William P. Kenoi
Mayor

Duane Kanuha
Director

Joaquin Gamiao-Kunkel
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
PLANNING DEPARTMENT

East Hawai'i Office
101 Pauahi Street, Suite 3
Hilo, Hawai'i 96720
Phone (808) 961-8288
Fax (808) 961-8742

July 27, 2016

Scott Glenn, Director
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, Hawai'i 96813

Dear Mr. Glenn:

SUBJECT: Draft Environmental Assessment (DEA)
Applicant: BioEnergy Hawaii, LLC
Request: Construct and Operate an Integrated Resource Recovery Facility (Waste to Energy Facility)
TMK: (3) 6-8-001: Portion of 066 Waikoloa, South Kohala, Hawai'i

The Hawai'i County Planning Department has reviewed the draft environmental assessment for the subject project and anticipates a Finding of No Significant Impact (FONSI) determination. Please publish notice of availability for this project in the August 23, 2016, OEQC Environmental Notice.

We have enclosed a completed OEQC Publication Form, one copy of the draft EA, and a copy of the draft EA and the project summary hardcopy on disk. If you have any questions, please feel free to contact Jeff Darrow at 961-8158.

Sincerely,

DUANE KANUHA
Planning Director

JWD:mad
P:\wpwin60\CH343\2016\LRobichaux-AntFonsiDEA.doc

Enclosures: Draft EA (1 copy)
Completed OEQC Publication Form
Draft EA and Project Summary (on disk)

cc ltr. only: Clint Knox, BioEnergy Hawaii, LLC
David Robichaux, North Shore Consultants

17-047

APPLICANT PUBLICATION FORM

Project Name:	Draft Environmental Assessment Hawaii Integrated Resource Recovery Facility, Waikoloa, South Kohala, Hawaii
Project Short Name:	DEA Hawaii Integrated Resource Recovery Facility
HRS §343-5 Trigger(s):	Waste-to-Energy
Island(s):	Hawaii
Judicial District(s):	South Kohala
TMK(s):	(3) 6-8-001:066
Permit(s)/Approval(s):	Special Permit, Subdivision, Solid Waste Management, Clean Air, building and grading
Approving Agency:	Planning Department, County of Hawaii
Contact Name, Email, Telephone, Address	Jeff Darrow Darrow, Jeff.Darrow@hawaiicounty.gov (808) 961-8288 Aupuni Center, 101 Pauahi Street, Suite 3, Hilo, HI 96720
Applicant:	BioEnergy Hawaii
Contact Name, Email, Telephone, Address	Clint Knox, Leed AP, Vice President, BioEnergy Hawaii Clint@komarinvestments.com 74-5610 Alapa Street, Kailua Kona, HI 96740 : (949) 903-4769
Consultant:	North Shore Consultants, LLC.
Contact Name, Email, Telephone, Address	David Robichaux, North Shore Consultants robichaud001@hawaii.rr.com (808) 368-5352 2091 Round Top Dr. Honolulu, HI 96822

Status (select one)	**Submittal Requirements**
__X__ DEA-AFNSI	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
____ FEA-FONSI	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the approving agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the approving agency, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the approving agency, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The approving agency simultaneously transmits to both the OEQC and the applicant a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
____ FEIS Statutory Acceptance	The approving agency simultaneously transmits to both the OEQC and the applicant a notice that it did not make a timely determination on the acceptance or nonacceptance of the applicant's FEIS under Section 343-5(c), HRS, and therefore the applicant's FEIS is deemed accepted as a matter of law.
____ Supplemental EIS 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 or is not required; no EA is required and no comment period ensues upon publication in the Notice.

____ Withdrawal	Identify the specific document(s) to withdraw and explain in the project summary section.
____ Other	Contact the OEQC if your action is not one of the above items.

Project Summary
Provide a description of the proposed action and purpose and need in 200 words or less.

BioEnergy Hawai`i, LLC (BEH) intends to lease 14.99 acres of land on the property now known as the West Hawaii Concrete Quarry to construct and operate an integrated resource recovery facility to divert municipal solid waste (MSW) from the County's Landfills. Recyclable materials will be recovered and collected for offsite sales. Organic materials will be further separated into those which can be digested in an anaerobic digester, and those that can be used for thermal conversion using a gasifier or pyrolysis unit. Waste digested in the AD system will produce renewable natural gas. Waste disposed in the thermal conversion unit will be used to produce electricity. The renewable natural gas will be used to power the waste collection fleet and also sold to offsite consumers to displace fossil fuels. The facility will provide a substantial reduction in greenhouse gas emission over the existing solid waste disposal system. Permits required include County Special Permit, Solid waste management permit, and subdivision.

Draft Environmental Assessment
Hawai`i Integrated Resource Recovery Facility
Waikoloa, South Kohala, Hawai`i

The County of Hawai`i Department of Planning

Applicant:

BioEnergy Hawaii, LLC

July 27, 2016

Draft Environmental Assessment
Hawai`i Integrated Resource Recovery Facility
Waikoloa, South Kohala, Hawai`i

Prepared for The County of Hawai`i
Department of Planning

Applicant:

BioEnergy Hawaii, LLC

Prepared by

NORTH SHORE CONSULTANTS, LLC
2333 Kapiolani Blvd. Suite 2111
Honolulu, HI 96826

July 27, 2016

Project Summary
This Environmental Assessment has been prepared in accordance with Chapter 343, Hawai`i Revised Statutes (HRS), for the BioEnergy Hawai`i Resource Recovery Facility proposed for South Kohala District, Island of Hawai`i.

Name: BioEnergy Hawai`i Resource Recovery Facility

Location: 68-1244 Waikoloa Road, Waikoloa, South Kohala District, Island of Hawai`i

Judicial District: South Kohala

Applicant: BioEnergy Hawai`i, LLC

Approving Agency: County of Hawai`i, Department of Planning

Recorded Fee Owner: WQJ2008 Investment, LLC, A Washington Limited Liability Company and Ukumehame Quarry Company Limited Partnership, a Hawaii Limited Partnership.

Tax Map Keys: TMK (3) 6-8-001:066 por.

Land Area: 14.99 acres

Existing Use: Rock Quarrying, greenwaste recycling, aggregate recycling

Proposed Use: Construction of a resource recovery and energy conversion facility designed to use anaerobic digestion and thermal conversion technologies to divert up to 70% of the incoming municipal solid waste (MSW) from West Hawai`i's landfill, with the resultant production of electrical power, and advanced biofuels in response to public policy which encourages bioconversion of waste and the domestic production of renewable energy.

Land Use Designations:
State Land Use: Agriculture District
General Plan: Agriculture Designation
County Zoning: Agriculture-5 acres (A-5a)
Special Management Area (SMA): Not within the SMA

Major Approvals Required:
County Special Use Permit
Solid Waste Management Permit
Clean Air Permit
NPDES Permits
Grading/Building Permits

TABLE OF CONTENTS

Appendices:

A. Comments Received prior to Publication
B. Flora and Fauna Survey
C. Archeological Assessment Survey
D. *Ka Pa`Akai* Discussion (Cultural Impacts)

List of Figures

List of Tables

EXECUTIVE SUMMARY

BioEnergy Hawai`i, LLC (BEH) intends to lease 14.99 acres of land on a portion of the property now known as the West Hawaii Concrete Quarry to construct and operate an integrated resource recovery facility to divert municipal solid waste (MSW) from the West Hawaii Sanitary Landfill (WHSL) and elsewhere. The project will substantially increase the landfill diversion and recycling rate as well as reduce the environmental impacts associated with conventional landfill disposal operations. It will be operated on approximately 200 tons of incoming MSW per day which is collected by local waste haulers, along with a variety of other waste materials. The facility design will allow for expanded capacity of over 400 tons per day (TPD) of MSW should the need arise. Of this volume approximately 70% will be suitable for energy conversion operations and the remaining 30% consisting of inert waste material will be disposed at the WHSL. In addition to the environmental benefits, the facility will generate a number of energy products, including engineered fuel, baseload electric power, renewable natural gas (RNG), and other advanced biofuels. The operations may also provide value-added products to support the local landscape and agricultural industry, such as soil amendment and natural fertilizer. The energy can be used for fleet fuel including the Pacific Waste Collection fleet, and can be sold to local users on the Big Island.

The site entrance will be located 2.7 miles east of the intersection of Queen Kaahumanu Highway and Waikoloa Road. The facility will be located approximately 1-mile south, of Waikoloa Road site entrance and accessed by a dedicated roadway and utility easement. Its location is 3 miles overland to the nearest development in Waikoloa Village, 3 miles from the WHSL, and 4 miles from the Waikoloa Beach Hotels.

Operations at the proposed facility will include:

- Delivery of waste and other organic materials in commercial collection trucks
- Mechanical and manual material sorting and separation,
- Recovery of recyclable materials
- Anaerobic digestion of the wet organic fraction of the waste,
- Thermal conversion of the dry fraction,
- Production and refining of renewable natural gas (RNG), which is primarily methane,
- Production of steam for generating electrical power,
- Composting the stabilized organic fraction leaving the anaerobic digester,
- Hauling residual inert waste material to WHSL.

The existing access road will be utilized from Waikoloa Road to the south approximately 4000 feet ending at the quarry gate, a new dedicated internal access road (approximately 2500 feet) will be constructed within the quarry, ending on the subject property. Approximately 5 acres of

the parcel will be used for material processing and energy production, the remaining 10 acres will be utilized for final processing of the treated organic materials to produce nutrient-rich soil amendment products (compost).

Incoming waste will be initially delivered by private haulers to a tipping floor located inside a negative pressure warehouse to control fugitive dust and odors. Bulky wastes and inorganic materials will be separated from the organic fraction using a state-of-the-art materials recovery facility. Recyclable materials will be recovered and collected for offsite sales. Organic materials will be further separated into those which can be digested in an anaerobic digester, and those that can be used for thermal conversion using a gasifier or pyrolysis unit. Waste digested in the AD system will produce renewable natural gas. Waste disposed in the thermal conversion unit will be used to produce electricity. Approximately 30% of incoming waste will be disposed in the landfill, almost all of which is expected to be inert.

The site is located in the Agriculture District and will require modification to the existing Special Permit that was obtained for the existing quarry operations. Other major permits include Solid Waste Management Permit, Clean Air Act Permit, and an NPDES Stormwater Permit for construction.

The applicant anticipates the proposed action to have impacts associated with construction and operation, the principal among these will be a slight increase in traffic along Waikoloa Road. All of the impacts identified with the proposed action are anticipated to be temporary and insignificant. Pending receipt of comments from agencies and interested parties, the applicant and approving agency anticipate a finding of no significant impact (FONSI) for the proposed action.

1. INTRODUCTION

1.1 ENVIRONMENTAL ASESSMENT PROCESS DESCRIPTION

Adopted in 1974 and patterned after the National Environmental Policy Act (NEPA) requirements, Hawai`i's environmental impact statement law, The Hawaii Environmental Protection Act (HEPA) requires the preparation of Environmental Assessments and Environmental Impact Statements for many development projects. The law is codified as in the Hawaii Revised Statutes (HRS) Chapter 343, which requires that government give systematic consideration to the environmental, social and economic consequences of proposed development projects prior to allowing construction to begin. The law also assures the public the right to participate in planning projects that may affect their community. The Office of Environmental Quality Control implements this law in Hawai`i.

An Environmental Assessment (EA) or Environmental Impact Statement (EIS) is an informational document prepared by the proposing agency or the private applicant and used to evaluate the possible environmental effects of a proposed action. An EA must give a detailed description of the proposed action or project and evaluate direct, indirect and cumulative impacts. The document must consider alternatives to the proposed project and describe any measures proposed to minimize potential impacts. An EA assesses the proposed project through research, discussion and review. It must, at a minimum, identify environmental concerns, obtain various relevant data, conduct necessary studies, receive public input, evaluate alternatives, and propose measures for minimizing adverse impacts. It is initially published as a Draft Environmental Assessment (DEA), and subjected to a 30-day review by the public and government agencies. After public comments are responded to, the draft is revised and submitted as the final EA (FEA). During the preparation of an EA, if significant environmental impacts are discovered or identified, the EA becomes and EIS Preparation Notice and the document is expanded into an EIS.

For agency actions, the accepting authority is the Governor or Mayor, who must determine the acceptability of a FEA or FEIS. For private applicant actions, the approving agency determines the acceptability of a FEA/FEIS. After environmental documents are accepted, the action may be implemented. The publication in *The Environmental Notice* of an acceptance or non-acceptance determination by either the accepting authority or the approving agency initiates a 60-day legal challenge period.

1.2 EIS TRIGGERS AND CONTROLLING REGULATIONS

The proposed project is subject to an environmental review under the terms of HRS Chapter 343, which is commonly referred to as The Hawai`i Environmental Policy Act (HEPA). HEPA compliance is required if one or more of the triggers specified in HRS 343-5 is in place. The OEQC guidance Manual lists these triggers as follows.

1. *Use of State or County lands or use of State or County funds, other than funds to be used for feasibility or planning studies for possible future programs or projects that the agency has not approved, adopted, or funded, or funds to be used for the acquisition of unimproved real property; provided that the agency shall consider environmental factors and available alternatives in its feasibility or planning studies; provided further that an EA for proposed uses under Section 205-2(d)(11) or 205-4.5(a)(13) shall only be required pursuant to Section 205-5(b).*

2. *Use of any land classified as conservation district by the state land use commission under chapter 205.*

3. *Use within a shoreline area as defined in Section 205A-41.*

4. *Use within any historic site as designated in the National Register or Hawaii Register, as provided for in the Historic Preservation Act of 1966, Public Law 89-665, or Chapter 6E.*

5. *Use within the Waikiki area of Oahu, the boundaries of which are delineated in the land use ordinance as amended, establishing the "Waikiki Special District".*

6. *Any amendments to existing county general plans where the amendment would result in designations other than agriculture, conservation or preservation, except actions proposing any new county general plan or amendments to any existing county general plan initiated by a county.*

7. *Any reclassification of any land classified as a conservation district by the state land use commission under Chapter 205.*

8. *Any construction of new or the expansion or modification of existing helicopter facilities within the State that may affect*:

A. Any land classified as a conservation district by the state land use commission
B. A shoreline area

C. Any historic site as designated in the National Register or Hawaii Register

9. *Propose any:*

A. Wastewater treatment unit, except an individual wastewater system or a wastewater treatment unit serving fewer than fifty single family dwellings or the equivalent
B. Waste-to-energy facility
C. Landfill
D. Oil refinery
E. Power-generating facility

Criteria No. 9 contains the primary trigger for HEPA. The proposed action is primarily waste conversion but is considered a waste-to-energy facility under the law. Municipal solid waste (MSW) will be diverted from the landfill to produce valuable products including electric power and renewable natural gas (RNG). This assessment is intended to satisfy the HEPA requirement for construction and operation of a waste-to-energy facility. Waste will not be buried or otherwise disposed on the property; therefore, the proposed action is not considered a landfill. Organic waste including cooking oil may be converted into non-liquid fuels as part of the process. The language of HRS 343 relating to oil refinery is not specific to refining petroleum oils, although that was likely to be its intended focus; however, as the law now stands, bioconversion of cooking oils or other fats could be considered an oil refinery. This assessment is intended to satisfy the HEPA requirement for construction and operation of an oil refinery. Power-generating facility as defined in HRS 343 does not apply to the proposed BEH facility as the definition of "power-generating facility" is limited to:

(1) A new, fossil-fueled, electricity-generating facility, where the electrical output rating of the new equipment exceeds 5.0 megawatts; or
(2) An expansion in generating capacity of an existing, fossil-fueled, electricity-generating facility, where the incremental electrical output rating of the new equipment exceeds 5.0 megawatts.

