0	0	0	0	0	0	16	12	0	28	19	0	47	3	69	51	18	0	0	69	166
Grand Total	0	1	1	17	19	1	86	54	5	146	68	1	315	15	399	313	110	0	10	433	997
Apprch %	0	5.3	5.3	89.5		0.7	58.9	37	3.4		17	0.3	78.9	3.8		72.3	25.4	0	2.3		
Total %	0	0.1	0.1	1.7	1.9	0.1	8.6	5.4	0.5	14.6	6.8	0.1	31.6	1.5	40	31.4	11	0	1	43.4	

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File Name : AM Alii Hwy - Alii Dr - Keauhou SC West DW
Site Code : 00000000
Start Date : 10/1/2013
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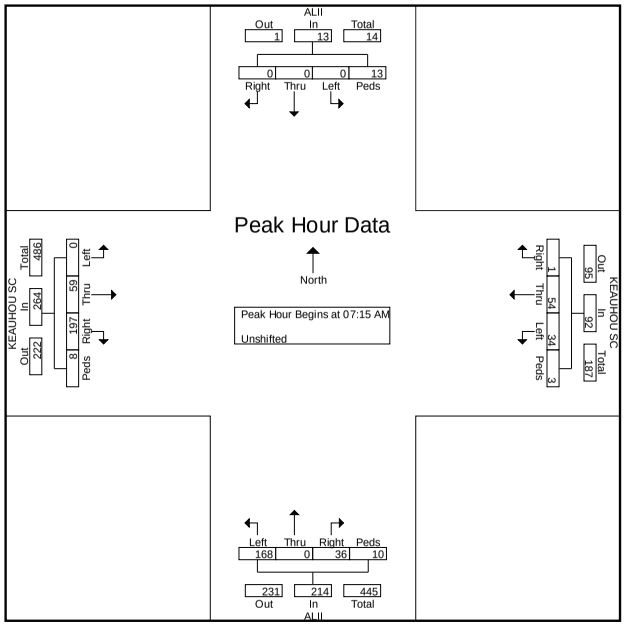
	ALII From North					KEAUHOU SC From East					ALII From South					KEAUHOU SC From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	0	0	0	2	2	0	**16**	8	0	24	**11**	0	45	2	**58**	**55**	10	0	2	67	151
07:30 AM	0	0	0	3	3	0	16	**10**	**2**	**28**	6	0	44	1	51	51	11	0	1	63	145
07:45 AM	0	0	0	2	2	**1**	15	6	0	22	10	0	**47**	0	57	55	**19**	0	**4**	**78**	**159**
08:00 AM	0	0	0	**6**	**6**	0	7	10	1	18	9	0	32	**7**	48	36	19	0	1	56	128
Total Volume	0	0	0	13	13	1	54	34	3	92	36	0	168	10	214	197	59	0	8	264	583
% App. Total	0	0	0	100		1.1	58.7	37	3.3		16.8	0	78.5	4.7		74.6	22.3	0	3		
PHF	.000	.000	.000	.542	.542	.250	.844	.850	.375	.821	.818	.000	.894	.357	.922	.895	.776	.000	.500	.846	.917



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File Name : AM_Alii - N Hotel DW
Site Code : 00000000
Start Date : 10/1/2013
Page No : 1

Groups Printed- Unshifted

	ALII From North					N HOTEL DW From East					ALII From South					N HOTEL DW From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:30 AM	0	16	0	0	16	0	0	0	5	5	0	19	1	0	20	0	0	0	1	1	42
06:45 AM	0	32	0	0	32	0	0	0	3	3	0	37	0	0	37	0	0	1	0	1	73
Total	0	48	0	0	48	0	0	0	8	8	0	56	1	0	57	0	0	1	1	2	115
07:00 AM	0	41	0	0	41	0	0	0	5	5	0	52	1	0	53	0	0	0	5	5	104
07:15 AM	0	59	0	0	59	0	0	0	3	3	0	45	2	0	47	0	0	0	7	7	116
07:30 AM	0	60	0	0	60	0	0	0	5	5	1	47	0	0	48	0	0	0	5	5	118
07:45 AM	0	68	0	0	68	0	0	0	3	3	0	52	0	0	52	0	0	0	8	8	131
Total	0	228	0	0	228	0	0	0	16	16	1	196	3	0	200	0	0	0	25	25	469
08:00 AM	0	48	1	0	49	0	0	0	1	1	0	45	0	0	45	0	0	0	13	13	108
08:15 AM	2	62	0	0	64	0	0	0	4	4	0	50	0	0	50	0	0	1	11	12	130
Grand Total	2	386	1	0	389	0	0	0	29	29	1	347	4	0	352	0	0	2	50	52	822
Apprch %	0.5	99.2	0.3	0		0	0	0	100		0.3	98.6	1.1	0		0	0	3.8	96.2		
Total %	0.2	47	0.1	0	47.3	0	0	0	3.5	3.5	0.1	42.2	0.5	0	42.8	0	0	0.2	6.1	6.3	

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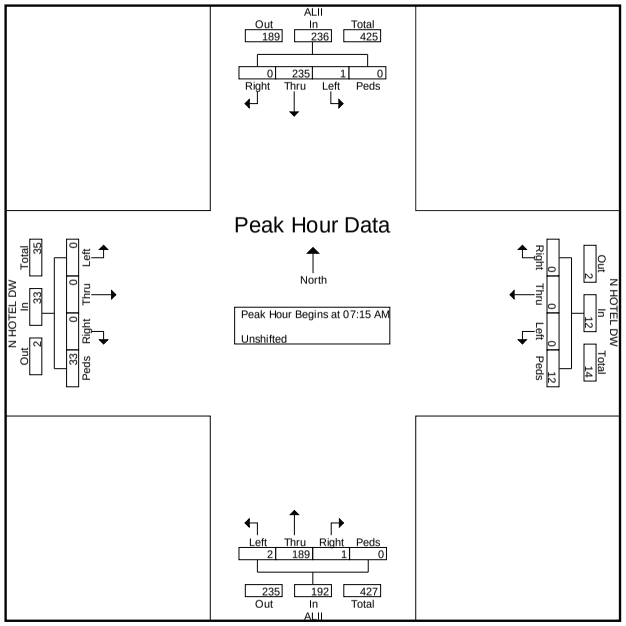
File Name : AM_Alii - N Hotel DW
Site Code : 00000000
Start Date : 10/1/2013
Page No : 2

	ALII From North					N HOTEL DW From East					ALII From South					N HOTEL DW From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	0	59	0	0	59	0	0	0	3	3	0	45	**2**	0	47	0	0	0	7	7	116
07:30 AM	0	60	0	0	60	0	0	0	**5**	**5**	**1**	47	0	0	48	0	0	0	5	5	118
07:45 AM	0	**68**	0	0	**68**	0	0	0	3	3	0	**52**	0	0	**52**	0	0	0	8	8	**131**
08:00 AM	0	48	**1**	0	49	0	0	0	1	1	0	45	0	0	45	0	0	0	**13**	**13**	108
Total Volume	0	235	1	0	236	0	0	0	12	12	1	189	2	0	192	0	0	0	33	33	473
% App. Total	0	99.6	0.4	0		0	0	0	100		0.5	98.4	1	0		0	0	0	100		
PHF	.000	.864	.250	.000	.868	.000	.000	.000	.600	.600	.250	.909	.250	.000	.923	.000	.000	.000	.635	.635	.903



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File Name : AM_Alii - Makolea
Site Code : 00000000
Start Date : 10/1/2013
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Groups Printed- Unshifted

	ALII From North					MAKOLE From East					ALII From South					MAKOLE From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:30 AM	0	15	1	4	20	2	0	0	2	4	2	18	0	1	21	0	0	0	2	2	47
06:45 AM	0	28	1	0	29	4	0	3	1	8	2	34	0	0	36	0	0	0	0	0	73
Total	0	43	2	4	49	6	0	3	3	12	4	52	0	1	57	0	0	0	2	2	120
07:00 AM	1	37	2	0	40	6	0	4	3	13	4	49	0	0	53	0	0	0	4	4	110
07:15 AM	2	56	1	2	61	4	0	4	0	8	3	37	3	0	43	0	0	1	5	6	118
07:30 AM	2	53	1	2	58	2	0	5	4	11	2	43	2	2	49	0	1	0	3	4	122
07:45 AM	6	67	5	0	78	4	0	2	2	8	3	44	5	0	52	2	0	4	5	11	149
Total	11	213	9	4	237	16	0	15	9	40	12	173	10	2	197	2	1	5	17	25	499
08:00 AM	4	42	1	0	47	1	0	2	4	7	6	39	1	1	47	2	0	3	9	14	115
08:15 AM	6	55	6	3	70	6	0	5	2	13	2	45	6	1	54	2	0	1	2	5	142
Grand Total	21	353	18	11	403	29	0	25	18	72	24	309	17	5	355	6	1	9	30	46	876
Apprch %	5.2	87.6	4.5	2.7		40.3	0	34.7	25		6.8	87	4.8	1.4		13	2.2	19.6	65.2		
Total %	2.4	40.3	2.1	1.3	46	3.3	0	2.9	2.1	8.2	2.7	35.3	1.9	0.6	40.5	0.7	0.1	1	3.4	5.3	

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File Name : AM_Alii - Makolea
Site Code : 00000000
Start Date : 10/1/2013
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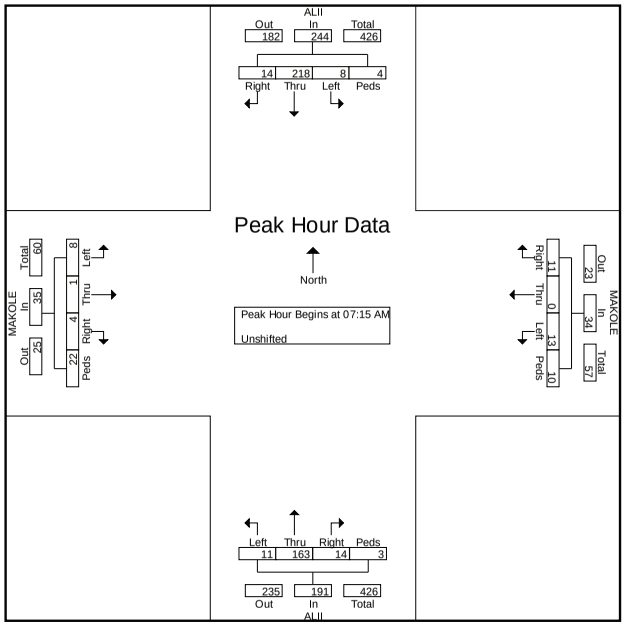
	ALII From North					MAKOLE From East					ALII From South					MAKOLE From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	2	56	1	**2**	61	**4**	0	4	0	8	3	37	3	0	43	0	0	1	5	6	118
07:30 AM	2	53	1	2	58	2	0	**5**	**4**	**11**	2	43	2	**2**	49	0	**1**	0	3	4	122
07:45 AM	**6**	**67**	**5**	0	**78**	4	0	2	2	8	3	**44**	**5**	0	**52**	**2**	0	**4**	5	11	**149**
08:00 AM	4	42	1	0	47	1	0	2	4	7	**6**	39	1	1	47	2	0	3	**9**	**14**	115
Total Volume	14	218	8	4	244	11	0	13	10	34	14	163	11	3	191	4	1	8	22	35	504
% App. Total	5.7	89.3	3.3	1.6		32.4	0	38.2	29.4		7.3	85.3	5.8	1.6		11.4	2.9	22.9	62.9		
PHF	.583	.813	.400	.500	.782	.688	.000	.650	.625	.773	.583	.926	.550	.375	.918	.500	.250	.500	.611	.625	.846



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File Name : PM_Keauhou SC - Kam III
Site Code : 00000000
Start Date : 10/1/2013
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Groups Printed- Unshifted

	KEAUHOU SC From North					KAMEHAMEHA III From East					KEAUHOU SC From South					KAMEHAMEHA III From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
03:00 PM	11	0	38	0	49	43	33	0	0	76	4	0	1	1	6	1	31	6	0	38	169
03:15 PM	9	2	40	0	51	38	41	2	0	81	4	0	3	0	7	1	33	10	0	44	183
03:30 PM	8	1	28	2	39	40	58	2	0	100	0	1	1	0	2	0	39	14	0	53	194
03:45 PM	11	0	40	1	52	41	45	2	0	88	3	0	0	2	5	0	35	8	1	44	189
Total	39	3	146	3	191	162	177	6	0	345	11	1	5	3	20	2	138	38	1	179	735
04:00 PM	8	0	45	0	53	35	51	1	0	87	1	1	0	0	2	0	40	16	0	56	198
04:15 PM	9	3	40	0	52	29	46	1	0	76	2	3	2	0	7	1	41	8	0	50	185
04:30 PM	10	1	50	0	61	28	39	0	0	67	3	1	1	0	5	1	40	12	0	53	186
04:45 PM	7	1	37	1	46	28	40	1	0	69	2	0	1	0	3	0	32	6	0	38	156
Total	34	5	172	1	212	120	176	3	0	299	8	5	4	0	17	2	153	42	0	197	725
Grand Total	73	8	318	4	403	282	353	9	0	644	19	6	9	3	37	4	291	80	1	376	1460
Apprch %	18.1	2	78.9	1		43.8	54.8	1.4	0		51.4	16.2	24.3	8.1		1.1	77.4	21.3	0.3		
Total %	5	0.5	21.8	0.3	27.6	19.3	24.2	0.6	0	44.1	1.3	0.4	0.6	0.2	2.5	0.3	19.9	5.5	0.1	25.8	

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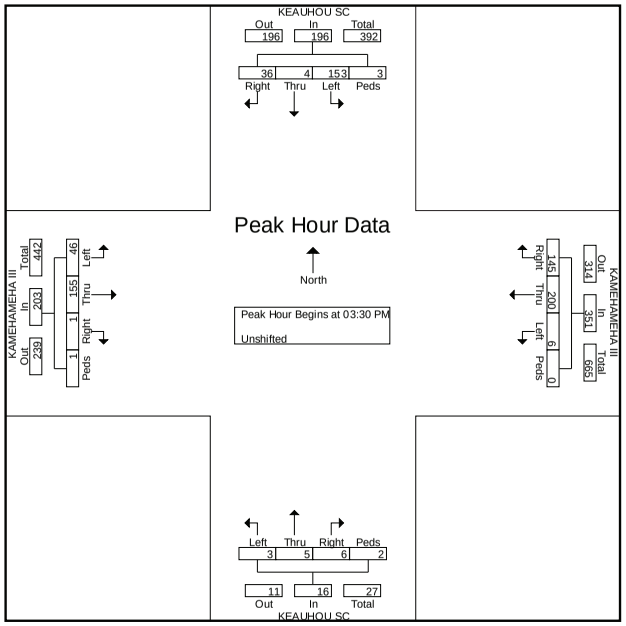
	KEAUHOU SC From North					KAMEHAMEHA III From East					KEAUHOU SC From South					KAMEHAMEHA III From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	8	1	28	**2**	39	40	**58**	**2**	0	**100**	0	1	1	0	2	0	39	14	0	53	194
03:45 PM	**11**	0	40	1	52	**41**	45	2	0	88	**3**	0	0	**2**	5	0	35	8	**1**	44	189
04:00 PM	8	0	**45**	0	**53**	35	51	1	0	87	1	1	0	0	2	0	40	**16**	0	**56**	**198**
04:15 PM	9	**3**	40	0	52	29	46	1	0	76	2	**3**	**2**	0	**7**	**1**	**41**	8	0	50	185
Total Volume	36	4	153	3	196	145	200	6	0	351	6	5	3	2	16	1	155	46	1	203	766
% App. Total	18.4	2	78.1	1.5		41.3	57	1.7	0		37.5	31.2	18.8	12.5		0.5	76.4	22.7	0.5		
PHF	.818	.333	.850	.375	.925	.884	.862	.750	.000	.878	.500	.417	.375	.250	.571	.250	.945	.719	.250	.906	.967



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File Name : PM_Alii - Kam III
Site Code : 00000000
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Groups Printed- Unshifted

	ALII From North					KAM III From East					ALII From South					KAM III From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
03:00 PM	5	35	17	3	60	30	3	16	0	49	19	35	0	0	54	2	3	5	1	11	174
03:15 PM	8	38	21	2	69	30	8	17	0	55	19	36	2	0	57	2	6	5	3	16	197
03:30 PM	9	36	18	2	65	25	4	37	0	66	22	32	0	0	54	2	8	9	2	21	206
03:45 PM	12	38	22	3	75	20	4	23	1	48	20	40	2	0	62	4	6	5	3	18	203
Total	34	147	78	10	269	105	19	93	1	218	80	143	4	0	227	10	23	24	9	66	780
04:00 PM	6	43	23	0	72	24	7	34	0	65	25	46	2	0	73	8	7	5	0	20	230
04:15 PM	6	34	23	0	63	23	7	22	1	53	19	27	1	0	47	1	10	8	0	19	182
04:30 PM	3	58	23	0	84	27	8	20	1	56	22	36	2	0	60	3	5	6	3	17	217
04:45 PM	4	47	22	0	73	16	8	24	0	48	12	42	4	0	58	0	4	5	3	12	191
Total	19	182	91	0	292	90	30	100	2	222	78	151	9	0	238	12	26	24	6	68	820
Grand Total	53	329	169	10	561	195	49	193	3	440	158	294	13	0	465	22	49	48	15	134	1600
Apprch %	9.4	58.6	30.1	1.8		44.3	11.1	43.9	0.7		34	63.2	2.8	0		16.4	36.6	35.8	11.2		
Total %	3.3	20.6	10.6	0.6	35.1	12.2	3.1	12.1	0.2	27.5	9.9	18.4	0.8	0	29.1	1.4	3.1	3	0.9	8.4	

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File Name : PM_Alii - Kam III
Site Code : 00000000
Start Date : 10/1/2013
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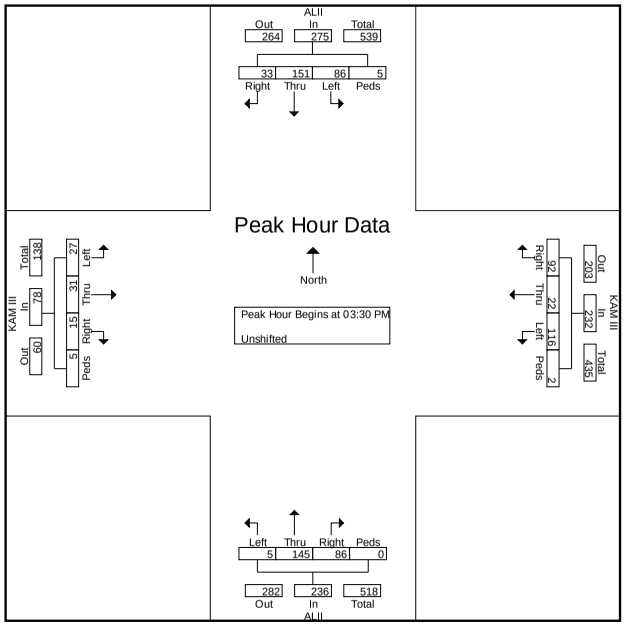
	ALII From North					KAM III From East					ALII From South					KAM III From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	9	36	18	2	65	**25**	4	**37**	0	**66**	22	32	0	0	54	2	8	**9**	2	**21**	206
03:45 PM	**12**	38	22	**3**	**75**	20	4	23	**1**	48	20	40	**2**	0	62	4	6	5	**3**	18	203
04:00 PM	6	**43**	**23**	0	72	24	**7**	34	0	65	**25**	**46**	2	0	**73**	**8**	7	5	0	20	**230**
04:15 PM	6	34	23	0	63	23	7	22	1	53	19	27	1	0	47	1	**10**	8	0	19	182
Total Volume	33	151	86	5	275	92	22	116	2	232	86	145	5	0	236	15	31	27	5	78	821
% App. Total	12	54.9	31.3	1.8		39.7	9.5	50	0.9		36.4	61.4	2.1	0		19.2	39.7	34.6	6.4		
PHF	.688	.878	.935	.417	.917	.920	.786	.784	.500	.879	.860	.788	.625	.000	.808	.469	.775	.750	.417	.929	.892



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File Name : PM Alii Hwy - Alii Dr - Keauhou SC West DW
Site Code : 00000000
Start Date : 10/1/2013
Page No : 1

Groups Printed- Unshifted

	ALII From North					KEAUHOU SC From East					ALII From South					KEAUHOU SC From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
03:00 PM	0	0	0	0	0	0	33	15	0	48	13	0	56	1	70	43	20	0	1	64	182
03:15 PM	0	0	0	2	2	0	28	19	0	47	17	0	53	0	70	42	21	0	0	63	182
03:30 PM	0	0	0	1	1	0	38	14	0	52	15	1	44	1	61	47	35	0	0	82	196
03:45 PM	0	1	1	0	2	0	30	27	1	58	14	0	46	1	61	43	31	0	3	77	198
Total	0	1	1	3	5	0	129	75	1	205	59	1	199	3	262	175	107	0	4	286	758
04:00 PM	1	0	0	0	1	0	29	19	0	48	18	1	55	0	74	53	40	1	0	94	217
04:15 PM	0	0	0	1	1	0	35	14	1	50	8	0	44	5	57	47	24	3	0	74	182
04:30 PM	0	0	0	0	0	1	27	24	0	52	15	0	54	3	72	57	28	0	0	85	209
04:45 PM	2	0	0	0	2	1	34	16	0	51	21	0	39	1	61	51	31	0	0	82	196
Total	3	0	0	1	4	2	125	73	1	201	62	1	192	9	264	208	123	4	0	335	804
Grand Total	3	1	1	4	9	2	254	148	2	406	121	2	391	12	526	383	230	4	4	621	1562
Apprch %	33.3	11.1	11.1	44.4		0.5	62.6	36.5	0.5		23	0.4	74.3	2.3		61.7	37	0.6	0.6		
Total %	0.2	0.1	0.1	0.3	0.6	0.1	16.3	9.5	0.1	26	7.7	0.1	25	0.8	33.7	24.5	14.7	0.3	0.3	39.8	

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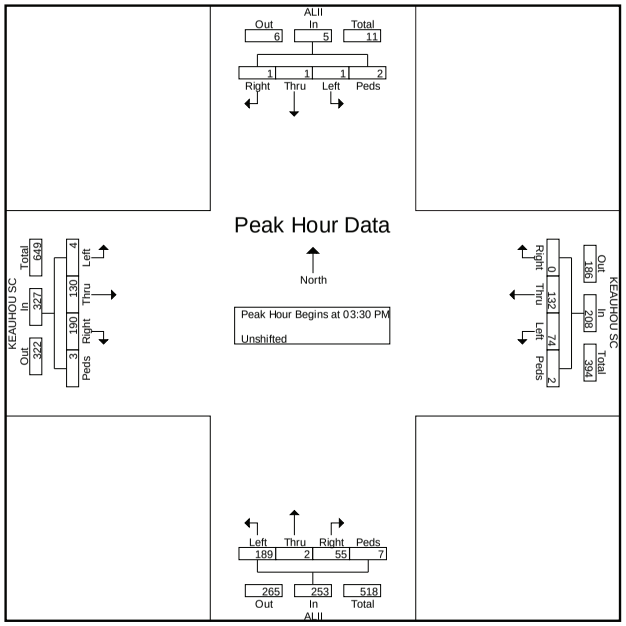
File Name : PM Alii Hwy - Alii Dr - Keauhou SC West DW
Site Code : 00000000
Start Date : 10/1/2013
Page No : 2