With the possible exception of the initial and any subsequent cold starts, fossil fuels will not be used to generate power; therefore, the proposed action is not considered a power generating facility under HEPA.

The use of a Special Purpose Revenue Bond (SPRB) authorized by the State Legislature may be considered Use of Public Funds, HRS 343-5 (1) requires environmental assessment for the use of public lands and funds. This assessment is intended to satisfy the HEPA requirement for the use of public funds.

HEPA requires the applicant to prepare an Environmental Assessment if there are no anticipated environmental impacts that are considered significant to the environment or quality of life in

Hawaii. An Environmental Impact Statement is prepared if the anticipated impacts are significant or cannot be accurately determined. At this time the applicant and approving agency have not identified significant impacts associated with the proposed action. Pending further analysis and consideration of input from agencies and interested parties, the Approving Agency anticipates a finding of no significant impact (FONSI).

The subject property is also controlled by land use restrictions and ordinances at the State and County level. The site of the proposed facility is within the State Land Use Agriculture District and the County agriculture zone. Quarry activities, the current use, and all waste management activities proposed herein are not permissible uses in the State Agriculture District, but under State Law Ch. 205 of the Hawaii Revises Statutes, land uses that are "unusual and reasonable" are allowed under a Special Use Permit issued by the State Land Use Commission, or a Special Permit from the County Planning Commission for uses that are less than 15 acres. Quarry operations have been permitted under a Special Use Permit since 1992. Special Use Permit SP92-381is issued to WHC, Ltd. by the Land Use Commission for 219.99 acres of the same property. This Special Use Permit was amended in February 2016 to allow for (1) an extension of quarry activities until at least 2043, (2) allow greenwaste composting activities within the 219.99-acre parcel, and (3) allow recycling operations for concrete and asphalt within the 219.99 acres. The amendment to SP92-381 did not authorize the integrated resource recovery facility proposed herein, and authorization for unusual and reasonable uses remains a requirement for the proposed action. The landowner and lessee have made a business decision to subdivide the parcel to separate 14.99 acres of the property proposed for use by integrated resource recovery facility. The new parcel will be withdrawn from the 219.99 acres and the landowner will amend the State Special Use Permit to reflect withdrawal of the new parcel. At that time the applicant intends to apply for a Special Permit from the County of Hawaii to authorize use of agricultural land for the proposed Integrated Resource Recovery Facility.

1.3 APPLICANT AND APPROVING AGENCY

BioEnergy Hawai`i, LLC (BEH) intends to develop a resource recovery and energy conversion facility that is subject to HEPA and will prepare the required environmental documents through its consultant North Shore Consultants, LLC (NSC). Use of the term applicant will apply to BEH.

BEH was formed in March of 2006. The purpose and mission of the company is to establish a waste conversion plant on the Island of Hawai`i to produce alternative energy from a sustainable renewable energy source (trash) thereby helping to reduce the Island's dependence on fossil fuel as its primary energy source and provide an environmentally sound alternative to landfill

disposal. Pacific Waste, Inc. with offices in Kailua-Kona is the managing partner of BEH. Guy Kaniho is General Manager of BEH and represents the applicant in all matters.

Whenever an applicant proposes an action, the authority for requiring statements and for accepting any required statements that have been prepared shall rest with the agency initially receiving and agreeing to process the request for an approval. In the event that there is more than one agency that has jurisdiction over the action, and these agencies are unable to agree as to which agency has the responsibility for complying with section 343-5(c), HRS, the office, after consultation with the agencies involved, shall determine which agency is responsible. In making the determination, the office shall take into consideration, including, but not limited to, the following factors:

1. The agency with the greatest responsibility for supervising or approving the action as a whole;
2. The agency that can most adequately fulfill the requirements of chapter 343, HRS, and this chapter;
3. The agency that has special expertise or access to information; and
4. The extent of participation of each agency in the action.

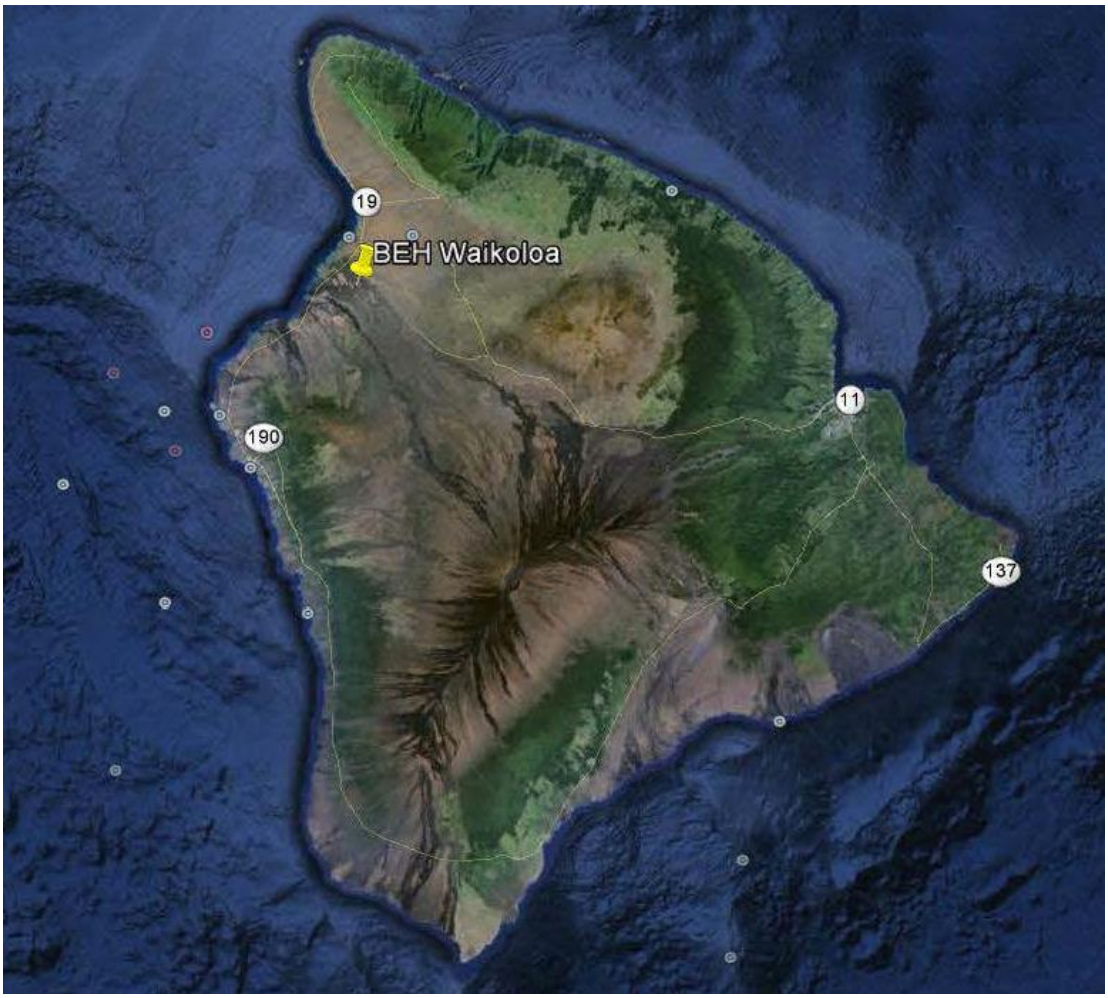
In practice the approving agency is generally the agency which has the major discretionary permits for approving the proposed action. The only major discretionary permit involved with this action is the Special Permit required for non-agricultural uses of land within the Agriculture District. That permit is through the County of Hawaii Council or Hawaii County Planning Commission and their representative the Hawaii County Planning Department (Planning Department), which will act as the approving agency. The Planning Department has the primary responsibility for approving non-agricultural uses of smaller parcels of land in the agricultural zone, as well as the expertise and access to information with regard to the regulatory requirements of the proposed action.

1.4 LOCATION

The proposed resource recovery facility will be co-located with the West Hawaii Concrete aggregate quarry located at 68-1244 Waikoloa Road, Waikoloa, South Kohala District, Island of Hawaii. (Figure 1-1). The facility entrance will be located 2.7 miles east of the intersection between Queen Kaahumanu Highway and Waikoloa Road. The facility will be located approximately 1-mile south, of Waikoloa Road site entrance and accessed by a dedicated road. Its location is 3 miles overland to the nearest development in Waikoloa Village, 3 miles from the WHSL, and 4 miles from the Waikoloa Beach Hotels.

The location is centered at latitude **19° 53.902'N** and longitude **155° 49.883'W**. The current designation of the property is TMK # 6-8-001:066 por., (14.94 acres).

Figure 1-1 Site location in the northwest portion of Hawaii Island



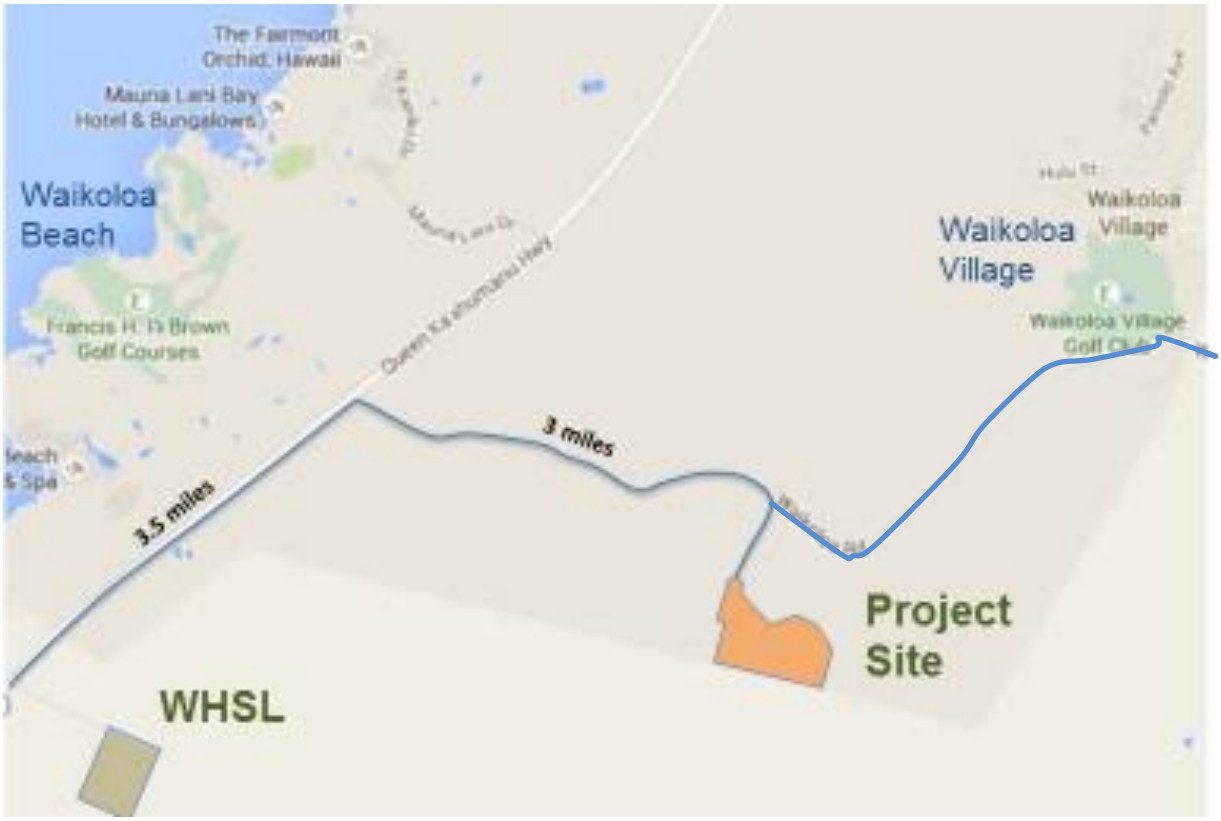


Figure 1-2 Location Map showing the northwestern half of the Island of Hawaii, State of Hawaii

Figure 1-3: The proposed Integrated Resource Recovery Facility will be located in the southwest corner of the West Hawaii Concrete quarry. The project site is 1mile south of Waikoloa Road.

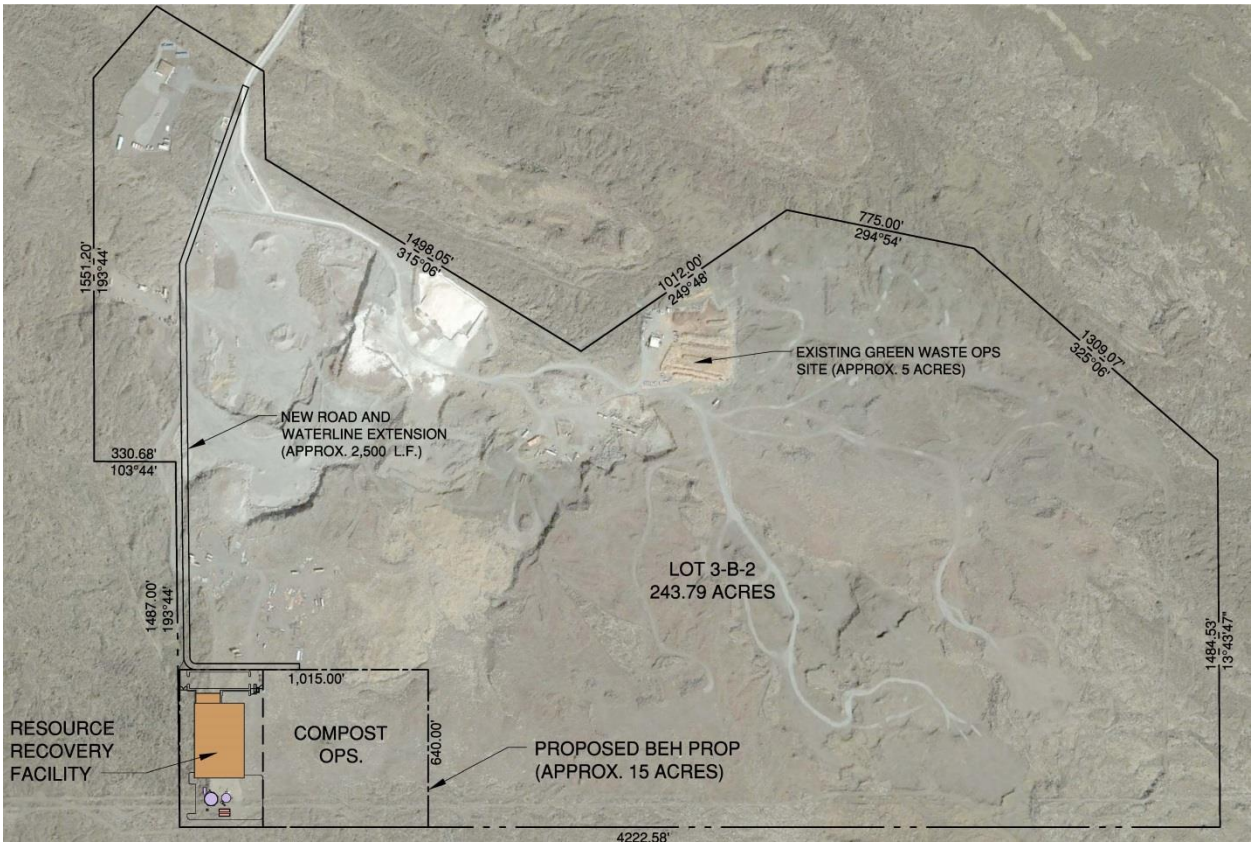


Figure 1-4: Site location within the Waikoloa Quarry.