	ALII From North					KEAUHOU SC From East					ALII From South					KEAUHOU SC From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	0	0	0	**1**	1	0	**38**	14	0	52	15	**1**	44	1	61	47	35	0	0	82	196
03:45 PM	0	**1**	**1**	0	**2**	0	30	**27**	**1**	**58**	14	0	46	1	61	43	31	0	**3**	77	198
04:00 PM	**1**	0	0	0	1	0	29	19	0	48	**18**	1	**55**	0	**74**	**53**	**40**	1	0	**94**	**217**
04:15 PM	0	0	0	1	1	0	35	14	1	50	8	0	44	**5**	57	47	24	**3**	0	74	182
Total Volume	1	1	1	2	5	0	132	74	2	208	55	2	189	7	253	190	130	4	3	327	793
% App. Total	20	20	20	40		0	63.5	35.6	1		21.7	0.8	74.7	2.8		58.1	39.8	1.2	0.9		
PHF	.250	.250	.250	.500	.625	.000	.868	.685	.500	.897	.764	.500	.859	.350	.855	.896	.813	.333	.250	.870	.914



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File Name : PM_Alii - N Hotel DW
Site Code : 00000000
Start Date : 10/1/2013
Page No : 1

Groups Printed- Unshifted

	ALII From North					N HOTEL DW From East					ALII From South					N HOTEL DW From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
03:00 PM	0	60	0	0	60	0	0	0	5	5	0	82	1	0	83	0	0	1	2	3	151
03:15 PM	1	56	0	0	57	0	0	0	0	0	0	73	1	1	75	1	0	0	1	2	134
03:30 PM	1	78	0	0	79	0	0	0	1	1	0	73	1	0	74	1	0	2	6	9	163
03:45 PM	1	66	0	3	70	0	0	0	5	5	0	75	0	0	75	1	0	1	1	3	153
Total	3	260	0	3	266	0	0	0	11	11	0	303	3	1	307	3	0	4	10	17	601
04:00 PM	1	71	0	0	72	0	0	0	1	1	0	79	1	0	80	0	0	1	2	3	156
04:15 PM	0	71	0	0	71	0	0	0	2	2	0	77	0	0	77	0	0	0	4	4	154
04:30 PM	1	67	0	0	68	0	0	0	0	0	0	69	1	0	70	3	0	0	5	8	146
04:45 PM	0	79	0	0	79	0	0	1	3	4	0	72	1	0	73	0	0	0	2	2	158
Total	2	288	0	0	290	0	0	1	6	7	0	297	3	0	300	3	0	1	13	17	614
Grand Total	5	548	0	3	556	0	0	1	17	18	0	600	6	1	607	6	0	5	23	34	1215
Apprch %	0.9	98.6	0	0.5		0	0	5.6	94.4		0	98.8	1	0.2		17.6	0	14.7	67.6		
Total %	0.4	45.1	0	0.2	45.8	0	0	0.1	1.4	1.5	0	49.4	0.5	0.1	50	0.5	0	0.4	1.9	2.8	

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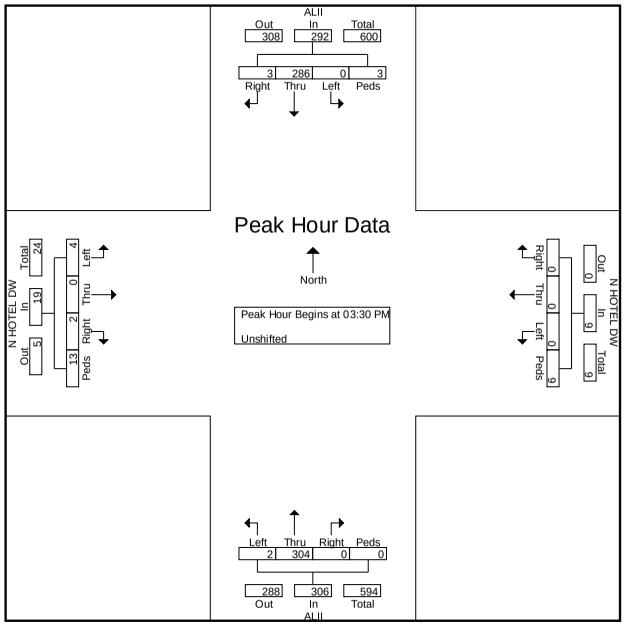
File Name : PM_Alii - N Hotel DW
Site Code : 00000000
Start Date : 10/1/2013
Page No : 2

	ALII From North					N HOTEL DW From East					ALII From South					N HOTEL DW From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	**1**	**78**	0	0	**79**	0	0	0	1	1	0	73	**1**	0	74	**1**	0	**2**	**6**	**9**	**163**
03:45 PM	1	66	0	**3**	70	0	0	0	**5**	**5**	0	75	0	0	75	1	0	1	1	3	153
04:00 PM	1	71	0	0	72	0	0	0	1	1	0	**79**	1	0	**80**	0	0	1	2	3	156
04:15 PM	0	71	0	0	71	0	0	0	2	2	0	77	0	0	77	0	0	0	4	4	154
Total Volume	3	286	0	3	292	0	0	0	9	9	0	304	2	0	306	2	0	4	13	19	626
% App. Total	1	97.9	0	1		0	0	0	100		0	99.3	0.7	0		10.5	0	21.1	68.4		
PHF	.750	.917	.000	.250	.924	.000	.000	.000	.450	.450	.000	.962	.500	.000	.956	.500	.000	.500	.542	.528	.960



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File Name : PM_Alii - Makolea
Site Code : 00000000
Start Date : 10/1/2013
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Groups Printed- Unshifted

	ALII From North					MAKOLE From East					ALII From South					MAKOLE From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
03:00 PM	9	52	2	0	63	5	0	2	5	12	2	71	6	0	79	4	0	3	0	7	161
03:15 PM	9	47	3	0	59	2	0	7	0	9	5	59	7	5	76	3	0	6	0	9	153
03:30 PM	4	77	3	0	84	3	0	2	0	5	4	72	2	0	78	5	0	5	8	18	185
03:45 PM	3	63	2	0	68	2	0	1	2	5	2	67	3	4	76	4	0	12	0	16	165
Total	25	239	10	0	274	12	0	12	7	31	13	269	18	9	309	16	0	26	8	50	664
04:00 PM	8	65	4	0	77	5	0	3	1	9	4	69	2	0	75	3	0	8	1	12	173
04:15 PM	2	63	1	0	66	4	0	3	3	10	6	69	5	0	80	4	0	8	3	15	171
04:30 PM	4	59	1	0	64	3	0	2	0	5	1	68	2	1	72	7	0	8	1	16	157
04:45 PM	6	69	5	0	80	4	1	3	2	10	4	65	2	0	71	8	0	6	0	14	175
Total	20	256	11	0	287	16	1	11	6	34	15	271	11	1	298	22	0	30	5	57	676
Grand Total	45	495	21	0	561	28	1	23	13	65	28	540	29	10	607	38	0	56	13	107	1340
Apprch %	8	88.2	3.7	0		43.1	1.5	35.4	20		4.6	89	4.8	1.6		35.5	0	52.3	12.1		
Total %	3.4	36.9	1.6	0	41.9	2.1	0.1	1.7	1	4.9	2.1	40.3	2.2	0.7	45.3	2.8	0	4.2	1	8	

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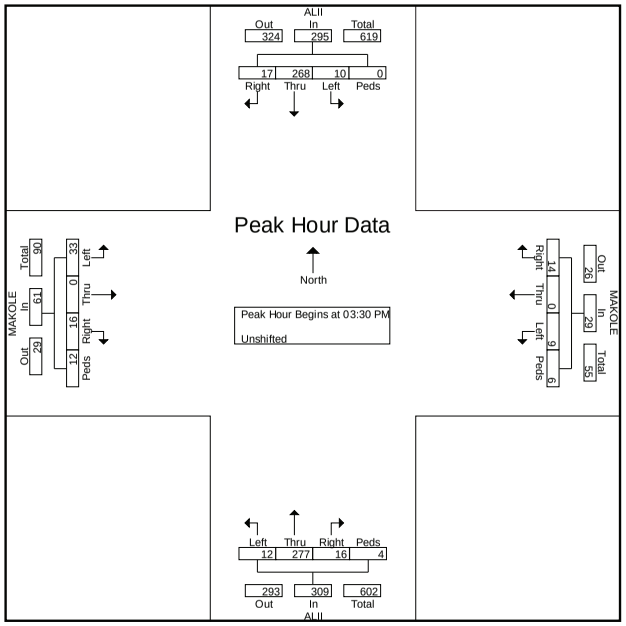
File Name : PM_Alii - Makolea
Site Code : 00000000
Start Date : 10/1/2013
Page No : 2

	ALII From North					MAKOLE From East					ALII From South					MAKOLE From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 04:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	4	**77**	3	0	**84**	3	0	2	0	5	4	**72**	2	0	78	**5**	0	5	**8**	**18**	**185**
03:45 PM	3	63	2	0	68	2	0	1	2	5	2	67	3	**4**	76	4	0	**12**	0	16	165
04:00 PM	**8**	65	**4**	0	77	**5**	0	**3**	1	9	4	69	2	0	75	3	0	8	1	12	173
04:15 PM	2	63	1	0	66	4	0	3	**3**	**10**	**6**	69	**5**	0	**80**	4	0	8	3	15	171
Total Volume	17	268	10	0	295	14	0	9	6	29	16	277	12	4	309	16	0	33	12	61	694
% App. Total	5.8	90.8	3.4	0		48.3	0	31	20.7		5.2	89.6	3.9	1.3		26.2	0	54.1	19.7		
PHF	.531	.870	.625	.000	.878	.700	.000	.750	.500	.725	.667	.962	.600	.250	.966	.800	.000	.688	.375	.847	.938



APPENDIX B

LEVEL OF SERVICE CRITERIA

APPENDIX B – LEVEL OF SERVICE (LOS) CRITERIA

LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 2000)

Level of service for signalized intersections is directly related to delay values and is assigned on that basis. Level of Service is a measure of the acceptability of delay values to motorists at a given intersection. The criteria are given in table below.

Level-of Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec./veh.)
A	< 10.0
B	>10.0 and ≤ 20.0
C	>20.0 and ≤ 35.0
D	>35.0 and ≤ 55.0
E	>55.0 and ≤ 80.0
F	> 80.0

Delay is a complex measure, and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group or approach in question.

LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 2000)

The level of service criteria for unsignalized intersections is defined as the average control delay, in seconds per vehicle.

LOS delay threshold values are lower for two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections than those of signalized intersections. This is because more vehicles pass through signalized intersections, and therefore, drivers expect and tolerate greater delays. While the criteria for level of service for TWSC and AWSC intersections are the same, procedures to calculate the average total delay may differ.

Level of Service Criteria for Two-Way Stop-Controlled Intersections

Level of Service	Average Control Delay (sec/veh)
A	≤ 10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	> 50

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing Conditions

HCM Unsignalized Intersection Capacity Analysis
1: Alii Drive & Hotel Driveway

4/9/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	2	189	235	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	2	205	255	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	465	255	255			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	465	255	255			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	555	783	1310			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	0	208	255
Volume Left	0	2	0
Volume Right	0	0	0
cSH	1700	1310	1700
Volume to Capacity	0.00	0.00	0.15
Queue Length 95th (ft)	0	0	0
Control Delay (s)	0.0	0.1	0.0
Lane LOS	A	A	
Approach Delay (s)	0.0	0.1	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	15.7%	ICU Level of Service	A
Analysis Period (min)	15		

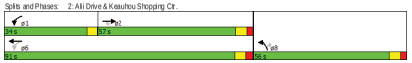
Timings
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	59	197	34	54	168	36
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Detector Phase	2	2	1	6	8	8
Switch Phase						
Minimum Initial (s)	5.0	5.0	1.0	5.0	5.0	5.0
Minimum Split (s)	39.5	39.5	5.0	44.8	40.5	40.5
Total Split (s)	57.0	57.0	34.0	91.0	56.0	56.0
Total Split (%)	38.8%	38.8%	23.1%	61.9%	38.1%	38.1%
Yellow Time (s)	4.0	4.0	3.7	4.0	4.0	4.0
All-Red Time (s)	2.5	2.5	0.3	2.8	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	Min	Min

Intersection Summary
Cycle Length: 147
Actuated Cycle Length: 29.6
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Alii Drive & Keauhou Shopping Ctr.



HCM Signalized Intersection Capacity Analysis
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	59	197	34	54	168	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.97	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1542	1770	1863	1770	1546
Flt Permitted	1.00	1.00	0.42	1.00	0.95	1.00
Satd. Flow (perm)	1863	1542	789	1863	1770	1546
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	214	37	59	183	39
RTOR Reduction (vph)	0	174	0	0	0	29
Lane Group Flow (vph)	64	40	37	59	183	10
Confl. Peds. (/hhr)		12				7
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	6.1	6.1	10.6	10.6	8.8	8.8
Effective Green, g (s)	6.1	6.1	10.6	10.6	8.8	8.8
Actuated g/C Ratio	0.19	0.19	0.32	0.32	0.27	0.27
Clearance Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Vehicle Extension (s)	1.6	1.6	1.5	1.6	1.6	1.6
Lane Grp Cap (vph)	347	287	279	603	476	416
v/s Ratio Prot	c0.03		0.00	c0.03	c0.10	
v/s Ratio Perm		0.03	0.04			0.01
v/c Ratio	0.18	0.14	0.13	0.10	0.38	0.03
Uniform Delay, d1	11.2	11.1	7.9	7.7	9.7	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.1	0.1	0.0	0.2	0.0
Delay (s)	11.3	11.2	8.0	7.7	9.9	8.8
Level of Service	B	B	A	A	A	A
Approach Delay (s)	11.2			7.8	9.7	
Approach LOS	B			A	A	

Intersection Summary			
HCM 2000 Control Delay	10.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	32.7	Sum of lost time (s)	17.0
Intersection Capacity Utilization	36.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

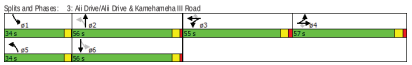
Timings
3: Alii Drive/Alii Drive & Kamehameha III Road

4/9/2014

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	27	24	34	90	14	100	59	149
Turn Type	NA	Perm	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	4		3		5	2	1	6
Permitted Phases		4		3	2		6	
Detector Phase	4	4	3	3	5	2	1	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	1.0	5.0	1.0	5.0
Minimum Split (s)	39.2	39.2	39.2	39.2	5.0	21.6	5.0	29.6
Total Split (s)	57.0	57.0	55.0	55.0	34.0	96.0	34.0	56.0
Total Split (%)	28.2%	28.2%	27.2%	27.2%	16.8%	27.7%	16.8%	27.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.7	4.0	3.7	4.0
All-Red Time (s)	2.2	2.2	2.2	2.2	0.3	1.6	0.3	1.6
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.2	6.2	6.2	6.2	4.0	5.6	4.0	5.6
Lead/Lag	Lag	Lag	Lead	Lead	Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 202
Actuated Cycle Length: 51.8
Natural Cycle: 115
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Alii Drive/Alii Drive & Kamehameha III Road



HCM Signalized Intersection Capacity Analysis
3: Ali Drive/Ali Drive & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	27	24	113	34	90	14	100	70	59	149	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.2	6.2		6.2	6.2	4.0	5.6		4.0	5.6	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00	0.98		1.00	0.97	1.00	0.98		1.00	0.99	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.94		1.00	0.97	
Flt Protected		0.98	1.00		0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1822	1550		1794	1541	1770	1720		1770	1805	
Flt Permitted		0.98	1.00		0.96	1.00	0.64	1.00		0.52	1.00	
Satd. Flow (perm)		1822	1550		1794	1541	1188	1720		972	1805	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	23	29	26	123	37	98	15	109	76	64	162	33
RTOR Reduction (vph)	0	0	24	0	0	80	0	13	0	0	3	0
Lane Group Flow (vph)	0	52	2	0	160	18	15	172	0	64	192	0
Confl. Peds. (/hhr)			1			8			11			11
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases			4			3	2			6		
Actuated Green, G (s)		4.8	4.8		10.3	10.3	15.2	14.5		21.8	17.8	
Effective Green, g (s)		4.8	4.8		10.3	10.3	15.2	14.5		21.8	17.8	
Actuated g/C Ratio		0.09	0.09		0.19	0.19	0.27	0.26		0.39	0.32	
Clearance Time (s)		6.2	6.2		6.2	6.2	4.0	5.6		4.0	5.6	
Vehicle Extension (s)		1.5	1.5		1.5	1.5	1.0	1.5		1.0	1.5	
Lane Grp Cap (vph)		157	133		332	285	330	448		438	577	
v/s Ratio Prot		c0.03			c0.09		0.00	0.10		c0.01	c0.11	
v/s Ratio Perm			0.00			0.01	0.01			0.05		
v/c Ratio		0.33	0.02		0.48	0.06	0.05	0.38		0.15	0.33	
Uniform Delay, d1		23.9	23.2		20.3	18.7	14.8	16.9		10.8	14.4	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.5	0.0		0.4	0.0	0.0	0.2		0.1	0.1	
Delay (s)		24.3	23.3		20.7	18.7	14.8	17.1		10.8	14.5	
Level of Service		C	C		C	B	B	B		B	B	
Approach Delay (s)		24.0			19.9			16.9			13.6	
Approach LOS		C			B			B			B	

Intersection Summary				
HCM 2000 Control Delay	17.5	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.38			
Actuated Cycle Length (s)	55.6	Sum of lost time (s)	22.0	
Intersection Capacity Utilization	47.2%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

Timings
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	32	114	8	196	125	3	0	56	0
Turn Type	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6	5	2			8		8
Permitted Phases	6		2		2	8		8	
Detector Phase	1	6	5	2	2	8	8	8	8
Switch Phase									
Minimum Initial (s)	1.0	8.0	1.0	8.0	8.0	5.0	5.0	5.0	5.0
Minimum Split (s)	5.0	33.9	5.0	30.6	30.6	35.0	35.0	35.0	35.0
Total Split (s)	34.0	56.0	34.0	56.0	56.0	46.0	46.0	46.0	46.0
Total Split (%)	25.0%	41.2%	25.0%	41.2%	41.2%	33.8%	33.8%	33.8%	33.8%
Yellow Time (s)	3.7	4.0	3.7	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.3	1.9	0.3	1.6	1.6	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	4.0	5.9	4.0	5.6	5.6		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag				
Lead-Lag Optimize?									
Recall Mode	None	Min	None	Min	Min	None	None	None	None

Intersection Summary
Cycle Length: 136
Actuated Cycle Length: 32
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Private DW/Keauhou SC & Kamehameha III Road

HCM Signalized Intersection Capacity Analysis
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	32	114	4	8	196	125	3	0	2	56	0	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frt	1.00	1.00		1.00	1.00	0.85		0.95			0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.97			0.97	
Satd. Flow (prot)	1770	1854		1770	1863	1583		1711			1703	
Flt Permitted	0.62	1.00		0.67	1.00	1.00		0.76			0.81	
Satd. Flow (perm)	1164	1854		1257	1863	1583		1336			1425	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	35	124	4	9	213	136	3	0	2	61	0	40
RTOR Reduction (vph)	0	1	0	0	0	79	0	4	0	0	48	0
Lane Group Flow (vph)	35	127	0	9	213	57	0	1	0	0	53	0
Confl. Peds. (/hhr)												1
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			8			8	
Permitted Phases	6			2		2	8			8		
Actuated Green, G (s)	15.7	15.0		16.0	15.3	15.3		4.9			4.9	
Effective Green, g (s)	15.7	15.0		16.0	15.3	15.3		4.9			4.9	
Actuated g/C Ratio	0.43	0.41		0.44	0.42	0.42		0.13			0.13	
Clearance Time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Vehicle Extension (s)	1.0	1.6		1.0	1.6	1.6		1.6			1.6	
Lane Grp Cap (vph)	512	761		560	780	663		179			191	
v/s Ratio Prot	c0.00	0.07		0.00	c0.11							
v/s Ratio Perm	0.03			0.01		0.04		0.00			c0.04	
v/c Ratio	0.07	0.17		0.02	0.27	0.09		0.00			0.28	
Uniform Delay, d1	6.0	6.8		5.8	7.0	6.4		13.7			14.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Incremental Delay, d2	0.0	0.0		0.0	0.1	0.0		0.0			0.3	
Delay (s)	6.1	6.8		5.8	7.0	6.4		13.7			14.5	
Level of Service	A	A		A	A	A		B			B	
Approach Delay (s)		6.7			6.8			13.7			14.5	
Approach LOS		A			A			B			B	

Intersection Summary				
HCM 2000 Control Delay	8.0	HCM 2000 Level of Service	A	
HCM 2000 Volume to Capacity ratio	0.27			
Actuated Cycle Length (s)	36.5	Sum of lost time (s)	15.9	
Intersection Capacity Utilization	33.7%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
1: Alii Drive & Hotel Driveway

4/9/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	4	2	19	304	286	3
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	2	21	330	311	3
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	684	312	314			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	684	312	314			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	100	98			
cM capacity (veh/h)	407	728	1246			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	7	351	314
Volume Left	4	21	0
Volume Right	2	0	3
cSH	477	1246	1700
Volume to Capacity	0.01	0.02	0.18
Queue Length 95th (ft)	1	1	0
Control Delay (s)	12.6	0.6	0.0
Lane LOS	B	A	
Approach Delay (s)	12.6	0.6	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	41.6%	ICU Level of Service	A
Analysis Period (min)	15		

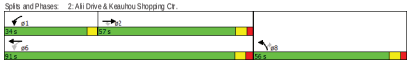
Timings
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	130	190	74	132	189	55
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Detector Phase	2	2	1	6	8	8
Switch Phase						
Minimum Initial (s)	5.0	5.0	1.0	5.0	5.0	5.0
Minimum Split (s)	39.5	39.5	5.0	44.8	40.5	40.5
Total Split (s)	57.0	57.0	34.0	91.0	56.0	56.0
Total Split (%)	38.8%	38.8%	23.1%	61.9%	38.1%	38.1%
Yellow Time (s)	4.0	4.0	3.7	4.0	4.0	4.0
All-Red Time (s)	2.5	2.5	0.3	2.8	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	Min	Min

Intersection Summary
Cycle Length: 147
Actuated Cycle Length: 36.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Alii Drive & Keauhou Shopping Ctr.