1.5 SITE HISTORY AND DESCRIPTION

The project site is within the existing Waikoloa Quarry approximately 1 mile south of the Waikoloa Road. The Waikoloa Quarry has been operated since 1995 and has held a pivotal role in supplying aggregate and concrete to construction and other sites in Hawaii County since that time. Portions of the Quarry have removed more than 40 feet of rock, and the top 5-feet of of rock has been removed from the project area. The entire parcel covers 243.8 acres, with 219 acres included in the Quarry license. The remainder is buffer area and exclusions. With the exception of the quarry and its support equipment and temporary buildings, the parcel has never been developed; however, the area is included in the Waikoloa Maneuver Area which was used by the Military for training purposes. The U.S. Navy through a licensing agreement with Richard Smart of Parker Ranch acquired approximately 123,000 acres in Waikoloa in December 1943. Portions were used as an artillery firing range on which live ammunition and other explosives were employed, with the remaining acreage utilized for troop maneuvers, and the largest encampment on the island of Hawaii. In September 1946, the property was returned to Parker Ranch. Two munitions clearance efforts were conducted by the military; one in 1946 just prior to the departure of the Marines and the other in 1954 following an accidental detonation of

a dud fuse or shell killing two civilians and seriously injuring three others. The 1954 effort detected as many as 400 dud items including hand grenades, 60 and 81mm mortars, 75mm shells, 105 and 155mm shell fuses, 31mm anti-tank cannon shells, and 4.2-inch mortars. The quarry and project site are within the Waikoloa Maneuver Area and they are classified as a Formerly Used Defense Site (FUDS). The US Army Corps of Engineers conducts environmental response activities at FUDS on behalf of the Department of Defense. The Corps is the lead agency for investigating, reporting, deciding and implementing remedial action within the Waikoloa Maneuver Area. The Remedial Action Objective for all FUDS areas is to reduce the explosive hazard to human health and the environment due to the presence of munitions that may remain within the Munitions Response Site (i.e., projectiles, mortars, rockets, rifle grenades and hand grenades) such that future exposures to the explosive hazard can be determined as negligible.

The project site is within Area L which is classified as a low risk area, but still within the FUDS, so there is some possibility of finding unexploded ordinance.

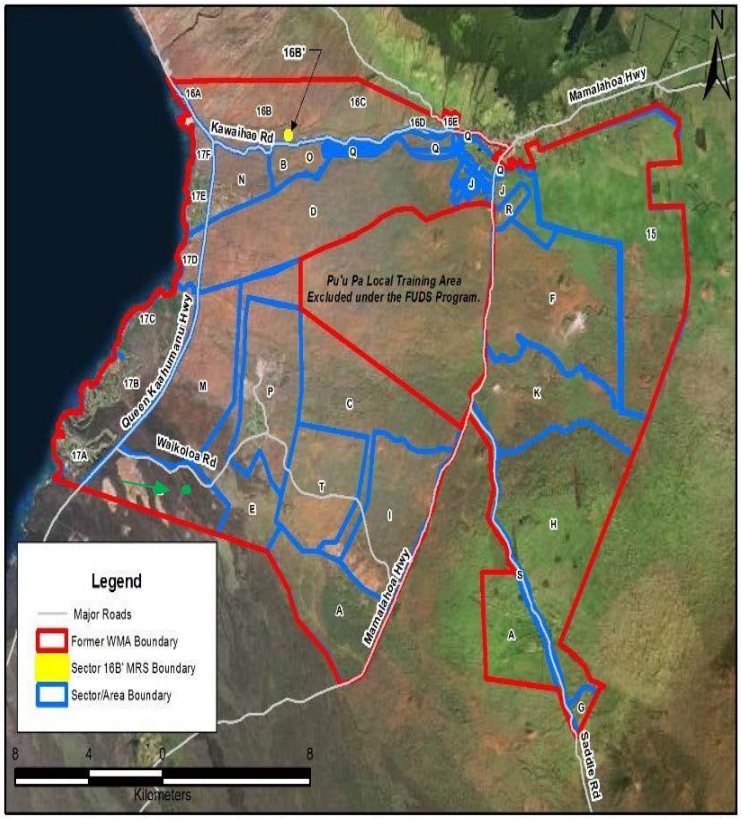


Figure 1-5: Map of the Waikoloa FUDS area.
The project site is within area L.

Before building permits are approved the proponent, landowner or the US Army Corps of Engineers will ensure that the site cleared on unexploded ordinance and other materials remaining from Military training during the 1940s.

PART 2: PURPOSE AND NEED FOR THE PROPOSED ACTION

2.1 PROJECT OBJECTIVE

The objective of the proposed action is to develop an integrated resource recovery and energy conversion facility that will:

1. Divert MSW from Big Island landfills
2. Recover valuable products from the waste steam, and
3. Utilize recovered materials to generate multiple revenue streams from renewable energy and material sales.

The facility will initially be utilized by commercial waste haulers to recover the organic and recyclable resources contained in their collections. The applicant controls a significant portion of waste generated in West Hawaii, and will secure long-term supply contracts with private waste haulers which primarily collect waste from West Hawaii. The gate fee will be kept as low as possible to encourage all waste haulers to take advantage of the facility. This pricing will reduce the operating expenses for the island's commercial haulers while insuring adequate feedstock for the facility and accompanying environmental benefits for the island through advance materials recovery and recycling.

At full development the plant will diminish the volume of MSW deposited into the WHSL by up to 70% thereby increasing its useful life. This volume reduction means a proportionate reduction in escaping greenhouse gases such as methane, carbon dioxide, and other volatile organic compounds being produced by existing landfill activities and potentially released to the atmosphere.

The positive impacts associated with the proposed action include:

- Reducing the release of greenhouse gasses through a substantial increase in the landfill diversion rate.
- Increase current recovery rate of recyclable materials, and begin to recover nutrient-rich organic materials for highest and best use.
- Generate renewable power and alternative biofuels to reduce dependence on imported fossil fuel.

2.2 SUPPORTING POLICIES AND PROGRAMS

2.2.1 COUNTY OF HAWAII LAND USE POLICIES

The proposed resource recovery facility will be sited on land that is in the state Agriculture District and on land zoned A-5a (agriculture with the minimum building lots size of 5 acres) by the County. The permitted uses in the agricultural zone include all types of agriculture and most accessory to agriculture uses. Waste management activities are referenced only briefly in Section 25-5-72(c)(12): *The following uses may be permitted in the A district, provided that a special permit is obtained for such use if the building site is located within the State land use agricultural district*: (12) *public dumps*. The land use ordinance was written before recycling and conservation activities gained importance. While the proposed action is not a public dump, the recovery of waste materials is less obtrusive, polluting, visible and permanent form of waste management than is a public dump and is likely to be an approved use with a special permit.

Likewise, the State agriculture district is reserved for agriculture and accessory to agriculture uses except those unusual and reasonable uses that may be authorized under a State Special Permit.

Each district has a community development plan that documents the priorities and directions for that region of the Big Island. The project area is within the district of South Kohala. The South Kohala Community Development Plan (CDP) has the following objectives:

- Be the forum for community input into managing growth and coordinating the delivery of government services to the community,
- Create a long-range framework and direction to guide future decision making and Actions,
- Translate the broad General Plan statements to specific actions, and
- Direct physical development and public improvements within a specific area.

Kohala CDP contains General Policy No. 5: Develop guidelines and programs that promote environmental stewardship and the concept of sustainability. Among the specific objectives are to encourage alternative energy, incorporate the concept of sustainability, and support programs that increase domestic food production. The proposed action supports all of the elements of General Policy No. 5 in the South Kohala CDP.

The Land Use Pattern Allocation Guide (LUPAG) contained within the General Plan is also an important declaration of permissible land uses around the county. LUPAG designations are usually consistent with the State Land Use Districts. However, the County can also use the LUPAG to indicate where they would like to see State Land Use reclassification changes in the future. For example, the Urban Expansion designation could show where the County thinks lands that are currently in the Agricultural District are appropriate for future reclassification to Urban.

The proposed project site is zoned agriculture but located within an area designated for urban expansion (Figure 2-1).

The South Kohala Community Development Plan (November 2008) defines the proposed land use in Urban expansion areas as follows:
Allows for a mix of high density, medium density, low density, industrial, industrial-commercial and/or open designations in areas where new settlements may be desirable, but where the specific settlement pattern and mix of uses have not yet been determined.

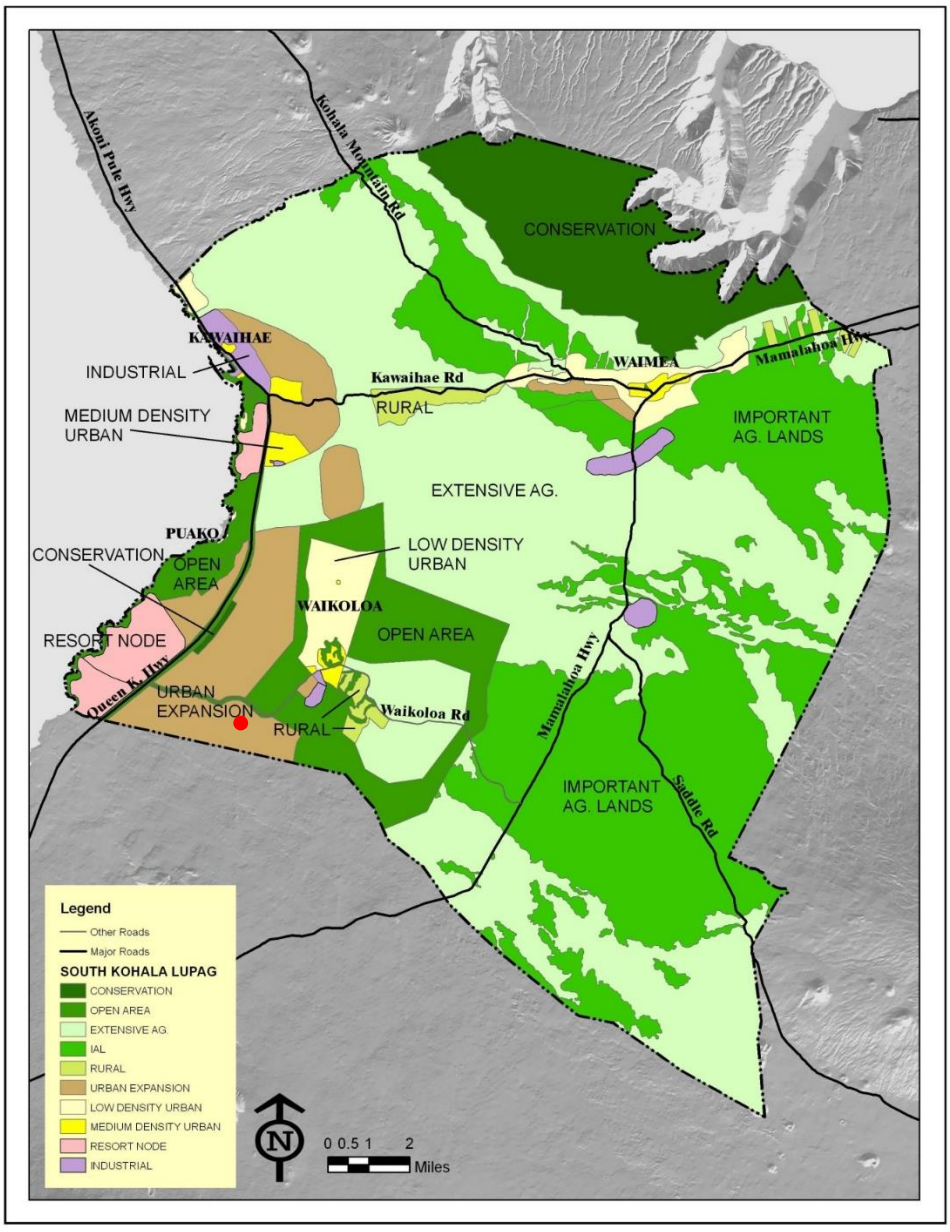


Figure 2-1: Land-use Pattern Allocation Guide (LUPAG) map showing the area (in red) near the proposed project site. It is located in an area designated for urban expansion in the LUPAG.

The County of Hawaii General Plan contains sections discussing solid waste management and land use guidelines that are relevant to the proposed action. Section 10.5.1 relates to health and sanitation. The General Plan discusses the objectives of the Integrated Solid Waste Management Plan (ISWMP, discussed her in section 2.2.2). The Plan relates shortcomings in the diversion rate with has never reached the goals contained in the ISWMP. Also relevant to the proposed action is the statistic that only 35% of the operating cost of the County solid waste management system is covered by tip fees, with 65% of the cost coming from the County General Fund. The General Plan calls for public-private cooperation to overcome the difficulties with solid waste management. By diverting 70 percent of incoming waste the proposed Waste Recovery Facility will substantially increase the diversion rate with Hawaii County and do so without using any public funding.

The County General Plan also discussed land uses within the agriculture District in Section 14.2.1. Forty-Six percent of the total land area in the County is in the State Agriculture District. It observes: *"Included in that area are lands with very high capacity or potential for agriculture as well as those with very low potential for agricultural productivity."*

It also states: *One key factor in adjusting to the changing socio-economic conditions is the restructuring of our land use regulatory system to distinguish between important agricultural land and other agricultural land. These distinctions should be made in the evaluative criteria for considering zone changes, permitted uses, minimum lots size requirements, and subdivision development standards.*

The proposed resource recovery facility is sited in a rock quarry that has little or no soil, little or no rainfall, and scarce sources of groundwater. The potential for productive agriculture is quite low, and it is a very good candidate for use other than agriculture.