HCM Signalized Intersection Capacity Analysis
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	130	190	74	132	189	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.97	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1541	1770	1863	1770	1546
Flt Permitted	1.00	1.00	0.44	1.00	0.95	1.00
Satd. Flow (perm)	1863	1541	814	1863	1770	1546
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	207	80	143	205	60
RTOR Reduction (vph)	0	129	0	0	0	45
Lane Group Flow (vph)	141	78	80	143	205	15
Confl. Peds. (/hhr)		12				7
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	7.9	7.9	14.6	14.6	9.4	9.4
Effective Green, g (s)	7.9	7.9	14.6	14.6	9.4	9.4
Actuated g/C Ratio	0.21	0.21	0.39	0.39	0.25	0.25
Clearance Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Vehicle Extension (s)	1.6	1.6	1.5	1.6	1.6	1.6
Lane Grp Cap (vph)	394	326	395	729	446	389
v/s Ratio Prot	c0.08		0.02	c0.08	c0.12	
v/s Ratio Perm		0.05	0.06			0.01
v/c Ratio	0.36	0.24	0.20	0.20	0.46	0.04
Uniform Delay, d1	12.5	12.2	7.5	7.5	11.8	10.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.1	0.1	0.0	0.3	0.0
Delay (s)	12.7	12.3	7.6	7.5	12.1	10.6
Level of Service	B	B	A	A	B	B
Approach Delay (s)	12.5			7.5	11.7	
Approach LOS	B			A	B	

Intersection Summary			
HCM 2000 Control Delay	10.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	37.3	Sum of lost time (s)	17.0
Intersection Capacity Utilization	46.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

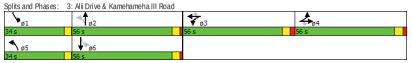
Timings
3: Alii Drive & Kamehameha III Road

4/9/2014

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	31	15	22	92	5	145	86	151
Turn Type	NA	Perm	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	4		3		5	2	1	6
Permitted Phases		4		3	2		6	
Detector Phase	4	4	3	3	5	2	1	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	1.0	5.0	1.0	5.0
Minimum Split (s)	39.2	39.2	39.2	39.2	5.0	21.6	5.0	29.6
Total Split (s)	56.0	56.0	56.0	56.0	34.0	96.0	34.0	56.0
Total Split (%)	27.7%	27.7%	27.7%	27.7%	16.8%	27.7%	16.8%	27.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.7	4.0	3.7	4.0
All-Red Time (s)	2.2	2.2	2.2	2.2	0.3	1.6	0.3	1.6
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.2	6.2	6.2	6.2	4.0	5.6	4.0	5.6
Lead/Lag	Lag	Lag	Lead	Lead	Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 202
Actuated Cycle Length: 57.8
Natural Cycle: 115
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Alii Drive & Kamehameha III Road



HCM Signalized Intersection Capacity Analysis
3: Alii Drive & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	31	15	116	22	92	5	145	86	86	151	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.2	6.2		6.2	6.2	4.0	5.6		4.0	5.6	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00	0.98		1.00	0.97	1.00	0.98		1.00	0.99	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.94		1.00	0.97	
Flt Protected		0.98	1.00		0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1821	1550		1788	1540	1770	1733		1770	1801	
Flt Permitted		0.98	1.00		0.96	1.00	0.63	1.00		0.46	1.00	
Satd. Flow (perm)		1821	1550		1788	1540	1178	1733		849	1801	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	34	16	126	24	100	5	158	93	93	164	36
RTOR Reduction (vph)	0	0	15	0	0	82	0	10	0	0	3	0
Lane Group Flow (vph)	0	63	1	0	150	18	5	241	0	93	197	0
Confl. Peds. (/hhr)			1			8			11			11
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases			4			3	2			6		
Actuated Green, G (s)		5.5	5.5		11.2	11.2	18.7	18.1		26.7	22.1	
Effective Green, g (s)		5.5	5.5		11.2	11.2	18.7	18.1		26.7	22.1	
Actuated g/C Ratio		0.09	0.09		0.18	0.18	0.30	0.29		0.43	0.36	
Clearance Time (s)		6.2	6.2		6.2	6.2	4.0	5.6		4.0	5.6	
Vehicle Extension (s)		1.5	1.5		1.5	1.5	1.0	1.5		1.0	1.5	
Lane Grp Cap (vph)		163	138		326	280	364	510		438	648	
v/s Ratio Prot		c0.03			c0.08		0.00	c0.14		c0.02	0.11	
v/s Ratio Perm			0.00			0.01	0.00			0.08		
v/c Ratio		0.39	0.01		0.46	0.07	0.01	0.47		0.21	0.30	
Uniform Delay, d1		26.4	25.5		22.4	20.8	14.9	17.7		10.6	14.1	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.6	0.0		0.4	0.0	0.0	0.3		0.1	0.1	
Delay (s)		26.9	25.5		22.8	20.8	14.9	18.0		10.7	14.2	
Level of Service		C	C		C	C	B	B		B	B	
Approach Delay (s)		26.6			22.0			17.9			13.1	
Approach LOS		C			C			B			B	

Intersection Summary				
HCM 2000 Control Delay	18.3	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.43			
Actuated Cycle Length (s)	61.4	Sum of lost time (s)	22.0	
Intersection Capacity Utilization	48.6%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

Timings
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	46	155	6	200	145	3	5	153	4
Turn Type	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6	5	2			8		8
Permitted Phases	6		2		2	8		8	
Detector Phase	1	6	5	2	2	8	8	8	8
Switch Phase									
Minimum Initial (s)	1.0	8.0	1.0	8.0	8.0	5.0	5.0	5.0	5.0
Minimum Split (s)	5.0	33.9	5.0	30.6	30.6	35.0	35.0	35.0	35.0
Total Split (s)	34.0	56.0	34.0	56.0	56.0	45.9	45.9	45.9	45.9
Total Split (%)	25.0%	41.2%	25.0%	41.2%	41.2%	33.8%	33.8%	33.8%	33.8%
Yellow Time (s)	3.7	4.0	3.7	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.3	1.9	0.3	1.6	1.6	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	4.0	5.9	4.0	5.6	5.6		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag				
Lead-Lag Optimize?									
Recall Mode	None	Min	None	Min	Min	None	None	None	None

Intersection Summary
Cycle Length: 135.9
Actuated Cycle Length: 39.9
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Private DW/Keauhou SC & Kamehameha III Road

HCM Signalized Intersection Capacity Analysis
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	46	155	1	6	200	145	3	5	6	153	4	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frt	1.00	1.00		1.00	1.00	0.85		0.94			0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99			0.96	
Satd. Flow (prot)	1770	1861		1770	1863	1583		1728			1742	
Flt Permitted	0.54	1.00		0.65	1.00	1.00		0.92			0.76	
Satd. Flow (perm)	1007	1861		1211	1863	1583		1605			1377	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	50	168	1	7	217	158	3	5	7	166	4	39
RTOR Reduction (vph)	0	0	0	0	0	108	0	5	0	0	7	0
Lane Group Flow (vph)	50	169	0	7	217	50	0	10	0	0	202	0
Confl. Peds. (/hhr)												1
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			8			8	
Permitted Phases	6			2		2	8			8		
Actuated Green, G (s)	17.8	15.2		14.1	13.5	13.5		11.0			11.0	
Effective Green, g (s)	17.8	15.2		14.1	13.5	13.5		11.0			11.0	
Actuated g/C Ratio	0.42	0.36		0.33	0.32	0.32		0.26			0.26	
Clearance Time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Vehicle Extension (s)	1.0	1.6		1.0	1.6	1.6		1.6			1.6	
Lane Grp Cap (vph)	466	662		407	589	500		433			354	
v/s Ratio Prot	c0.01	0.09		0.00	c0.12							
v/s Ratio Perm	0.04			0.01		0.03		0.01			c0.15	
v/c Ratio	0.11	0.26		0.02	0.37	0.10		0.02			0.57	
Uniform Delay, d1	7.5	9.7		9.6	11.3	10.3		11.8			13.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Incremental Delay, d2	0.0	0.1		0.0	0.1	0.0		0.0			1.4	
Delay (s)	7.6	9.8		9.6	11.4	10.3		11.8			15.2	
Level of Service	A	A		A	B	B		B			B	
Approach Delay (s)		9.3			11.0			11.8			15.2	
Approach LOS		A			B			B			B	

Intersection Summary				
HCM 2000 Control Delay	11.6	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.43			
Actuated Cycle Length (s)	42.7	Sum of lost time (s)	15.9	
Intersection Capacity Utilization	44.6%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2023 Traffic Operation without Project-Generated Traffic

HCM Unsignalized Intersection Capacity Analysis
1: Alii Drive & Hotel Driveway 4/9/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	5	380	510	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	5	413	554	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	978	554	554			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	978	554	554			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	99			
cM capacity (veh/h)	276	532	1016			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	0	418	554
Volume Left	0	5	0
Volume Right	0	0	0
cSH	1700	1016	1700
Volume to Capacity	0.00	0.01	0.33
Queue Length 95th (ft)	0	0	0
Control Delay (s)	0.0	0.2	0.0
Lane LOS	A	A	
Approach Delay (s)	0.0	0.2	0.0
Approach LOS	A		

Intersection Summary			
Average Delay		0.1	
Intersection Capacity Utilization		30.2%	ICU Level of Service A
Analysis Period (min)		15	

11/12/2013 Baseline
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Synchro 8 Report
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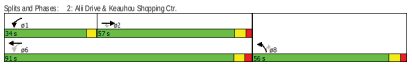
Timings
2: Alii Drive & Keauhou Shopping Ctr. 4/9/2014

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	70	440	40	60	320	40
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Detector Phase	2	2	1	6	8	8
Switch Phase						
Minimum Initial (s)	5.0	5.0	1.0	5.0	5.0	5.0
Minimum Split (s)	39.5	39.5	5.0	44.8	40.5	40.5
Total Split (s)	57.0	57.0	34.0	91.0	56.0	56.0
Total Split (%)	38.8%	38.8%	23.1%	61.9%	38.1%	38.1%
Yellow Time (s)	4.0	4.0	3.7	4.0	4.0	4.0
All-Red Time (s)	2.5	2.5	0.3	2.8	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	Min	Min

Intersection Summary
Cycle Length: 147
Actuated Cycle Length: 38
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Alii Drive & Keauhou Shopping Ctr.



11/12/2013 Baseline
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Synchro 8 Report
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HCM Signalized Intersection Capacity Analysis
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	70	440	40	60	320	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.97	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1541	1770	1863	1770	1545
Flt Permitted	1.00	1.00	0.46	1.00	0.95	1.00
Satd. Flow (perm)	1863	1541	860	1863	1770	1545
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	478	43	65	348	43
RTOR Reduction (vph)	0	384	0	0	0	22
Lane Group Flow (vph)	76	94	43	65	348	21
Confl. Peds. (/hhr)		12				7
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	7.8	7.8	13.3	13.3	12.9	12.9
Effective Green, g (s)	7.8	7.8	13.3	13.3	12.9	12.9
Actuated g/C Ratio	0.20	0.20	0.34	0.34	0.33	0.33
Clearance Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Vehicle Extension (s)	1.6	1.6	1.5	1.6	1.6	1.6
Lane Grp Cap (vph)	367	304	331	627	578	504
v/s Ratio Prot	0.04		0.01	c0.03	c0.20	
v/s Ratio Perm		c0.06	0.04			0.01
v/c Ratio	0.21	0.31	0.13	0.10	0.60	0.04
Uniform Delay, d1	13.3	13.6	9.1	9.0	11.1	9.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.2	0.1	0.0	1.2	0.0
Delay (s)	13.4	13.8	9.2	9.0	12.4	9.1
Level of Service	B	B	A	A	B	A
Approach Delay (s)	13.7			9.1	12.0	
Approach LOS	B			A	B	

Intersection Summary				
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.47			
Actuated Cycle Length (s)	39.5	Sum of lost time (s)	17.0	
Intersection Capacity Utilization	42.6%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

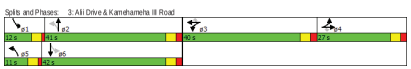
Timings
3: Alii Drive & Kamehameha III Road

4/9/2014

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	125	75	155	140	45	150	105	310
Turn Type	NA	Perm	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	4		3		5	2	1	6
Permitted Phases		4		3	2		6	
Detector Phase	4	4	3	3	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0	27.0	27.0	8.0	29.0	8.0	33.0
Total Split (s)	27.0	27.0	40.0	40.0	11.0	41.0	12.0	42.0
Total Split (%)	22.5%	22.5%	33.3%	33.3%	9.2%	34.2%	10.0%	35.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag	Lag	Lag	Lead	Lead	Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 79.5
Natural Cycle: 95
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Alii Drive & Kamehameha III Road