Although waste recovery is not considered an accessory to agriculture, the proposed action will benefit agriculture by providing a convenient and low-cost method of disposing agricultural waste, which will subsequently be converted to energy. They will also produce a substantial amount of nutrient rich compost soil amendment which can be utilized by the agricultural community to reduce the amount of fossil-fuel based fertilizers that are imported.

2.2.2 COUNTY OF HAWAII WASTE MANAGEMENT POLICIES

The County of Hawaii has documented its policies and preferences for solid waste management in The County of Hawaii Integrated Resources and Solid Waste Management Plan Update, December 2009 (IRSWMP). The IRSWMP bears a subtitle of *The Path to Zero Waste*. Following the lead of the State ISWMP the waste management preferences are listed as:

1. Source Reduction, 2. Reuse, 3. Recycling and Bioconversion,
4. Landfilling, and 5. Incineration.

The Integrated Resource Recovery Facility proposed herein falls into category three. The 2009 IRSWMP did not expand upon the 2002 edition that called for a waste reduction technology for East Hawaii. Instead it specifically recommended against a Waste Reduction procurement for East Hawaii. The IRSWMP emphasized two options for East Hawaii waste; build a new landfill in the adjacent quarry, or truck waste to the West Hawaii Sanitary Landfill (WHSL). Its major recommendations were to:

1. Implement programs designed to reduce the amount of waste entering the County's landfills,
2. Improve the County's infrastructure to accommodate waste reduction activities such as greenwaste composting and recycling.
3. Implement a Pay-as-you-throw system for residents,
4. Develop detailed cost estimates for a new landfill and trucking waste to WHSL.

The Plan states that "*Other Big Island projects may develop which would provide the opportunities to process organic materials and convert them into soil products that could be used to support land development…"* It concludes that the County should continue to consider long-term options that may have synergy with other County needs and opportunities.

Hawaii County adopted Resolution 356-07 which originally paced the County to a path toward zero waste in 2007. The resolution states that the County should "embrace and adopt the principals of zero-waste as a long term goal, and espouses a closed loop between production and consumption.

The County commissioned a zero-waste implementation Plan in 2007. As of this date all that could be found was a draft delivered in 2009. The Draft Zero-Waste Implementation Plan urges greater recycling and composting an emphasis on source separation, on-island processing and recovery of waste, and changes in consumer behavior.

2.2.3 COUNTY OF HAWAI`I ENERGY POLICIES

The Hawai`i County General Plan is the controlling document for development throughout the county (Hawai`i County General Plan, 2005). Energy concerns are referenced throughout the Plan but the overall policy for the county is described below:

Hawai`i County's Energy Goals and Policies

Goals:

1. Strive towards energy self-sufficiency.

2. Establish the Big Island as a demonstration community for the development and use of natural energy resources.

Policies:

1. Encourage the development of alternative energy resources.
2. Encourage the development and use of agricultural products and by-products as sources of alternative fuel.
3. Encourage the expansion of energy research industry.
4. Strive to educate the public on new energy technologies and foster attitudes and activities conducive to energy conservation.
5. Ensure a proper balance between the development of alternative energy resources and the preservation of environmental fitness and ecologically significant areas.
6. Strive to assure a sufficient supply of energy to support present and future demands.
7. Provide incentives that will encourage the use of new energy sources and promote energy conservation.
8. Seek funding from both government and private sources for research and development of alternative energy resources.
9. Coordinate energy research and development efforts of both the government and private sectors.
10. Encourage the continuation of studies concerning the development of power that can be distributed at lower costs to consumers.
11. Strive to diversify the energy supply and minimize the environmental impacts associated with energy usage.
12. Continue to encourage the development of geothermal resources to meet the energy needs of the County of Hawai`i.
13. Encourage the use of solar water heating through the continuation of State tax credit programs, through the Building Code, and in County construction.
14. Encourage energy-saving design in the construction of buildings.
15. Support net-metering and other incentives for independent power producers.

The proposed action directly supports items 1, 2, 3, 5, 6, 10, and 11 of the County Energy Policy and does so without the use of public funds.

2.2.4 STATE LAND USE POLICIES

The State of Hawaii has several overarching policy documents. Chie among these is the Hawaii State Planning Act HRS 226.

HRS 226 "The Hawaii State Planning Act" was originally prepared in 1978. The purpose of this chapter was to prepare the Hawaii State Plan which serves as a guide for the future long-range development of the State; identify the goals, objectives, policies, and priorities for the State. HRS 226 identifies the goals, objectives, policies, and priorities for the State; provides a basis for determining priorities for allocating limited resources, such as public funds, services, human

resources, land, energy, water, and other resources; and to establishes a system for coordination of all major state, and county activities. HRS 226 contains 25 specific objectives and policies to guide state legislation and priorities for planning, permitting and funding. Table 2-1 provides an assessment as to the consistency of the proposed action with the objectives and policies contained in The Hawaii State Plan.

T*able 2-1: Assessment of the consistency with State planning priorities contained in HRS 226.*

Objective #	**Objective and policy for:**	**consistent ?**
226-5	population	NA*
226-6	economy-in general	Yes
226-7	economy-agriculture	Yes
226-8	economy-visitor industry	NA
226-9	economy-federal expenditures	NA
226-10	economy-potential growth and innovative Activities	Yes
226-10.5	economy-information industry	NA
226-11	physical environment-land-based, shoreline, and marine resources	Yes
226-12	physical environment-scenic, natural beauty and historic resources	NA
226-13	physical environment-land, air and water quality	Yes
226-14	facility systems-in general	NA
226-15	facility systems-solid and liquid wastes	Yes
226-16	facility systems-water	Yes
226-17	facility systems-transportation	NA
226-18	facility systems-energy	Yes
226-18.5	facility systems-telecommunication	NA
226-19	socio-cultural advancement-housing	NA
226-20	socio-cultural advancement - health	NA
226-21	socio-cultural advancement - education	NA
226-22	socio-cultural advancement-social services	NA
226-23	socio-cultural advancement- leisure	NA
226-24	socio-cultural advancement-individual rights and personal wellbeing	NA
226-25	socio-cultural advancement - culture	NA
226-26	socio-cultural advancement- public safety	NA
226-27	socio-cultural advancement-government	NA

**NA = not applicable to the proposed action*

The proposed action is consistent with specific objectives and policies in HRS 226 for the economy, the physical environment, and certain facility systems. None of the objectives and

policies contained in the State Planning Act are inconsistent with the proposed action, but many are not applicable.

HRS Chapter 205 is the Statue which defines the four different land use districts used by State law, and describes the permissible uses within each district. HRS 205-2 and section 4.5 establish the permissible use of agricultural land. The permissible uses are designed to protect valuable agriculture land from competing uses. Although the proposed action is not accessory to agriculture, it will benefit agriculture, and is within the range of uses that can be authorized by a special use permit.

HRS Chapter 344: State Environmental Policy Act. HRS 344 broadly defines the State's environmental policy. Its purpose is to "*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*" [HRS §344-3 (1)]. The proposed action provides a vast improvement in diversion rate, and reduces the release of greenhouse gasses over the existing methods of waste management now utilized in Hawaii County.

HRS 205A-2, Coastal Zone Management Act (CZMA): The entire State is within the Coastal Zone according to Ch. 205-A. Of the 11 CZM initiatives the majority apply to coastal resources which are at its closest point 3.8 miles to the west at Anaehoomalu Bay. The ground conditions at in the vicinity of the project site are not conducive to surface runoff. Rainwater infiltrates rapidly and would intersect the groundwater within 10 feet of the mean sea level, where it would flow toward the west until it emerges along the western shore of Hawaii Island. Table 2-2 lists the objectives and policies of the Coastal Zone Management Act and an assessment of the consistency of the proposed action with those objectives and policies.

Table 2-2: Assessment of the consistency with objectives and policies of the CZMA

Objective #	**Resource**	**Objective and policy**	**consistent**
205-A.2 (1)	Recreation	Provide coastal recreational opportunities accessible to the public.	NA
205-A.2 (2)	Historic	Protect, preserve, and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.	NA
205-A.2 (3)	Scenic and open spaces	Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.	Yes

205-A.2 (4)	Coastal ecosystems	Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.	NA
205-A.2 (5)	Economic use	Provide public or private facilities and improvements important to the State's economy in suitable locations.	Yes
205-A.2 (6)	Coastal hazards	Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.	NA
205-A.2 (7)	Managing development	Improve the development review process, communication, and public participation in the management of coastal resources and hazards.	NA
205-A.2 (8)	Public participation	Stimulate public awareness, education, and participation in coastal management.	NA
205-A.2 (9)	Beach protection	Protect beaches for public use and recreation.	NA
205-A.2 (10)	Marine resources	Promote the protection, use, and development of marine and coastal resources to assure their sustainability.	NA

**NA is not applicable to the proposed action*

Objective 205-A.2 (3) to preserve and protect scenic open vistas is supported by the proposed action. The project site is not visible from any public right of way.

Objective 205-A.2(5) is supported by the proposed action by providing private investment and facilities to provide what is usually an essential public service. These facilities will be used to stimulate the economy of the County in a sustainable manner by providing employment and reducing the amount of local capital that leaves the island to purchase fossil fuels.

None of the objectives and policies of the CZMA are inconsistent with the proposed action, but many are not applicable.

2.2.5 STATE ENERGY POLICIES

Policy development is a key to achieving the goal of meeting 70% of Hawai`i's energy needs with clean energy by 2030. Statewide, 90% of our energy comes from imported petroleum. By working to develop policies that support energy-efficiency efforts, renewable energy development, and transportation clean energy objectives, the Hawai`i Clean Energy Initiative is paving the way for Hawai`i to reach its clean energy goals.

On June 25, 2009, the initiative reached an important milestone when Gov. Linda Lingle signed into law four key energy bills that enhance Hawai`i's energy efficiency and renewable energy programs. The energy agreement, part of the Hawai`i Clean Energy Initiative, puts Hawai`i on a path to supply 40 percent of electricity needs and 70 percent of overall energy needs (including transportation) using clean sources by 2030, a far-reaching change for a state now over 90 percent dependent on imported fossil fuels.

The 2009 Hawai`i State Legislature enacted this goal into law by establishing a renewable portfolio standard of 40 percent and an energy efficiency standard of 30 percent by 2030 in Act 155. Hawai`i Revised Statutes, Chapter 226-18, "Objectives and policies for facility systems - energy," as amended: "Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all:

1. Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;
2. Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased;
3. Greater energy security in the face of threats to Hawai`i's energy supplies and systems; and
4. Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use.

On June 8, 2015 Governor David Ige signed House Bill 623 into law; requiring the State's utilities generate 100% of the power needed for local consumption from renewable sources by the year 2045. This statement of resolve is a clear message that renewable energy technologies including waste-to-energy will be part of Hawaii's future.

2.2.6 FEDERAL POLICY

Waste conversion is a renewable energy technology because its fuel source, post-recycled MSW, is sustainable and non-depletable. According to the U.S. EPA, waste conversion is a "clean, reliable, renewable source of energy." In addition, the Energy Policy Act of 2005, the Federal Power Act, the Public Utility Regulatory Policies Act, the Biomass Research and Development Act of 2000, the Federal Energy Regulatory Commission's regulations, recognize waste conversion power as renewable.

2.3 FUEL AND POWER INFRASTRUCTURE NEEDS

2.3.1 CURRENT SOURCES OF POWER GENERATION

The US Energy Information Administration produces annual data on consumption of energy in each state. Table 2-1 shows the sources of our statewide energy consumption as of the end of 2013.

Table 2-3 Energy Consumption in the State (Trillions of BTUs).

Coal	Nat. gas	Petroleum	Hydro	Biomass	Ethanol	Geothem	Solar	Wind
15.3	3.5	233	0.7	8.2	3.0	2.6	9.3	4.8
5.45%	1.25%	83.1%	0.25%	2.9%	1.1%	0.93%	3.38%	1.7%

USEIA 2013:
http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_sum/html/sum_btu_totcb.html&sid=HI

The data shows the extent of our dependence, with over 83% of our energy derived from imported fossil fuels. This figure is significantly better in Hawaii County due to the 38% of alternative energy produced for utility-line power on the Big Island (DBEDT 2014). According to Johnson et al (2006), per capita demand is lower than the U.S. average across all sectors, and the cost of electricity in Hawaii is among the highest in the nation.
The island of Hawaii currently has approximately 300 MW of electricity generation capacity and a peak demand of 189 MW (DBEDT 2014). Geothermal dominates the production of energy from renewable sources, but there are sizeable inputs from solar thermal and run-of-the-river hydropower as well. The Hawaii Electric Light Company (HELCO), in contrast to its situation 20 years ago, now enjoys an excess of generating capacity. HELCOs generating assets run most efficiently at near full load. This along with its current excess of capacity creates market conditions that are not conducive for independent power producers to sell electricity to the utility. BEH began planning to utilize municipal solid waste for electricity production in 2008, but due to HELCO's excess of generating capacity and extensive PPA process, they concluded that production of alternative fuels was a more appropriate solution. Over 83 million gallons of gasoline and diesel were sold for highway use in Hawaii County during 2013 (DBEDT, 2013). Another 40 million gallons were sold for non-highway and miscellaneous use. A small amount of biodiesel was sold, figures were not readily available, but the applicant believes that it is safe to assume that the market for alternative fuels is relatively large and untapped. Drop in fuels such as RNG/CNG are expected to be readily marketable to public and private consumers including the utility. Fuel production also does not require as much up front capital cost and infrastructure as electricity. Finally, private waste haulers have expressed an interest to switch the collection fleet to run on CNG, making it into a closed loop recycling system.

2.4 ENVIRONMENTAL DIFFERENCES BETWEEN LAND FILLING AND WASTE CONVERSION OPERATIONS

Disposing of solid waste in modern, managed landfills is the most commonly used waste management technique in the United States. After being placed in a landfill, organic waste (such as paper, food scraps, and yard trimmings) is initially decomposed by aerobic bacteria. After the oxygen has been depleted, the remaining waste is available for consumption by anaerobic bacteria, which break down organic matter into substances such as cellulose, amino acids, and sugars. These substances are further broken down through fermentation into gases and short-chain organic compounds that form the substrates for the growth of methanogenic bacteria. These methane (CH4) producing anaerobic bacteria convert the fermentation products into stabilized organic materials and biogas consisting of approximately 50 percent biogenic carbon dioxide (CO2) and 50 percent methane (CH4), by volume. Methane's lifetime in the atmosphere

is much shorter than carbon dioxide (CO2), but CH4 is more efficient at trapping radiation than CO2. Pound for pound, the comparative impact of CH4 on climate change is more than 25 times greater than CO2 over a 100-year period (EPA, 2016). Methane production typically begins within the first year after the waste is disposed of in a landfill and will continue for 10 to 60 years or longer as the degradable waste decomposes over time.

In 2014, landfill CH4 emissions were approximately 181.8 MMT CO2 Eq., representing 25.7 percent of total U.S. anthropogenic methane, the largest single source of CH4 emissions in the United States, followed by enteric fermentation and natural gas drilling and production facilities. Emissions from MSW landfills accounted for approximately 95 percent of total landfill emissions, while industrial landfills accounted for the remainder. The incineration of waste in the United States in 2014 resulted in another 9.7 MMT CO2 Eq. emissions, over half of which (4.9 MMT CO2 Eq.) is attributable to the combustion of plastics.

According to the Energy Recovery Council (2008), converting MSW to energy has tremendous potential to reduce climate-changing greenhouse gases. According to a model developed by the EPA, each megawatt-hour (MWh) of electricity generated through conversion of MSW results in a net negative CO2 footprint of 3,636 lbs. of carbon dioxide equivalent (CO_2-eq). If one considers life cycle carbon budgets, recycling and the conversion of organic waste recover almost pound-for-pound the same amount of greenhouse gasses as are disposed. Conversion systems achieve this net reduction by offsetting fossil sources of electricity, eliminating the methane emissions that would have occurred if the waste were landfilled, and recovering metals that can be recycled (which is much more energy-efficient than using raw materials). Anaerobic digestion converts approximately ½ of the biomass into methane which is captured for combustion or upgraded to biofuel, and the other half into CO_2 which is released. This is one of the reasons that anaerobic digestion has been utilized for years in countries around the world to treat and stabilize the organic waste fraction of MSW. Advanced thermal conversion technologies such as gasification and pyrolysis have the ability to capture more than 90% of the carbon; however, pyrolysis and gasification technologies using MSW residue as the primary feedstock have not achieved widespread large scale commercial use in the US.

The proposed action will virtually eliminate the release of methane from waste processed at the facility. CO_2 will still be released to the atmosphere, however, because methane has a CO_2 equivalence of 25, its removal by anaerobic digestion results in greenhouse gas emissions 96% less than would be expected from landfilling.

PART 3: DESCRIPTION OF THE PROPOSED ACTION

BioEnergy Hawaii, LLC ("BEH") is developing an integrated resource recovery and waste conversion facility on the Big Island of Hawaii. The facility will process Municipal Solid Waste (MSW) and other organic materials to produce a renewable feedstock for use in biogas production as well as a post-recycled engineered fuel, suitable for energy conversion operations. The integrated facility design will separate and process the MSW by its material composition, allowing for the production of advanced biofuels for use in the transportation and power generation industry, as well as baseload renewable electricity. The organic recycling operations will also generate value-added agricultural products, such as natural fertilizer and compost-based soil to support the local landscaping and agriculture industry.

In addition to providing a variety of energy and agricultural products, the facility will recover otherwise wasted recyclable commodities and divert the majority of the island's waste stream from its landfills. Recycling and waste diversion is a priority for all of the Islands in Hawaii, due to our limited land area and fresh water resources.

Biogas production will be accomplished by incorporating anaerobic digestion operations into the integrated facility design. The process will utilize proven technology that has been developed to convert organic materials in a fully enclosed and continuous, biological process to produce an energy-rich biogas. The biogas can be used to generate renewable electricity and upgraded to natural gas-quality bio-methane known as "renewable natural gas" (RNG). RNG can also be compressed to produce bio-CNG and utilized as a low-carbon alternative transportation fuel. The facility will also produce a high calorific engineered fuel in order to maximize the energy value from the post-recycled MSW residue, such as, mixed paper, low-value plastics, textiles, and wood which cannot be utilized in the organic recycling operations. The high heating value of the engineered fuel can then be recovered through thermal energy conversion operations to generate renewable electricity.

3.1 APPEARANCE OF THE PROPOSED FACILITY

The proposed action includes construction and operation of a materials recovery facility (MRF) for waste processing and conversion and installation of an anaerobic digestion (AD) facility for treatment of organic waste and agricultural materials. The physical MRF facility will consist of a central material handling building (approx. 50,000 SF) along with an administration building. The AD facilities will consist of high-solids plug flow-type digesters, biogas storage and associated gas cleanup equipment. The plug-flow anaerobic digesters are horizontally or vertically–oriented cylinders. Figure 3.1 shows an example of an anaerobic digester facility using a horizontal plug-flow type of digester with its accompanying biogas holding tank and materials

processing building. Figure 3.2 shows an example of an anaerobic digestion facility using a vertical plug-flow type of digester with its accompanying biogas holding tank and material processing building. The location of the facility will be on a portion of TMK # 6-8-001:066, which is nearly 1-mile south of Waikoloa Road within an existing quarry operated by West Hawaii Concrete. The quarry is currently utilized to remove rock, recycle waste concrete and asphalt, and compost greenwaste. These currently permitted activities are highly compatible and synergistic with the proposed action. The facility cannot be seen from any public right of way because of topography surrounding the site.

Figure 3-1 Example of a plug-flow anaerobic digester facility: (1) material receiving building; (2) horizontal plug-flow digester; (3) biogas storage tank; (4) biogas upgrade system

Figure 3-2 Example of a high-solids anaerobic digester facility: (1) material receiving building; (2) vertical plug-flow digester; (3) biogas storage tank

3.2 OPERATIONAL DESCRIPTION

The resource recovery and conversion technologies proposed by BEH to transform MSW into energy are accomplished in nine steps:

1) Waste receiving;
2) Waste sorting, and removing unsuitable materials;
3) Separation and recovery of recyclable materials;
4) Separation and recovery of heavy “wet" organic materials and light “dry” high heating value materials;
5) Anaerobic digestion of wet organic materials into biogas;
6) Cleaning the biogas
7) On-site energy generation and heat-recovery
8) Upgrading biogas to produce RNG and compressing of the gas to produce bio-CNG
9) Thermal conversion of dry materials for energy generation

Additional actions to be included with the proposed development and discussed in the operational assessment include full organic recycling operations that will incorporate production of composted soil amendment products, and farming bioenergy crops, shown schematically in Figure 3-3.

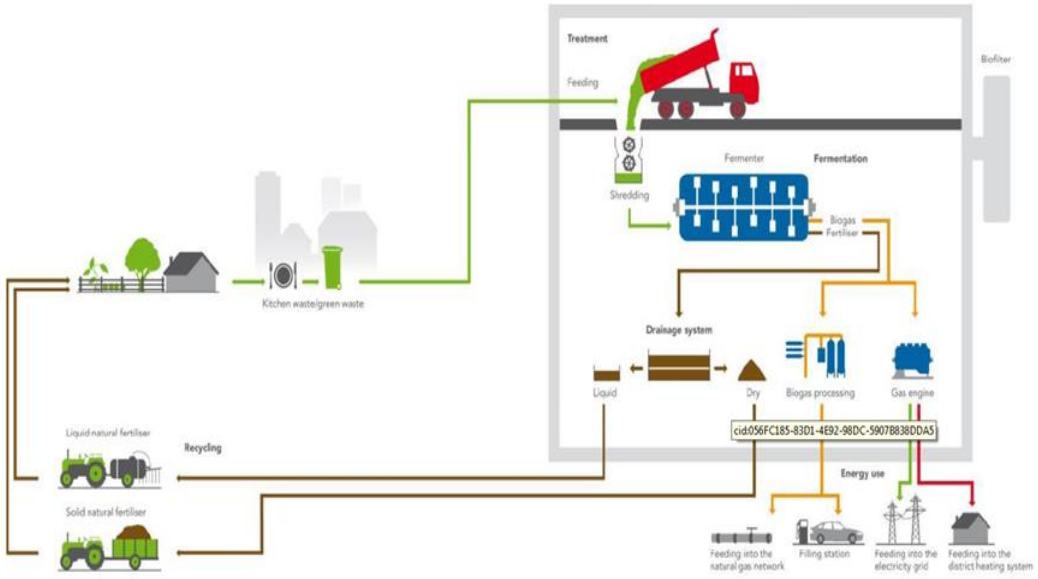
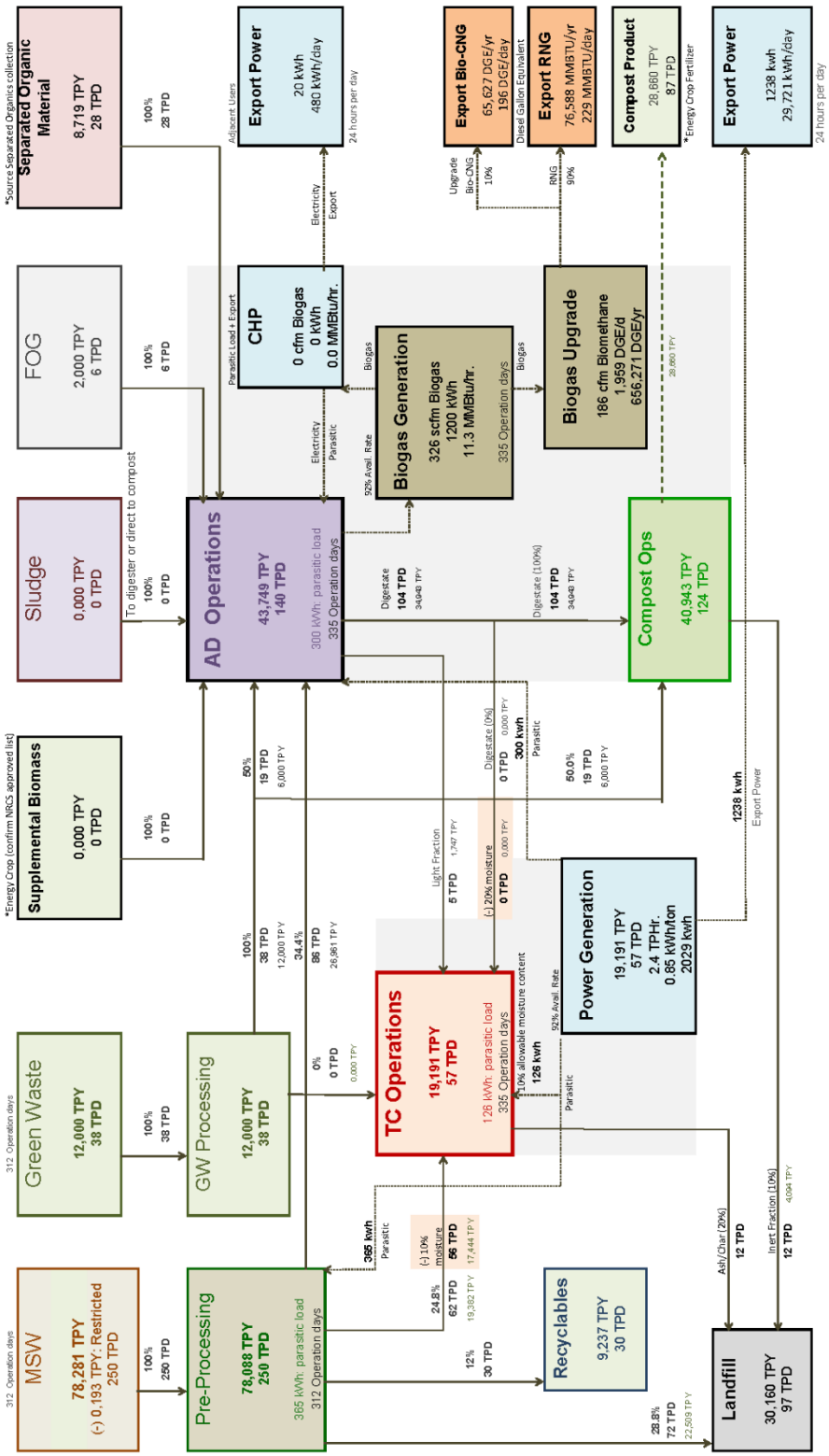


Figure 3-3: Schematic overview of organic recovery and recycling operations.

A process flow drawing depicting the conversion process for the different materials to be processed in the facility is shown in Figure 3-4. This figure shows anticipated volumes at initial development for MSW. The Facility is designed to allow increased quantities of waste materials as needed. The facility may also receive greenwaste, energy crop biomass, sludge, fats, oil and grease, or other source separated organics such as food waste.

Figure 3-4: Process flow for various materials in the integrated resource recovery facility.



3.2.1 WASTE RECEIVING

The conversion process commences when MSW arrives at the facility in waste collection vehicles (WCVs) such as front loaders, roll-off trucks and transfer trailers. The facility will be open approximately three hundred and twelve (312) days per year. It is anticipated that the facility will receive an average range of three to six (3 - 6) WCVs per hour between the hours of 7 a.m. and 4 p.m. Monday through Saturday. The WCVs enter the material handling building through a fast operated bay door that automatically opens as the vehicle approaches and closes once it is inside. The WCV will then maneuver within the building as directed to a partitioned receiving area to unload its contents. It will then pull forward to exit the building through a second fast operated bay door. The MSW is discharged and sorted within an enclosed building, onto a steel-impregnated concrete sorting floor (tipping floor). No waste will ever be stored outside of the building or in any uncontrolled area. Waste will not be visible to persons outside the building and fugitive litter such as paper or plastic waste if released from inside the building will be collected daily from the perimeter fence. Waste screening for inappropriate materials will be done for each load entering the tipping floor. Hazardous waste, bulky waste and pure recyclables will be directed to the appropriate facility.

Figure 3-5: An example of material processing operations showing waste sorting equipment

Resource recovery begins with pre-processing of the waste materials. Pre-processing includes:

- Removing bulky, hazardous, and inert material from the incoming MSW.
- Sorting and separating recyclables (metals, glass and high-value plastics).
- Recovery and separation of the dry high BTU materials (for thermal conversion).
- Recovery and separation of the wet organic fraction (for anaerobic digestion).
- Collection of residuals for landfill disposal (primarily unusable inert materials).

3.2.2 REMOVAL OF UNSUITABLE MATERIALS AND INITIAL SEPARATION PROCESS

After the MSW is deposited on the tipping floor visual inspection and first level pre-sorting is performed manually to remove large and noticeable prohibitive materials (i.e. appliances, structural steel, automobile parts, tires, large metal and steel items, concrete, large rocks, etc.). All extracted items will be placed in roll-off containers for commodity sale, reuse, or disposal depending on the inherent value or lack thereof. A Hazardous Waste Exclusion Program will also be implemented to divert restricted material from the incoming waste stream.

The waste that remains after the initial pre-sorting is loaded onto a conveyor that feeds the main processing line, which is also located inside the material handling building and has its own air filtration system to reduce dust generated form processing equipment. The first step is to open all trash bags and reduce the size of large items (such as construction and demolition material). This is performed by a bag opener or primary shredder which will cut the waste material to a uniform size of no more than 10" minus. The waste material will then be transferred via conveyor to a screening process to remove most of the fines, glass, and organics. Screening is accomplished by trommel or disk screen operations to remove the inert and organic material that is less than 3" minus. The separated inert material is transferred to a trailer for landfill disposal. The organic material will be delivered to a temporary holding area (biogas system reception area) to be fed into the anaerobic digestion operations.