HCM Signalized Intersection Capacity Analysis
3: Alii Drive & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	75	125	75	125	155	140	45	150	80	105	310	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0	4.0	5.0		4.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00	0.98		1.00	0.97	1.00	0.99		1.00	0.99	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.95		1.00	0.97	
Flt Protected		0.98	1.00		0.98	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1828	1549		1822	1529	1770	1742		1770	1800	
Flt Permitted		0.98	1.00		0.98	1.00	0.30	1.00		0.44	1.00	
Satd. Flow (perm)		1828	1549		1822	1529	556	1742		821	1800	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	136	82	136	168	152	49	163	87	114	337	76
RTOR Reduction (vph)	0	0	67	0	0	116	0	17	0	0	7	0
Lane Group Flow (vph)	0	218	15	0	304	36	49	233	0	114	406	0
Confl. Peds. (/hhr)			1			8			11			11
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases			4			3	2			6		
Actuated Green, G (s)		14.5	14.5		18.9	18.9	25.0	21.9		29.4	24.1	
Effective Green, g (s)		14.5	14.5		18.9	18.9	25.0	21.9		29.4	24.1	
Actuated g/C Ratio		0.18	0.18		0.24	0.24	0.31	0.28		0.37	0.30	
Clearance Time (s)		5.0	5.0		5.0	5.0	4.0	5.0		4.0	5.0	
Vehicle Extension (s)		1.5	1.5		1.5	1.5	1.0	1.5		1.0	1.5	
Lane Grp Cap (vph)		332	282		432	363	221	479		366	544	
v/s Ratio Prot		c0.12			c0.17		0.01	0.13		c0.02	c0.23	
v/s Ratio Perm			0.01			0.02	0.06			0.09		
v/c Ratio		0.66	0.05		0.70	0.10	0.22	0.49		0.31	0.75	
Uniform Delay, d1		30.2	26.9		27.8	23.7	19.8	24.1		17.2	25.0	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		3.5	0.0		4.2	0.0	0.2	0.3		0.2	4.9	
Delay (s)		33.8	26.9		32.0	23.7	20.0	24.4		17.4	29.9	
Level of Service		C	C		C	C	C	C		B	C	
Approach Delay (s)		31.9			29.3			23.7			27.2	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	28.0	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.70			
Actuated Cycle Length (s)	79.6	Sum of lost time (s)	19.0	
Intersection Capacity Utilization	67.5%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group

Timings
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	40	265	25	360	155	10	0	70	0
Turn Type	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6	5	2			8		8
Permitted Phases	6		2		2	8		8	
Detector Phase	1	6	5	2	2	8	8	8	8
Switch Phase									
Minimum Initial (s)	1.0	8.0	1.0	8.0	8.0	5.0	5.0	5.0	5.0
Minimum Split (s)	5.0	33.9	5.0	30.6	30.6	35.0	35.0	35.0	35.0
Total Split (s)	34.0	56.0	34.0	56.0	56.0	46.0	46.0	46.0	46.0
Total Split (%)	25.0%	41.2%	25.0%	41.2%	41.2%	33.8%	33.8%	33.8%	33.8%
Yellow Time (s)	3.7	4.0	3.7	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.3	1.9	0.3	1.6	1.6	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	4.0	5.9	4.0	5.6	5.6		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag				
Lead-Lag Optimize?									
Recall Mode	None	Min	None	Min	Min	None	None	None	None

Intersection Summary
Cycle Length: 136
Actuated Cycle Length: 39.6
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Private DW/Keauhou SC & Kamehameha III Road

HCM Signalized Intersection Capacity Analysis
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	288	5	25	360	155	10	0	15	70	0	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frt	1.00	1.00		1.00	1.00	0.85		0.92			0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.98			0.97	
Satd. Flow (prot)	1770	1858		1770	1863	1583		1680			1700	
Flt Permitted	0.47	1.00		0.58	1.00	1.00		0.81			0.80	
Satd. Flow (perm)	883	1858		1082	1863	1583		1367			1407	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	288	5	27	391	168	11	0	16	76	0	54
RTOR Reduction (vph)	0	1	0	0	0	95	0	22	0	0	45	0
Lane Group Flow (vph)	43	292	0	27	391	73	0	5	0	0	85	0
Confl. Peds. (#/hr)												1
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			8			8	
Permitted Phases	6			2		2	8			8		
Actuated Green, G (s)	19.8	18.3		18.7	17.9	17.9		7.6			7.6	
Effective Green, g (s)	19.8	18.3		18.7	17.9	17.9		7.6			7.6	
Actuated g/C Ratio	0.46	0.43		0.44	0.42	0.42		0.18			0.18	
Clearance Time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Vehicle Extension (s)	1.0	1.6		1.0	1.6	1.6		1.6			1.6	
Lane Grp Cap (vph)	441	798		487	782	665		247			251	
v/s Ratio Prot	c0.00	0.16		0.00	c0.21							
v/s Ratio Perm	0.04			0.02		0.05		0.00			c0.06	
v/c Ratio	0.10	0.37		0.06	0.50	0.11		0.02			0.34	
Uniform Delay, d1	6.3	8.2		6.8	9.1	7.5		14.4			15.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Incremental Delay, d2	0.0	0.1		0.0	0.2	0.0		0.0			0.3	
Delay (s)	6.3	8.3		6.8	9.2	7.5		14.4			15.6	
Level of Service	A	A		A	A	A		B			B	
Approach Delay (s)		8.1			8.6			14.4			15.6	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	9.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	42.6	Sum of lost time (s)	15.9
Intersection Capacity Utilization	46.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
1: Alii Drive & Hotel Driveway

4/9/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	5	5	5	498	590	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	5	5	538	641	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1193	644	647			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1193	644	647			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	99	99			
cM capacity (veh/h)	205	473	939			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	11	543	647
Volume Left	5	5	0
Volume Right	5	0	5
cSH	286	939	1700
Volume to Capacity	0.04	0.01	0.38
Queue Length 95th (ft)	3	0	0
Control Delay (s)	18.1	0.2	0.0
Lane LOS	C	A	
Approach Delay (s)	18.1	0.2	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	41.4%	ICU Level of Service	A
Analysis Period (min)	15		

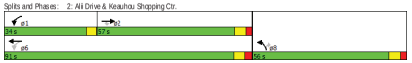
Timings
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	145	446	85	150	345	65
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Detector Phase	2	2	1	6	8	8
Switch Phase						
Minimum Initial (s)	5.0	5.0	1.0	5.0	5.0	5.0
Minimum Split (s)	39.5	39.5	5.0	44.8	40.5	40.5
Total Split (s)	57.0	57.0	34.0	91.0	56.0	56.0
Total Split (%)	38.8%	38.8%	23.1%	61.9%	38.1%	38.1%
Yellow Time (s)	4.0	4.0	3.7	4.0	4.0	4.0
All-Red Time (s)	2.5	2.5	0.3	2.8	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	Min	Min

Intersection Summary
Cycle Length: 147
Actuated Cycle Length: 54.1
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Alii Drive & Keauhou Shopping Ctr.



HCM Signalized Intersection Capacity Analysis
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	145	445	85	150	345	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.97	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1537	1770	1863	1770	1543
Flt Permitted	1.00	1.00	0.51	1.00	0.95	1.00
Satd. Flow (perm)	1863	1537	942	1863	1770	1543
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	158	484	92	163	375	71
RTOR Reduction (vph)	0	295	0	0	0	33
Lane Group Flow (vph)	158	229	92	163	375	38
Confl. Peds. (#/hr)		12				7
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	13.7	13.7	22.4	22.4	17.5	17.5
Effective Green, g (s)	13.7	13.7	22.4	22.4	17.5	17.5
Actuated g/C Ratio	0.26	0.26	0.42	0.42	0.33	0.33
Clearance Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Vehicle Extension (s)	1.6	1.6	1.5	1.6	1.6	1.6
Lane Grp Cap (vph)	479	395	474	784	582	507
v/s Ratio Prot	0.08		0.02	c0.09	c0.21	
v/s Ratio Perm		c0.15	0.06			0.02
v/c Ratio	0.33	0.58	0.19	0.21	0.64	0.08
Uniform Delay, d1	16.0	17.2	9.6	9.8	15.2	12.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	1.4	0.1	0.0	1.8	0.0
Delay (s)	16.2	18.6	9.6	9.8	17.0	12.3
Level of Service	B	B	A	A	B	B
Approach Delay (s)	18.0			9.8	16.3	
Approach LOS	B			A	B	

Intersection Summary				
HCM 2000 Control Delay	15.9	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.57			
Actuated Cycle Length (s)	53.2	Sum of lost time (s)	17.0	
Intersection Capacity Utilization	54.1%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

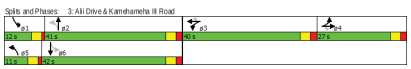
Timings
3: Alii Drive & Kamehameha III Road

4/9/2014

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	135	60	120	145	30	180	145	315
Turn Type	NA	Perm	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	4		3		5	2	1	6
Permitted Phases		4		3	2		6	
Detector Phase	4	4	3	3	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0	27.0	27.0	8.0	29.0	8.0	33.0
Total Split (s)	27.0	27.0	40.0	40.0	11.0	41.0	12.0	42.0
Total Split (%)	22.5%	22.5%	33.3%	33.3%	9.2%	34.2%	10.0%	35.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag	Lag	Lag	Lead	Lead	Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 80
Natural Cycle: 95
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Alii Drive & Kamehameha III Road



HCM Signalized Intersection Capacity Analysis
3: Alii Drive & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	135	60	125	120	145	30	180	55	145	315	75
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0	4.0	5.0		4.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00	0.98		1.00	0.97	1.00	0.99		1.00	0.99	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.95		1.00	0.97	
Flt Protected		0.98	1.00		0.98	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1828	1549		1816	1529	1770	1743		1770	1796	
Flt Permitted		0.98	1.00		0.98	1.00	0.36	1.00		0.35	1.00	
Satd. Flow (perm)		1828	1549		1816	1529	662	1743		643	1796	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	147	65	136	130	158	33	196	103	158	342	82
RTOR Reduction (vph)	0	0	53	0	0	125	0	17	0	0	7	0
Lane Group Flow (vph)	0	239	12	0	266	33	33	282	0	158	417	0
Confl. Peds. (#/hr)			1			8			11			11
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases			4			3	2			6		
Actuated Green, G (s)		15.1	15.1		16.8	16.8	25.2	22.4		33.8	27.0	
Effective Green, g (s)		15.1	15.1		16.8	16.8	25.2	22.4		33.8	27.0	
Actuated g/C Ratio		0.19	0.19		0.21	0.21	0.31	0.28		0.42	0.33	
Clearance Time (s)		5.0	5.0		5.0	5.0	4.0	5.0		4.0	5.0	
Vehicle Extension (s)		1.5	1.5		1.5	1.5	1.0	1.5		1.0	1.5	
Lane Grp Cap (vph)		342	289		378	318	245	483		372	600	
v/s Ratio Prot		c0.13			c0.15		0.00	0.16		c0.04	c0.23	
v/s Ratio Perm			0.01			0.02	0.04			0.14		
v/c Ratio		0.70	0.04		0.70	0.10	0.13	0.58		0.42	0.70	
Uniform Delay, d1		30.7	26.9		29.6	25.9	19.8	25.1		15.8	23.3	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		5.0	0.0		4.8	0.1	0.1	1.2		0.3	2.8	
Delay (s)		35.6	26.9		34.4	25.9	19.8	26.3		16.1	26.1	
Level of Service		D	C		C	C	B	C		B	C	
Approach Delay (s)		33.8			31.3			25.7			23.4	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	27.8	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.70			
Actuated Cycle Length (s)	80.7	Sum of lost time (s)	19.0	
Intersection Capacity Utilization	67.6%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group