3.2.3 SEPARATION OF RECYCLABLE MATERIALS

The recovery of recyclable commodities will be accomplished through a combination of automated and manual sort operations. Metals will be separated from the light and heavy fractions using magnetic and induced current separators. All ferrous metal ("FE") such as tin cans and lids and thin sheet metal, will be automatically separated using an over-band magnet separator. The aluminum and light non-ferrous ("NF") material (i.e. aluminum cans, pie tins, brass and copper) will be recovered by manual sort and an eddy current system. The plastics will be separated by type through both manual recovery as well as automated optical sort equipment, this flexible design allows for increased recovery based on commodity values.

3.2.4 SEPARATION OF LIGHT AND HEAVY MATERIALS

After the screening process the remaining waste material will be directed to air separation equipment. This process will separate the dry "light" high caloric material (i.e. paper, fiber, textiles and wood), from the wet or heavy fraction. The light fraction will a suitable engineered fuel and directed to thermal conversion operations to generate electrical power. The wet "heavy" fraction includes organic materials such as food waste, plant materials, manure and waste that is easily digestible by bacterial metabolism and low caloric material such as dirt, rocks and small pieces of glass which will ultimately be transferred to the same transfer trailers as the inert material screened in the first step.

3.2.5 ANAEROBIC DIGESTION

The separated organic fraction of the MSW is delivered to the biogas system reception area via belt conveyor or front end loader from the Material Recovery Facility. The organic fraction which is free of metals and large debris greater than 2 inches in size is temporarily held in storage bunkers. Small contaminants such as plastics, stones and glass fragments can remain in the material as they will pass through a plug-flow type digester and can be easily removed during the processing of the final product. The pre-treated material remains in flat bunkers from which the anaerobic digesters are fed continuously for round-the-clock operation. Feeding of the digesters is accomplished by the use of a conveyor chain system and a plug screw conveyor which introduces the material into the digester automatically. The infeed operations can utilize a loader or crane feeding system as shown in Figure 3-6 below.

Figure 3-6: Photo on left shows loader infeed; photo on right shows automatic crane delivery.

Anaerobic digestion is the degradation of organic matter by microorganisms under anaerobic conditions (absence of oxygen). The principle used for the design of anaerobic digesters is based on ensuring an adequate residence time of suspended solids (solids retention time) inside the reactor that will ensure a consistent yield of removal of the volatile solids (and corresponding COD).

The proposed high-solids anaerobic digester design will utilize an approximate 20 to 30-day hydraulic retention time to ensure adequate treatment of the organic material. Moisture in the form of excess process water or other on-site sources is added to the material fed to the digester as needed in order to maintain optimal dry matter content in the digester. A portion of the treated discharge from the digester is recirculated to the feeding line in order to inoculate the newly-introduced feed with a pre-conditioned biological population for optimal digestion. A schematic depiction of a horizontal and vertical high-solids plug-flow type anaerobic digester is shown is Figure 3.7.

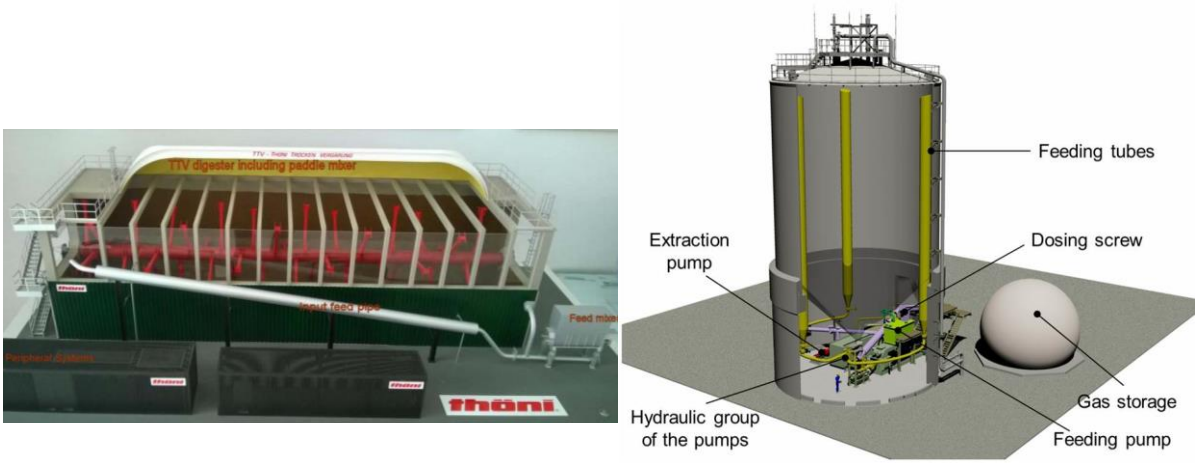


Figure 3-7 Schematic representations of a horizontal (left) and a vertical (right) plug-flow anaerobic digester

In the horizontal design, movement of the material from the feed inlet to the digested product outlet of the digester is carried out by a central turning paddle mechanism. The paddle mechanism is designed to prevent settling out of any heavy material while providing optimal mixing and opportunity for biogas escape to the gas collection system. In the vertical design, material is circulated through the digester utilizing a pump and gravity design, which does not require any internal paddle mechanism. In both designs, the digestion process is carried out at thermophilic digestion conditions; temperature range between 99 to 131°F (approx. 37 to 55°C). Heat input for the digestion process is supplied by the onsite CHP heat exchanger. The major part of the organic material is degraded and converted into biogas with a methane content of approximately 60 %, CO2 near 40% and hydrogen sulfide and other minor components making up the remainder. Gas produced is collected in a separate storage tank for use as raw biogas, or further refinement.

3.2.6 SOLID-LIQUID SEPARATION

After the 20 to 30-day residence in the anaerobic digester the material within the digester is converted into a mixture of liquid and solid digestate which is devoid of refractory organic materials and enteric bacteria. If required, the solid and liquid digestate can be separated with a decanter centrifuge located within the reception building. Depending on the infeed material, the anaerobic digester unit selected may require more moisture than is derived from waste, and therefore could be a net consumer of water and effluent liquids. Separated solids will be conveyed to a storage area or transfer trailer for additional composting or land application. Digestate solids can be used to amend the poor soils in order to allow cultivation of areas that are now fallow to produce biomass for digestion.

3.2.7 BIOGAS CLEANING

Removal of hydrogen sulfide (H_2S) from raw biogas is required to eliminate its corrosive effects on machinery and to avoid the production of sulfur dioxide (SO_2) during combustion. Biogas purification and upgrading can be achieved a number of ways, including scrubber towers that utilize a bio-catalytic process or incorporating a compression phase combined with membrane filtration. Either process can be implemented to produce bio-methane, also known as Renewable Natural Gas (RNG), which can also be compressed to be used as a transportation fuel (bio-CNG or compressed biogas). Some clean-up technologies produce waste products that require management and disposal. Solid and liquid wastes produced from gas cleanup will be disposed or recycled using licensed contractors in association with permitted disposal facilities.
Market forces will determine the percentage of gas that is upgraded to RNG and bio-CNG. Raw biogas from the AD units contains between 400 to 600 BTU per standard cubic foot (scf). After sulfide removal this gas can be used in new biogas generating systems designed by Caterpillar, Jenbacher and others. The term renewable natural gas (RNG) is reserved for biogas that has been stripped of CO2, complex volatile organic compounds, silica, and the remaining hydrogen sulfide. RNG is normally between 930 to 1000 BTU/scf. The higher energy content makes it a suitable substitute for propane or other pipeline gas. RNG can be stored at room temperature and distributed by blowers for movement around the local area, or distributed to a utility system if gas pipelines are available. Compressed Natural Gas (CNG) is required for transportation fuel so that the required energy content can be stored in a portable container. Transportation fuels will be made available for retail sales to the waste collection fleets and other interested fleet managers. CNG (or bio-CNG) is still a compressed gas and not a liquid fuel. Liquefied natural gas (LNG) must be stored at very low temperatures and is not required for distribution within Hawaii.

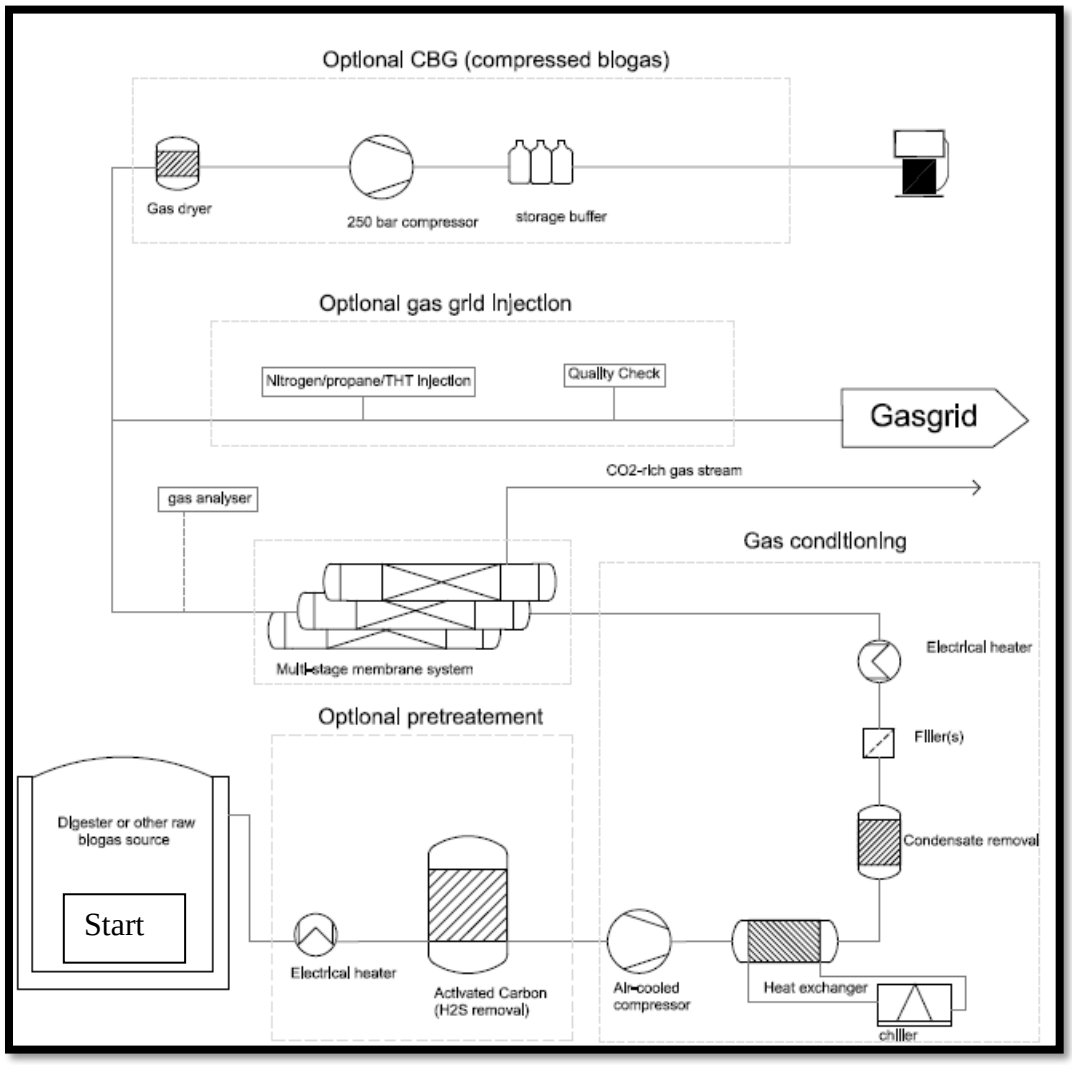


Figure 3-8: Diagrammatic description of gas clean-up process with multiple products.

3.2.8 POWER GENERATION AND ENERGY PRODUCTION

A portion of the cleaned biogas can be supplied via biogas blower stations to one or more combined heat and power (CHP) units, which are modified diesel engines capable of performing on raw biogas. The CHP unit can be installed pre-mounted in a special container, including all necessary peripheral equipment, including heat storage tanks and heat distributors.

Figure 3-9: Example: CHP unit in Container with heat Recovery and Cooling System

The exhaust gasses will be cleaned by air pollution control equipment before being released. Regulated pollutants such as nitrous oxide (NOX), carbon monoxide (CO) and minor component such as volatile organic compounds (VOC) generated by these engines are anticipated to be well below the limits established under the Clean Air Act. It is likely that these units will require a permit to operate under the Clean Air Act.

3.2.9 EMERGENCY FLARE

A biogas flare will be installed as an emergency consumer of biogas to avoid methane emissions to the environment in case of a breakdown of the CHP unit or other downstream production. The capacity of the biogas flare should be a minimum 120 % of the expected biogas production. The flare height is approximately 50 ft. above ground level. During normal operations it will have only a pilot light burning. In the event of a shutdown within the plant the flare will activate to prevent the release of methane. No actual flame would be visible.

Figure 3-10: An example of the emergency flare configuration

3.2.10. THERMAL CONVERSION

The facility will also produce a smaller amount of high calorific engineered fuel in order to maximize the energy value from the post-recycled MSW residue, such as, mixed paper, low-value plastics, textiles, and wood which cannot be utilized in the anaerobic digestion operations. The high heating value of the post-recycled engineered fuel (PREF) can then be recovered through thermal energy conversion operations to generate baseload renewable electricity.
The integrated project design provides for the opportunity to incorporate modular thermal conversion units on-site to generate auxiliary electrical power. The proposed thermal conversion (TC) system is a distributed-scale conversion technology capable of processing a broad range of feedstocks. The modular design allows for expandability while maintaining a small efficient footprint. High-temperature TC operations are conducted within enclosed chambers with limited or no oxygen in order to convert solid materials into a combustible gas. The high-BTU gas can be utilized in standard steam boilers or gas generator configurations.

Alternatively, thermal conversion may be designed to produce pyrolysis oils, which could also displace diesel fuel in the generators and other machinery and equipment used to power the facility. Distribution of electrical power to other tenants on or near the site are planned. Electrical power sales and distribution to the Hawaii Island utility is possible by tying into power lines in a nearby transmission corridor, but new electrical infrastructure to connect to the transmission lines would be required.

The applicant may also have the option to sell this PREF to an off-site energy producer to support other alternative energy initiatives. By manufacturing a locally sourced fuel product from waste material, the project may be able to displace imported fuel oil required for power generation for dedicated loads or to support local micro-grid development.

3.2.11 COMPOSTING

Anaerobic digestion of organic wastes uses bacteria, fungi and other microorganisms to produce methane in conditions where there is no oxygen. This process kills enteric bacteria and other disease vectors, and reduces the volume of waste by around 25%. After 20 to 30 days of digestion without oxygen the digestate is moved to a composting facility where a completely different set of bacteria, fungi and other microorganisms further break down organic materials into bioavailable plant nutrients. As the organic materials exist the digester the moisture content is adjusted, greenwaste chips or similar bulking agents are mixed into the compost materials and they are place in windrows using specialized composting equipment. Each windrow is over 100 feet long 8-9 feet high and around 16-feet wide at the base. Windrows are kept aerated by turning them at least 5 times over the course of the next 21 days. During that period internal windrow temperatures will be maintained in excess of 55-degrees Celsius for more than 15 days.

Once again this composting process is effective in killing enteric bacteria, such as e-coli and other disease vectors. At the end of this process the finished compost will be tested by batch to ensure pathogen removal and sold as soil amendment for landscape and agricultural use.

3.2.12 ALTERNATIVE USES OF DIGESTATE

Stabilized organic materials such as digestate from this facility have value as post recycled engineered fuel (PREF). Composting may be deferred if a market is identified for PREF. Also the digestate and greenwaste materials may have value as feed for livestock after further processing. BEH has identified the highest and best use of organic waste as feedstock for production of renewable natural gas (RNG), and to this end will direct as much of the incoming materials as possible toward that goal. Secondary markets such as soil amendment may be used to maximize waste diversion and reuse of value added products as necessary to support production of RNG.

3.2.13 SUMMARY OF INPUTS AND OUTPUTS FROM THE RESOURCE RECOVERY FACILITY

The initial design volume for the proposed action is approximately 100,000 tons per year (TPY), or 320 tons per day (TPD) of incoming mixed materials. This feedstock material will include; municipal solid waste (MSW), construction and demolition waste (C&D), source separated organics (SSO), green waste, biomass and other organic material. The majority of the feedstock, 87,000 TPY (280 TPD) is composed of MSW and C&D waste. The estimated material composition of this feedstock consists of 10% recyclables (9,200 TPY), 39% organic fraction (34,500 TPY), 22% light fraction (19,800 TPY), and 29% inert landfill residue (23,500 TPY). The remainder of the incoming feedstock, 13,000 TPY is composed of mixed organic materials. The recovered recyclable commodities (30 TPD) of glass, metal and plastic will be delivered to local recycling brokers and buyers. The organic waste fraction (110 TPD) will be combined with the mixed organic materials (40 TPD) and processed through anaerobic digestion and compost operations to produce energy-rich biogas and nutrient-rich soil amendment material. At this design load the biogas will generate approximately 11 MMBTU per hour, which is equivalent to 2,000 diesel gallon equivalents per day. The post-digester stabilized organic material (digestate) can be mixed with shredded green waste to produce high-quality compost (105 TPD). The light waste fraction (63 TPD) consisting of high-heating value materials can be used for on-site power generation through thermal conversion operations or sold for off-site energy production. On-site energy conversion would generate approximately 2,000 kWh/day of renewable electric power and produce an estimated 20% ash and char residue to be landfilled (12 TPD). In addition to the 29% landfill residue (75 TPD) that is separated during the waste pre-processing operations; the organic/compost operations will produce another 11 TPD on inert landfill material. Additional

minor waste streams will be produced in air, wastewater and filtration residue. These will also be disposed at WHSL.

3.2.14 AGRICULTURAL PRODUCTION

BEH intends to use end products of anaerobic digestion (AD) to support the local farming efforts on the dry side of the Island. Land-applied solid digestate will increase local recycling of carbon, energy, and nutrients.

Solid digestate has been marketed for years as both a compost-based agricultural product and a commercial home-and-garden soil amendment product. The proposed operations may add shredded green waste material from collections to the digestate if soil improvement requires soil structural changes for improved growing conditions. In environments similar to the dry side of Waimea, there is considerable value in both the water and inorganic nutrients. Nutrients within the digestate are largely sufficient to offset the use of fossil fuel based chemical fertilizers, as well as associated environmental impacts caused by such fertilizers.

The proposed action includes use of both digestate fractions to increase agricultural production in the vicinity of the project site. Soils over a very large area in the project vicinity are classified as very poor (Class E) by the University of Hawaii Land Study Bureau (See Section 5.1.2). This classification is based on the soil productivity, availability of water, and suitability for tilling and cultivation. None of these criteria are favorable. Much of the land surrounding the proposed project site is not suitable for agriculture, and only poorly suited for extensive grazing operations. The use of digestate for soil improvements could open normally unsuitable areas for crops including cattle feed, biomass, sugarcane and other processed food production where similar productivity problems exist.

3.3 FINANCIAL DESCRIPTION AND DEVELOPMENT SCHEDULE

In 2009, the Hawai`i legislature approved legislation authorizing the issuance of up to one-hundred million dollars in special purpose revenue bonds ("SPRB") to assist BEH in the development of a waste conversion facility in Hawai`i. BEH intends to utilize the SPRB to finance eighty percent (80%) of the capital costs to develop the property, construct the facility, purchase and install the necessary equipment for the cogeneration plant. The remaining twenty percent (20%) of the project cost will be funded with equity contribution by the developer. BEH intends to submit its LOI to the Department of Budget and Finance in the second quarter of 2016. The application and review procedures including preparation of due diligence documents may take up to one year to complete. The SPRB therefore will be put to sale in the first or second quarter of 2017. The sale of the bonds may be made to the public through an investment banker, or directly to a financial institution. As mentioned above, the remaining equity required funding the balance of the cost and expenses will be paid through additional capital contributions made by the project developer.

3.4 REQUIRED PERMITS AND APPROVALS

A preliminary list of the major permits and approvals required for completion of the project include:

Land Lease: BEH has executed a Lease Option Agreement with WQJ2008 Investment, LLC and the Ukumehame Quarry Company LP tenants in common to lease a 14.99-acre portion within the 244-acre parcel. The landowners will subdivide the BEH lease area into a second parcel.

Subdivision: An application to subdivide a 14.99-acre portion of parcel 6-8-001:066 will be prepared and submitted to the County. The subdivision will produce a new parcel that remains under the same ownership, but will be leased to the proponent and used for the proposed action.

Special Permit from County of Hawaii: The County of Hawaii's zoning code allows waste treatment facilities only on industrial zoned (MG) parcels. The development of a resource recovery facility on agricultural lands requires a Special Permit from the Hawaii County Zoning Commission. Language of the ordinance is contained in the Zoning Commission Rule 6.
Zoning Commission Rule Paragraph 6-2 states:

Any person who desires to use its land within a State Land Use agricultural or rural district other than for an agricultural or rural use may petition the Commission for permission to use its land in the manner desired.
The Commission may grant the Special Permit if the proposed use:

> (a) Is an unusual and reasonable use of land situated within the Agricultural or Rural District, whichever the case may be; and
> (b) Would promote the effectiveness and objectives of Chapter 205, Hawaii Revised Statutes, as amended.

The Planning Commission shall also consider the criteria listed under section 6.b(3) (5) (A-G), which are:

A. Such use shall not be contrary to the objectives sought to be accomplished by the Land Use Law and Regulations;
B. The desired use shall not adversely affect surrounding properties;
C. Such use shall not unreasonably burden public agencies to provide roads and streets, sewers, water, drainage, school improvements and police and fire protection;
D. Unusual conditions, trends, and needs have arisen since the district boundaries and regulations were established;
E. The land upon which the proposed uses sought is unsuited for the uses permitted within the district;

F. The proposed use will not substantially alter or change the essential character of the land and present use; and
G. The request will not be contrary to the General Plan and official Community Development Plan and other documents such as Design Plans.

The proposed action is consistent with the objectives and criteria for Special Use Permits. It will be built and operated on the same parcel now having a Special Use Permit (Permit No. 833 (SP92-381 as amended) granted to West Hawaii Concrete for quarry and other activities. The State Land Use Commission has recommended that the 14.99-acre subject parcel be withdrawn by amendment to Special Use Permit SP92-381 at such time that the subdivision is completed. Because of the size of the proposed new parcel, jurisdiction would remain with the County Planning Commission. The Special Permit could be granted upon withdrawal of the portion of land from the State Special Use Permit SP 92-381.

Solid Waste Management Permit: All solid waste management facilities in the State are required to obtain a solid waste management permit from the Hawai`i Department of Health. Initial discussions with the appropriate personnel in DOH have begun to support the HEPA process.

RCRA Small Quantity Generator Permit: The EPA requires businesses and individuals who regularly generate less than 1,000kg per month of hazardous wastes or less than 10 KG of extremely hazardous waste to register as a small quantity generator. Although the facility will not accept any hazardous materials for thermal conversion, it is likely that some household hazardous wastes will get through the inspections and be left with the operator. A RCRA small quantity generators permit will be obtained in the event that hazardous materials are left at the facility.

Clean Air Permit: The facility will require a permit to operate under the Clean Air Act. The type of Air permit whether covered or non-covered is yet to be determined; however, the process for obtaining an air permit has begun and is likely to continue until after publication of the DEA. Initial discussions with the Hawai`i Department of Health Clean Air Branch have begun as part of the HEPA process.

NPDES Permit: Grading of the facility will ultimately cover more than one acre of land. A National Pollution Discharge Elimination System (NPDES) Form C construction stormwater permit will be required along with a notice of Intent for general coverage under the NPDES program. This permit will be obtained from the Hawai`i Department of Health prior to the start of construction. Initial discussions with the Clean Water Branch of DOH have begun to support the HEPA process.

Grading/Building Permits: Building, electrical, plumbing and grading permits will be obtained from the County of Hawai`i at such time as the final designs are completed.

PART 4: ALTERNATIVES TO THE PROPOSED ACTION

4.1 ALTERNATE TECHNOLOGIES

In 2014, the United States generated about 4,093 billion kilowatt-hours of electricity US Energy Information Administration, 2015). About 67% of the electricity generated was from fossil fuels (coal, natural gas, and petroleum).

Major energy sources and percent share of total U.S. electricity generation in 2014:

- Coal = 39%
- Natural gas = 27%
- Nuclear = 19%
- Hydropower = 6%
- Other renewables = 7%
    - Biomass = 1.7%
    - Geothermal = 0.4%
    - Solar = 0.4%
    - Wind = 4.4%
- Petroleum = 1%
- Other gases < 1%

By contrast over 70% of electric generation in Hawaii is from petroleum. 13.6% was from coal; 5% from wind, and around 3% each from biomass, solar and geothermal (Hawaii State Databook 2013).

Energy used for transportation tells quite a different story. Americans burn 13 million barrels of petroleum fuels per day. 98% of transportation is fueled by petroleum, with the vast majority of the remaining 2% taken up by ethanol. Only around 3200 of the 1.2 million vehicles registered in Hawaii are electric. Other alternative fuels now in development include methanol, fossil propane, hydrogen and methane.

When used for transportation methane is called Compressed natural gas (CNG) or when is from a renewable source it is renewable natural gas (RNG). CNG/RNG vehicles emit 85-90 percent less carbon monoxide, 10-20 percent less carbon dioxide, and 90 percent fewer reactive non-methane hydrocarbons than gasoline-powered vehicles. Reactive hydrocarbon emissions produce ozone, one of the components of smog that causes respiratory problems. These favorable emission characteristics result because natural gas is 25 percent hydrogen by weight; the only combustion product of hydrogen is water vapor. Natural gas is usually placed in pressurized tanks when used as a transportation fuel. Even compressed to 2,400-3,600 pounds per square

inch (psi), it still has only about one-third as much energy per gallon as gasoline, requiring extra tanks to be installed (US Department of Energy 2014).

Biomass power in Hawai`i has historically centered on waste materials that would represent a cost or environmental problem if not used for energy. The economics of most biomass technologies rely on a tipping fee. Examples include H-Power and AES Power in Honolulu that burn MSW and tires respectively. The Hawaiian Commercial and Sugar (HC&S) Mill on Maui is the last remaining sugar mill in the State which uses bagasse that would otherwise be a significant disposal problem. The historical relationship between biomass power and waste products is long and closely tied; but historically for production of electric power, not transportation fuels. Hawaii's utilities, except for Kauai, are publicly traded monopolies. The primary responsibility of their directors, by law, is to benefit the shareholders. For the Utilities, purchasing power from independent power producers does not serve that objective. While fuels are also regulated by the PUC it will be difficult for the dominant suppliers to build the barriers to entry that are equivalent to the electric utilities.

Many entities, including Hawaii Gas and the HEI utilities have embraced the concept of fossil natural gas as a bridge fuel as a primary supplement to liquid petroleum fuels until such time as hydrogen or other clean renewable fuels become practical. RNG is a clean-burning carbon neutral fuel. RNG can be used in the same way as traditional natural gas, to heat water, cook food and warm our homes and businesses. It's part of our clean energy future. Securing economic growth and protecting the environment, long viewed as competing ends, are increasingly seen as interdependent. As a result, efforts to pursue these ends through both government policy and private investment have, in part, focused on the role that renewable natural gas can play in achieving the critical objectives of a clean energy economy: reducing greenhouse gas (GHG) emissions, creating sustainable jobs and increasing the diversity of the domestic energy supply portfolio, thereby enhancing America's energy security. At its full potential, RNG could well be the most reliable and the most cost-effective renewable energy source. It's clean and efficient. When burned for energy, renewable natural gas has the same low-carbon properties as natural gas, but with an added unique benefit. When captured for conversion into renewable gas, methane that would otherwise have entered directly into the atmosphere is combusted, resulting in the release of water vapor and a smaller amount of CO_2, which is a much less harmful GHG. The heat trapping (or greenhouse) effect resulting from burned methane is up to 20 times less potent than that resulting from directly released methane. Capturing these gases for renewable natural gas production is a positive step toward climate change mitigation. Renewable natural gas can be used directly at the site of production; in residential, commercial and industrial applications; for electricity generation or for transportation in the form of compressed natural gas; or even for liquefied natural gas.

Benefits of Renewable Natural Gas include:

- Reduction in Direct Greenhouse Gas Emissions. Renewable gas reduces GHG emissions by making use of a renewable fuel. This scenario represents recycling the carbon already circulating in the environment. As a transportation fuel, renewable gas produces more than 25 percent less GHG emissions than gasoline. The biogas potential from all feasible sources would be equivalent to 10 billion gallons of gasoline per year, reducing GHG production by the equivalent of 580 million tons of CO_2.
- Improved Waste Management. Collecting and processing animal waste from agricultural activities prevents run-off into local waterways and reduces groundwater contamination.
- It represents a new revenue source for American farmers. Renewable gas creates an opportunity for dairy, hog and poultry farmers to convert waste into a valuable supplementary revenue source.
- Increased domestic energy production. Renewable gas provides improved energy and national security by increasing the domestic production of renewable energy that could replace foreign produced transportation fuels such as oil.
- Innovative Domestic Job Creation. As the renewable natural gas industry continues to grow, increasing production leads to the development and deployment of new technologies, while creating new green jobs for Americans.

Currently, renewable natural gas that is used directly for electricity generation receives a production tax credit (PTC), but there are no incentives for renewable gas production directed towards non-electricity producing applications. There are many other tax incentives for various renewable energy sources and technologies. An investment tax credit (ITC) for renewable gas for direct use would create a level playing field for investors and help generate a clean and renewable resource from products that are currently emitting greenhouse gas emissions.
BEH has long standing relationships with local waste management companies currently operating collection services throughout the Big Island and Maui. The objective of the proposed action is to develop a more efficient method of waste management which reduces environmental impacts and waste management cost in their area of operation.