Timings
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	55	135	20	335	180	10	30	190	5
Turn Type	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6	5	2			8		8
Permitted Phases	6		2		2	8		8	
Detector Phase	1	6	5	2	2	8	8	8	8
Switch Phase									
Minimum Initial (s)	1.0	8.0	1.0	8.0	8.0	5.0	5.0	5.0	5.0
Minimum Split (s)	5.0	33.9	5.0	30.6	30.6	35.0	35.0	35.0	35.0
Total Split (s)	34.0	56.0	34.0	56.0	56.0	46.0	46.0	46.0	46.0
Total Split (%)	25.0%	41.2%	25.0%	41.2%	41.2%	33.8%	33.8%	33.8%	33.8%
Yellow Time (s)	3.7	4.0	3.7	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.3	1.9	0.3	1.6	1.6	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	4.0	5.9	4.0	5.6	5.6		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag				
Lead-Lag Optimize?									
Recall Mode	None	Min	None	Min	Min	None	None	None	None

Intersection Summary
Cycle Length: 136
Actuated Cycle Length: 51
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Private DW/Keauhou SC & Kamehameha III Road

HCM Signalized Intersection Capacity Analysis
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	315	5	20	335	180	10	10	20	190	5	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frt	1.00	1.00		1.00	1.00	0.85		0.93			0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99			0.96	
Satd. Flow (prot)	1770	1859		1770	1863	1583		1716			1742	
Flt Permitted	0.42	1.00		0.53	1.00	1.00		0.90			0.74	
Satd. Flow (perm)	777	1859		990	1863	1583		1558			1342	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	342	5	22	364	196	11	11	22	207	5	49
RTOR Reduction (vph)	0	1	0	0	0	129	0	15	0	0	6	0
Lane Group Flow (vph)	60	346	0	22	364	67	0	29	0	0	255	0
Confl. Peds. (#/hr)												1
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			8			8	
Permitted Phases	6			2		2	8			8		
Actuated Green, G (s)	21.5	18.8		19.2	17.8	17.8		16.0			16.0	
Effective Green, g (s)	21.5	18.8		19.2	17.8	17.8		16.0			16.0	
Actuated g/C Ratio	0.41	0.36		0.37	0.34	0.34		0.31			0.31	
Clearance Time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Vehicle Extension (s)	1.0	1.6		1.0	1.6	1.6		1.6			1.6	
Lane Grp Cap (vph)	372	670		384	636	540		478			412	
v/s Ratio Prot	c0.01	0.19		0.00	c0.20							
v/s Ratio Perm	0.06			0.02		0.04		0.02			c0.19	
v/c Ratio	0.16	0.52		0.06	0.57	0.12		0.06			0.62	
Uniform Delay, d1	9.5	13.1		10.5	14.0	11.8		12.7			15.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Incremental Delay, d2	0.1	0.3		0.0	0.8	0.0		0.0			1.9	
Delay (s)	9.6	13.4		10.5	14.8	11.8		12.8			17.4	
Level of Service	A	B		B	B	B		B			B	
Approach Delay (s)		12.8			13.6			12.8			17.4	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	52.1	Sum of lost time (s)	15.9
Intersection Capacity Utilization	54.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2023 Traffic Operations with Project-Generated Traffic

HCM Unsignalized Intersection Capacity Analysis
1: Alii Drive & Hotel Driveway

4/9/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	10	15	20	385	515	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	16	22	418	560	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1027	565	571			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1027	565	571			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	97	98			
cM capacity (veh/h)	254	524	1002			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	27	440	571
Volume Left	11	22	0
Volume Right	16	0	11
cSH	368	1002	1700
Volume to Capacity	0.07	0.02	0.34
Queue Length 95th (ft)	6	2	0
Control Delay (s)	15.6	0.7	0.0
Lane LOS	C	A	
Approach Delay (s)	15.6	0.7	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	46.6%	ICU Level of Service	A
Analysis Period (min)	15		

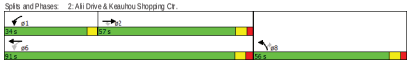
Timings
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	70	460	40	60	340	40
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Detector Phase	2	2	1	6	8	8
Switch Phase						
Minimum Initial (s)	5.0	5.0	1.0	5.0	5.0	5.0
Minimum Split (s)	39.5	39.5	5.0	44.8	40.5	40.5
Total Split (s)	57.0	57.0	34.0	91.0	56.0	56.0
Total Split (%)	38.8%	38.8%	23.1%	61.9%	38.1%	38.1%
Yellow Time (s)	4.0	4.0	3.7	4.0	4.0	4.0
All-Red Time (s)	2.5	2.5	0.3	2.8	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	Min	Min

Intersection Summary
Cycle Length: 147
Actuated Cycle Length: 39.3
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Alii Drive & Keauhou Shopping Ctr.



HCM Signalized Intersection Capacity Analysis
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	70	460	40	60	340	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.97	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1540	1770	1863	1770	1545
Flt Permitted	1.00	1.00	0.47	1.00	0.95	1.00
Satd. Flow (perm)	1863	1540	875	1863	1770	1545
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	500	43	65	370	43
RTOR Reduction (vph)	0	399	0	0	0	20
Lane Group Flow (vph)	76	101	43	65	370	23
Confl. Peds. (/hhr)		12				7
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	8.2	8.2	13.7	13.7	13.7	13.7
Effective Green, g (s)	8.2	8.2	13.7	13.7	13.7	13.7
Actuated g/C Ratio	0.20	0.20	0.34	0.34	0.34	0.34
Clearance Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Vehicle Extension (s)	1.6	1.6	1.5	1.6	1.6	1.6
Lane Grp Cap (vph)	375	310	334	627	595	520
v/s Ratio Prot	0.04		0.01	c0.03	c0.21	
v/s Ratio Perm		c0.07	0.04			0.01
v/c Ratio	0.20	0.32	0.13	0.10	0.62	0.04
Uniform Delay, d1	13.5	13.9	9.4	9.3	11.3	9.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.2	0.1	0.0	1.5	0.0
Delay (s)	13.6	14.1	9.4	9.3	12.8	9.1
Level of Service	B	B	A	A	B	A
Approach Delay (s)	14.0			9.4	12.4	
Approach LOS	B			A	B	

Intersection Summary			
HCM 2000 Control Delay	13.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	40.7	Sum of lost time (s)	17.0
Intersection Capacity Utilization	43.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

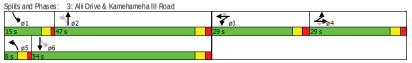
Timings
3: Alii Drive & Kamehameha III Road

4/9/2014

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	125	75	159	360	45	155	125	315
Turn Type	NA	Perm	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	4		3		5	2	1	6
Permitted Phases		4		3	2		6	
Detector Phase	4	4	3	3	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0	27.0	27.0	8.0	29.0	8.0	33.0
Total Split (s)	29.0	29.0	29.0	29.0	8.0	47.0	15.0	54.0
Total Split (%)	24.2%	24.2%	24.2%	24.2%	6.7%	39.2%	12.5%	45.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag	Lag	Lag	Lead	Lead	Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 78.3
Natural Cycle: 95
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Alii Drive & Kamehameha III Road



HCM Signalized Intersection Capacity Analysis
3: Alii Drive & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	75	125	75	125	155	180	45	855	80	125	345	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0	4.0	5.0		4.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00	0.98		1.00	0.97	1.00	0.99		1.00	0.99	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.95		1.00	0.97	
Flt Protected		0.98	1.00		0.98	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1828	1549		1822	1529	1770	1745		1770	1800	
Flt Permitted		0.98	1.00		0.98	1.00	0.38	1.00		0.38	1.00	
Satd. Flow (perm)		1828	1549		1822	1529	702	1745		706	1800	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	136	82	136	168	174	49	168	87	136	342	76
RTOR Reduction (vph)	0	0	67	0	0	134	0	18	0	0	7	0
Lane Group Flow (vph)	0	218	15	0	304	40	49	237	0	136	411	0
Confl. Peds. (/hhr)			1			8			11			11
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases			4			3	2			6		
Actuated Green, G (s)		14.1	14.1		18.3	18.3	21.9	19.8		31.7	25.6	
Effective Green, g (s)		14.1	14.1		18.3	18.3	21.9	19.8		31.7	25.6	
Actuated g/C Ratio		0.18	0.18		0.23	0.23	0.28	0.25		0.40	0.32	
Clearance Time (s)		5.0	5.0		5.0	5.0	4.0	5.0		4.0	5.0	
Vehicle Extension (s)		1.5	1.5		1.5	1.5	1.0	1.5		1.0	1.5	
Lane Grp Cap (vph)		325	276		421	353	222	436		389	582	
v/s Ratio Prot		c0.12			c0.17		0.01	0.14		c0.03	c0.23	
v/s Ratio Perm			0.01			0.03	0.06			0.11		
v/c Ratio		0.67	0.05		0.72	0.11	0.22	0.54		0.35	0.71	
Uniform Delay, d1		30.3	27.0		28.1	24.0	21.5	25.7		15.9	23.4	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		4.2	0.0		5.1	0.1	0.2	0.7		0.2	3.2	
Delay (s)		34.6	27.0		33.2	24.1	21.6	26.5		16.1	26.6	
Level of Service		C	C		C	C	C	C		B	C	
Approach Delay (s)		32.5			29.9			25.7			24.1	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	27.6	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.70			
Actuated Cycle Length (s)	79.1	Sum of lost time (s)	19.0	
Intersection Capacity Utilization	67.7%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group

Timings
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	40	285	25	380	155	10	0	70	0
Turn Type	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6	5	2			8		8
Permitted Phases	6		2		2	8		8	
Detector Phase	1	6	5	2	2	8	8	8	8
Switch Phase									
Minimum Initial (s)	1.0	8.0	1.0	8.0	8.0	5.0	5.0	5.0	5.0
Minimum Split (s)	5.0	33.9	5.0	30.6	30.6	35.0	35.0	35.0	35.0
Total Split (s)	34.0	56.0	34.0	56.0	56.0	46.0	46.0	46.0	46.0
Total Split (%)	25.0%	41.2%	25.0%	41.2%	41.2%	33.8%	33.8%	33.8%	33.8%
Yellow Time (s)	3.7	4.0	3.7	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.3	1.9	0.3	1.6	1.6	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	4.0	5.9	4.0	5.6	5.6		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag				
Lead-Lag Optimize?									
Recall Mode	None	Min	None	Min	Min	None	None	None	None

Intersection Summary
Cycle Length: 136
Actuated Cycle Length: 40.3
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Private DW/Keauhou SC & Kamehameha III Road

HCM Signalized Intersection Capacity Analysis
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	285	5	25	380	155	10	0	15	70	0	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frt	1.00	1.00		1.00	1.00	0.85		0.92			0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.98			0.97	
Satd. Flow (prot)	1770	1858		1770	1863	1583		1680			1700	
Flt Permitted	0.47	1.00		0.57	1.00	1.00		0.81			0.80	
Satd. Flow (perm)	875	1858		1054	1863	1583		1390			1407	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	310	5	27	413	168	11	0	16	76	0	54
RTOR Reduction (vph)	0	1	0	0	0	90	0	22	0	0	45	0
Lane Group Flow (vph)	43	314	0	27	413	78	0	5	0	0	85	0
Confl. Peds. (/hhr)												1
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			8			8	
Permitted Phases	6			2		2	8			8		
Actuated Green, G (s)	18.9	17.4		19.4	17.8	17.8		7.7			7.7	
Effective Green, g (s)	18.9	17.4		19.4	17.8	17.8		7.7			7.7	
Actuated g/C Ratio	0.44	0.41		0.46	0.42	0.42		0.18			0.18	
Clearance Time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Vehicle Extension (s)	1.0	1.6		1.0	1.6	1.6		1.6			1.6	
Lane Grp Cap (vph)	419	758		506	778	661		251			254	
v/s Ratio Prot	c0.00	0.17		0.00	c0.22							
v/s Ratio Perm	0.04			0.02		0.05		0.00			c0.06	
v/c Ratio	0.10	0.41		0.05	0.53	0.12		0.02			0.33	
Uniform Delay, d1	6.8	9.0		6.4	9.3	7.6		14.3			15.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Incremental Delay, d2	0.0	0.1		0.0	0.4	0.0		0.0			0.3	
Delay (s)	6.8	9.1		6.4	9.6	7.6		14.4			15.5	
Level of Service	A	A		A	A	A		B			B	
Approach Delay (s)		8.8			8.9			14.4			15.5	
Approach LOS		A			A			B			B	

Intersection Summary				
HCM 2000 Control Delay	9.8	HCM 2000 Level of Service	A	
HCM 2000 Volume to Capacity ratio	0.46			
Actuated Cycle Length (s)	42.6	Sum of lost time (s)	15.9	
Intersection Capacity Utilization	47.4%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Alii Drive

4/9/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	5	10	10	400	530	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	11	11	435	576	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None	None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1035	579	582			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1035	579	582			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	98	99			
cM capacity (veh/h)	254	515	993			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	16	446	582
Volume Left	5	11	0
Volume Right	11	0	5
cSH	384	993	1700
Volume to Capacity	0.04	0.01	0.34
Queue Length 95th (ft)	3	1	0
Control Delay (s)	14.8	0.3	0.0
Lane LOS	B	A	
Approach Delay (s)	14.8	0.3	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	39.1%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Alii Drive & Hotel Driveway

4/9/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	25	35	35	500	595	25
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	38	38	543	647	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1280	660	674			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1280	660	674			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	85	92	96			
cM capacity (veh/h)	175	463	917			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	65	582	674
Volume Left	27	38	0
Volume Right	38	0	27
cSH	275	917	1700
Volume to Capacity	0.24	0.04	0.40
Queue Length 95th (ft)	23	3	0
Control Delay (s)	22.1	1.1	0.0
Lane LOS	C	A	
Approach Delay (s)	22.1	1.1	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	65.3%	ICU Level of Service	C
Analysis Period (min)	15		

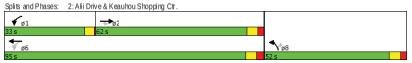
Timings
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	145	465	85	150	380	65
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Detector Phase	2	2	1	6	8	8
Switch Phase						
Minimum Initial (s)	5.0	5.0	1.0	5.0	5.0	5.0
Minimum Split (s)	39.5	39.5	5.0	44.8	40.5	40.5
Total Split (s)	62.0	62.0	33.0	95.0	52.0	52.0
Total Split (%)	42.2%	42.2%	22.4%	64.6%	35.4%	35.4%
Yellow Time (s)	4.0	4.0	3.7	4.0	4.0	4.0
All-Red Time (s)	2.5	2.5	0.3	2.8	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	Min	Min

Intersection Summary
Cycle Length: 147
Actuated Cycle Length: 57
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Alii Drive & Keauhou Shopping Ctr.



HCM Signalized Intersection Capacity Analysis
2: Alii Drive & Keauhou Shopping Ctr.

4/9/2014

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	145	465	85	150	380	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.97	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1536	1770	1863	1770	1543
Flt Permitted	1.00	1.00	0.51	1.00	0.95	1.00
Satd. Flow (perm)	1863	1536	999	1863	1770	1543
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	158	527	92	163	413	71
RTOR Reduction (vph)	0	292	0	0	0	28
Lane Group Flow (vph)	158	235	92	163	413	43
Confl. Peds. (/hhr)		12				7
Turn Type	NA	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	14.5	14.5	23.5	23.5	19.2	19.2
Effective Green, g (s)	14.5	14.5	23.5	23.5	19.2	19.2
Actuated g/C Ratio	0.26	0.26	0.42	0.42	0.34	0.34
Clearance Time (s)	6.5	6.5	4.0	6.8	6.5	6.5
Vehicle Extension (s)	1.6	1.6	1.5	1.6	1.6	1.6
Lane Grp Cap (vph)	482	397	477	781	606	529
v/s Ratio Prot	0.08		0.02	c0.09	c0.23	
v/s Ratio Perm		c0.15	0.06			0.03
v/c Ratio	0.33	0.59	0.19	0.21	0.68	0.08
Uniform Delay, d1	16.8	18.2	10.1	10.3	15.8	12.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	1.6	0.1	0.0	2.5	0.0
Delay (s)	16.9	19.7	10.2	10.4	18.3	12.5
Level of Service	B	B	B	B	B	B
Approach Delay (s)	19.1			10.3	17.4	
Approach LOS	B			B	B	

Intersection Summary			
HCM 2000 Control Delay	17.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	56.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	55.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

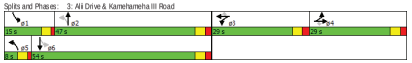
Timings
3: Alii Drive & Kamehameha III Road

4/9/2014

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	135	60	120	175	30	190	175	325
Turn Type	NA	Perm	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	4		3		5	2	1	6
Permitted Phases		4		3	2		6	
Detector Phase	4	4	3	3	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	27.0	27.0	27.0	27.0	8.0	29.0	8.0	33.0
Total Split (s)	29.0	29.0	29.0	29.0	8.0	47.0	15.0	54.0
Total Split (%)	24.2%	24.2%	24.2%	24.2%	6.7%	39.2%	12.5%	45.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag	Lag	Lag	Lead	Lead	Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Min	None	Min

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 79.6
Natural Cycle: 95
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Alii Drive & Kamehameha III Road



HCM Signalized Intersection Capacity Analysis
3: Alii Drive & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	85	135	60	125	120	175	30	190	95	175	325	75
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0	4.0	5.0		4.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00	0.98		1.00	0.97	1.00	0.99		1.00	0.99	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	0.95		1.00	0.97	
Flt Protected		0.98	1.00		0.98	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1828	1549		1816	1529	1770	1748		1770	1798	
Flt Permitted		0.98	1.00		0.98	1.00	0.39	1.00		0.31	1.00	
Satd. Flow (perm)		1828	1549		1816	1529	736	1748		580	1798	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	147	65	136	130	190	33	207	103	190	353	82
RTOR Reduction (vph)	0	0	53	0	0	152	0	17	0	0	8	0
Lane Group Flow (vph)	0	239	12	0	266	38	33	293	0	190	427	0
Confl. Peds. (/hhr)			1			8			11			11
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	4	4		3	3		5	2		1	6	
Permitted Phases			4			3	2			6		
Actuated Green, G (s)		15.1	15.1		16.3	16.3	23.1	21.0		34.1	28.0	
Effective Green, g (s)		15.1	15.1		16.3	16.3	23.1	21.0		34.1	28.0	
Actuated g/C Ratio		0.19	0.19		0.20	0.20	0.29	0.26		0.42	0.35	
Clearance Time (s)		5.0	5.0		5.0	5.0	4.0	5.0		4.0	5.0	
Vehicle Extension (s)		1.5	1.5		1.5	1.5	1.0	1.5		1.0	1.5	
Lane Grp Cap (vph)		342	290		367	309	238	456		380	625	
v/s Ratio Prot		c0.13			c0.15		0.00	0.17		c0.06	c0.24	
v/s Ratio Perm			0.01			0.02	0.04			0.16		
v/c Ratio		0.70	0.04		0.72	0.12	0.14	0.64		0.50	0.68	
Uniform Delay, d1		30.6	26.8		30.0	26.3	21.0	26.4		16.0	22.5	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		5.0	0.0		5.9	0.1	0.1	2.3		0.4	2.5	
Delay (s)		35.5	26.8		35.9	26.3	21.1	28.7		16.3	24.9	
Level of Service		D	C		D	C	C	C		B	C	
Approach Delay (s)		33.7			31.9			28.0			22.3	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	28.0	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.70			
Actuated Cycle Length (s)	80.5	Sum of lost time (s)	19.0	
Intersection Capacity Utilization	69.3%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group

Timings
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	55	345	20	365	180	10	10	190	5
Turn Type	pm+pt	NA	pm+pt	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6	5	2			8		8
Permitted Phases	6		2		2	8		8	
Detector Phase	1	6	5	2	2	8	8	8	8
Switch Phase									
Minimum Initial (s)	1.0	8.0	1.0	8.0	8.0	5.0	5.0	5.0	5.0
Minimum Split (s)	5.0	33.9	5.0	30.6	30.6	35.0	35.0	35.0	35.0
Total Split (s)	34.0	56.0	34.0	56.0	56.0	46.0	46.0	46.0	46.0
Total Split (%)	25.0%	41.2%	25.0%	41.2%	41.2%	33.8%	33.8%	33.8%	33.8%
Yellow Time (s)	3.7	4.0	3.7	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.3	1.9	0.3	1.6	1.6	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	4.0	5.9	4.0	5.6	5.6		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag				
Lead-Lag Optimize?									
Recall Mode	None	Min	None	Min	Min	None	None	None	None

Intersection Summary
Cycle Length: 136
Actuated Cycle Length: 53.1
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: Private DW/Keauhou SC & Kamehameha III Road

HCM Signalized Intersection Capacity Analysis
4: Private DW/Keauhou SC & Kamehameha III Road

4/9/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	345	5	20	365	180	10	10	20	190	5	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Frt	1.00	1.00		1.00	1.00	0.85		0.93			0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99			0.96	
Satd. Flow (prot)	1770	1859		1770	1863	1583		1716			1742	
Flt Permitted	0.38	1.00		0.48	1.00	1.00		0.90			0.74	
Satd. Flow (perm)	715	1859		894	1863	1583		1541			1341	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	375	5	22	397	196	11	11	22	207	5	49
RTOR Reduction (vph)	0	1	0	0	0	121	0	15	0	0	6	0
Lane Group Flow (vph)	60	379	0	22	397	75	0	29	0	0	255	0
Confl. Peds. (/hhr)												1
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6		5	2			8			8	
Permitted Phases	6			2		2	8			8		
Actuated Green, G (s)	22.9	20.2		20.8	19.3	19.3		16.7			16.7	
Effective Green, g (s)	22.9	20.2		20.8	19.3	19.3		16.7			16.7	
Actuated g/C Ratio	0.42	0.37		0.38	0.36	0.36		0.31			0.31	
Clearance Time (s)	4.0	5.9		4.0	5.6	5.6		6.0			6.0	
Vehicle Extension (s)	1.0	1.6		1.0	1.6	1.6		1.6			1.6	
Lane Grp Cap (vph)	353	691		346	662	562		480			412	
v/s Ratio Prot	c0.01	0.20		0.00	c0.21							
v/s Ratio Perm	0.06			0.02		0.05		0.02			c0.19	
v/c Ratio	0.17	0.55		0.06	0.60	0.13		0.06			0.62	
Uniform Delay, d1	9.7	13.5		10.5	14.3	11.8		13.3			16.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Incremental Delay, d2	0.1	0.5		0.0	1.0	0.0		0.0			1.9	
Delay (s)	9.8	13.9		10.5	15.3	11.9		13.3			18.0	
Level of Service	A	B		B	B	B		B			B	
Approach Delay (s)		13.4			14.1			13.3			18.0	
Approach LOS		B			B			B			B	

Intersection Summary				
HCM 2000 Control Delay	14.6	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.58			
Actuated Cycle Length (s)	54.3	Sum of lost time (s)	15.9	
Intersection Capacity Utilization	55.9%	ICU Level of Service	B	
Analysis Period (min)	15			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
6: Alii Drive

4/9/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	5	10	10	530	625	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	11	11	576	679	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None	None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1280	682	685			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1280	682	685			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	98	99			
cM capacity (veh/h)	181	450	909			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	16	587	685
Volume Left	5	11	0
Volume Right	11	0	5
cSH	301	909	1700
Volume to Capacity	0.05	0.01	0.40
Queue Length 95th (ft)	4	1	0
Control Delay (s)	17.7	0.3	0.0
Lane LOS	C	A	
Approach Delay (s)	17.7	0.3	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	45.9%	ICU Level of Service	A
Analysis Period (min)	15		