Intermittent sources are not considered a suitable alternative due to the excess capacity that now exists in the generating infrastructure. Replacement of stable power sources with intermittent sources may be difficult for HELCO to justify on the basis of grid stability. Methods that do not utilize waste are also not considered because the proponents' primary objective is to improve current waste management practices. Alternatives to the proposed action must be currently available waste conversion technologies with potential to:

- Produce a reliable source of energy or fuels,
- Reduce environmental impacts associated with traditional waste disposal, and

- Stimulate the local economy through reduction in imports, increased local production, and maintaining Hawaii's primary asset, its environment.

Several technologies can be identified to meet the criteria for reliability and reduction of imports.

Geothermal Energy: A principle asset of Hawaii County is its plentiful supply of geothermal heat. At its ultimate development geothermal energy may supply a substantial fraction of the line power required to run the County, and with interisland cable possibly the entire State. Geothermal power is cost effective and Rankine cycle technologies create virtually no emissions during normal operations. Geothermal energy can be produced at competitive rates and is a well demonstrated technology. Although geothermal energy could and should be developed, it does not satisfy the criteria on reducing the environmental impacts of traditional waste disposal, and will receive no further consideration in this assessment.

Incineration: Hawaii has only recently been so dependent on fossil fuels due to the sugar industry, which supplied almost half of the electricity needed in the State at its peak. All of it was derived from waste bagasse which would otherwise be a disposal problem. Incineration of biomass is still done at the HC&S mill on Maui, which is the last operating sugar mill in Hawaii. Incineration of municipal solid waste for many years was the cheapest form of solid waste management. The Clean Air Act of 1972 placed restrictions on emissions from incinerators and other sources of air pollution. The cost of operating air pollution control equipment dramatically increased the cost of incineration, which surpassed landfilling as the most economical method for disposing waste.

Incineration of MSW is an important component of the waste management strategy for Oahu. Incoming waste is prepared and cleaned of non-processable and non-burnable materials through a series of conveyors and shredders, then combusted in furnaces at temperatures approaching 2,000 degrees Fahrenheit to reduced organic materials to an inert ash residue that is only 10 percent of its original volume. As a result of the combustion process, heat is released and transferred to the boiler tube surfaces where water inside the tubes is turned into high pressure steam. The steam is then sent to a turbine/generator where mechanical energy is converted to electricity. Flue gases pass through a state-of-the-art pollution control system before being released through the stack. The facility operates two 854 tons-per-day (RDF) water wall furnaces and one 900 ton-per-day mass burn unit. The refuse capacity is 3,000 tons per day.

Up to 90 megawatts of electricity is generated and sold to Hawaiian Electric Company. H-Power supplies up to 9% of the electric demand for Oahu. Incineration may be an acceptable alternative to the proposed action or for the dry organic component of incoming waste. If the proponent chose to incinerate this dry organic material, it would consist of between 94 and 150 tons per day of sorted wood paper, textile and dried digestate. Energy production from incineration would be similar to that discussed in Chapter 3.2.10.

Incineration of MSW meets the three criteria for consideration in this assessment. This technology is well demonstrated and reliable source of electric energy. It reduces the environmental impacts of landfilling by converting organic materials into CO_2 rather than methane (CH4). Methane, as a greenhouse gas, is 23 times more damaging to the atmosphere than an equivalent amount of CO_2. It allows for greater recovery of recyclable materials, and displaces imported petroleum, and would require local labor to operate. Despite its advantages incineration of waste is not being considered in the proposed action due the controversial nature of the practice and likely public opposition.

Pyrolysis/Gasification: Gasification is a term used for a process similar to combustion but with limited or no oxygen so that organic materials are not completely oxidized (burned) but instead they are dissociated into their gaseous components (gasification), or reduced to long-chain hydrocarbons (pyrolysis). One of the big differences between gasification and incineration is that a gasifier has no stack and very few emissions because the gasses produced are the most valuable component and they are captured and refined into gaseous or (through the Fischer-Tropsch process) liquid fuels. Gasification of coal or biomass begins with long-chain organic molecules and ends with the production of hydrogen gas, methane, carbon dioxide, carbon monoxide, water, and minor components as shown in Figure 4-1.

The chemistry of gasification is quite complex and is accomplished through a series of physical transformations and chemical reactions within the gasifier. Some of the major chemical reactions are shown in the diagram below. In a gasifier, the carbonaceous feedstock undergoes several different processes and/or reactions:

- *Dehydration* – Any free water content of the feedstock evaporates, leaving dry material and evolving water vapor which may enter into later chemical reactions.
- *Pyrolysis* – This occurs as the feedstock is exposed to rising temperature in the gasifier. Devolatization and breaking of the weaker chemical bonds occurs, releasing volatile gases such as tar vapors, methane, and hydrogen, along with producing a high molecular weight char which will undergo gasification reactions.
- *Combustion* – The volatile products and some of the char react with limited oxygen to form carbon dioxide (CO_2), carbon monoxide (CO), and in doing so, provide the heat needed for subsequent gasification reactions.
- *Gasification* – The remaining char reacts with CO_2 and steam to produce CO and hydrogen (H_2).
- *Water-gas-shift and methanation* – These are separate reversible gas phase reactions taking place simultaneously based on gasifier conditions. These are minor reactions which play a small role within in the gasifier. Depending on the desired product, the syngas may undergo further water-gas shift and methanation processing downstream from the gasifiers.

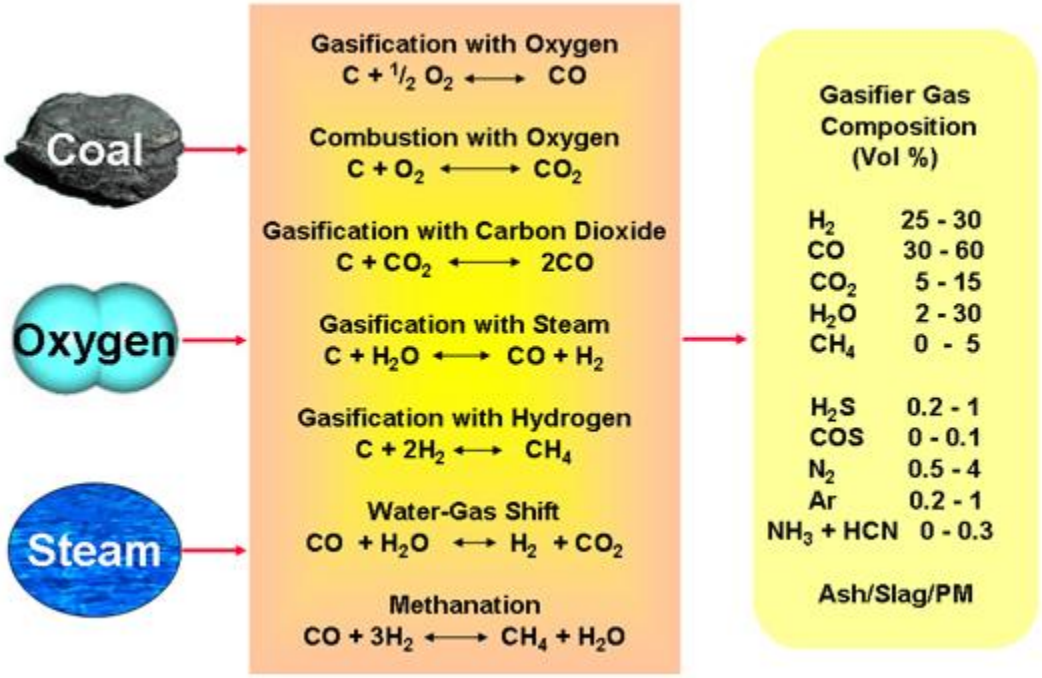


Figure 4-1: Schematic representation of the chemical reactions and products of gasification.

Thermal technologies such as gasification and pyrolysis will play a vital role in the future of waste management and energy production as they have in the past. Gasification of coal began in the early 1900s. Coal gasification and conversion to synthetic fuels was developed in Germany by Franz Fischer and Hans Tropsch in 1923. During World War II, Germany used synthetic oil manufacturing to produce substitute oil products by using the Fischer–Tropsch process.

Today, worldwide commercial synthetic fuels plant capacity is over 240,000 barrels per day, including gasification/Fischer Tropsch plants in South Africa, Qatar, and Malaysia. The leading company in the commercialization of synthetic fuel is Sasol, a company based in South Africa. Sasol operates the world's only commercial Fischer Tropsch coal-to-liquids facility with a capacity of 150,000 barrels per day (24,000 m^3/d). Numerous large projects have also been built in China and Qatar.

Biomass gasification has been demonstrated at smaller scales by European and American companies and are successfully operating around the world. The majority of biomass gasification plants use the producer gas for direct firing of boilers or turbine generators. Clean-up of syngas can be done using the Fischer-Tropsch method, although the catalysts are somewhat expensive particularly on a smaller scale. Biomass gasification requires a very stable internal environment to produce consistent quality syngas. Lumber mills in the Pacific Northwest and Canada have successfully demonstrated the use of sawdust for gasification, but to date, successful gasification of municipal solid waste (MSW) has not been demonstrated. The difficulty associated with gasification of MSW is the heterogeneity of the incoming fuel which results in an unstable reaction within the gasifier. This may be resolved through pre-treatment,

sorting or drying waste as well as artful blending; however, gasification of MSW is not well demonstrated and not nearly as reliable as anaerobic digestion.

The major components of the proposed action will involve preparation of waste for anaerobic digestions, but the proposed action is likely to include some form of gasification or pyrolysis for the residual light fraction of organic waste entering the facility. Using the sorted, dried, and blended light fraction will reduce variations introduced from infeed variations. Gasification technologies meet the three criteria for consideration in this assessment. It reduces the environmental impacts of landfilling by converting organic materials into usable gas or liquid fuels. It allows for greater recovery of recyclable materials, and displaces imported petroleum, and would require local labor to operate. On this basis pyrolysis/gasification cannot be eliminated from further consideration, and is likely to be a component of the proposed resource recovery effort at the project site. Pyrolysis and gasification differ in one significant area from incineration; that is the gasses are largely captured and converted to fuel rather than discharged to the atmosphere.

4.2 ALTERNATIVE LOCATIONS

Three alternative locations were analyzed for suitability. The criteria for assessing the site selection are:

- Sufficient available land and water,
- Proximity to the source of waste generation,
- Proximity to sensitive areas,
- Potential impacts to view planes, and
- Adequate access and egress.

The site selection criteria are not weighted but the first criterion is considered a project killer; and as a result, no sites without at least 10 acres of land and ability to obtain water for agricultural and industrial uses are considered.

For this document we assume that the center of generation is at the intersection of Ali`i Drive and Kuakini Highway in Kailua Kona. The haul distance between the collection and disposal points has a significant effect on the cost of doing business as well as social and environmental impacts associated with heavy truck traffic and emissions. The proximity of this facility to sensitive areas may have influence on both environmental quality and quality of life issues. Sensitive areas can include those frequented by threatened and endangered species, a scenic natural area, any unique or irreplaceable site from a cultural or historical perspective, or sensitivity can be defined as a location with competing land uses that may be impacted by the proposed development.

The view planes along the coastline of the Big Island are quite important to residents and visitors alike. Locations that interfere with the viewplane or scenic vistas in West Hawaii would be considered to have a significant impact.

The adequacy of access and egress from the facility is important to safety of BEH drivers and other highway users as well as the cost of development. A location that requires significant infrastructure development is likely to increase the cost of construction to the extent that it would impact the economics of the proposed action.

4.2.1 THE PROPOSED LOCATION

Siting for resource recovery facilities in Hawaii has been challenging for both municipal and private developers. BEH has been actively seeking suitable locations for their facility since 2008. The proposed action is to co-locate the facility with the West Hawaii Concrete quarry in Waikoloa. The site was chosen over approximately 4 others because of its location and physical characteristics.

The West Hawaii Concrete (WHC) site is located off of Waikoloa Road 2.7 miles east of its origin at Queen Ka`ahumanu Highway. The site is 3 miles by road to Waikoloa Village (2.8 miles overland); 6.6 miles by road to the WHSL (3 miles overland); 9.7 miles west of the intersection with Mamalahoa Highway; 20 miles southwest of Waimea and 28 miles north of Kailua-Kona. Its nearest residential neighbor is in Waikoloa approximately 2.8 miles to the north, and The Waikoloa resort is 3.5 miles to the east. The parcel is isolated from Waikoloa Road by a paved dedicated access road ¾ of a mile. The project site and existing quarry and waste management uses are not visible from any developed parcel. Similar and complementary land-use activities are already in-place, including quarry operation, rock crushers, and a greenwaste recycling area.

Figure 4-2: Location Map showing Alternative Waikoloa Quarry site in relation to Waikoloa Village, Waikoloa Resort and the West Hawaii Sanitary Landfill.

The area is arid with little rainfall and no soil. Local topography is uneven, which reduces the ability to observe the area from a distance. The quarry operations have been ongoing since 1996, and are authorized under Special Permit No. 833 (92-381).

The Waikoloa Quarry location has both strong points.

- Land area is more than adequate
- Water is supplied by an existing 6-inch force main;
- It is 28.5 miles from the center of waste generation,
- There are no nearby sensitive areas or receptors,
- There are no impacts to view planes, and the site is quite far from any other development,
- Access and egress from Waikoloa Road is adequate to handle traffic associated with the facility.

4.2.2 ALTERNATE LOCATION NO. 1: WAIMEA WASTEWATER TREATMENT PLANT SITE

Alternate site 1 is adjacent to the Waimea Wastewater Treatment Plant at 68-1650 Mamalahoa Highway in Kamuela, Hawai`i. (Figure 1-1). The current designation of the property is TMK #

6-8-001:070, (14.94 acres). The parcel is one mile southwest of the Waimea airport, 2 miles south of the urban areas of Waimea, and 6.5 miles northeast of Waikoloa as the crow flies.

The proposed location scores well on many points.

- It has the adequate amount of land available within a suitable parcel.
- It is 36 miles from the center of waste generation which is longer than some of the other potential locations, but centrally located to allow for Island-wide growth.
- It is not close to any known sensitive area,
- It is protected from view from almost all angles, and
- It has an existing access and egress easement through Parker Ranch land.

Alternate site No 1 would be a suitable location for the proposed action. Parker Ranch has extended a lease offer to BEH for lease of the property for the purpose of resource recovery activities, and BEH has negotiated to acquire the property. The terms of the lease are not as favorable as those for the proposed action and the site is further from the center of generation than the selected site resulting is a higher cost of operation. Environmental impacts associated with the proposed action are similar between the sites, except that Alternative 1 is slightly more visible from public right of ways, closer to residential areas and would require more improvements. These factors make the proposed location preferable to Alternative 1.

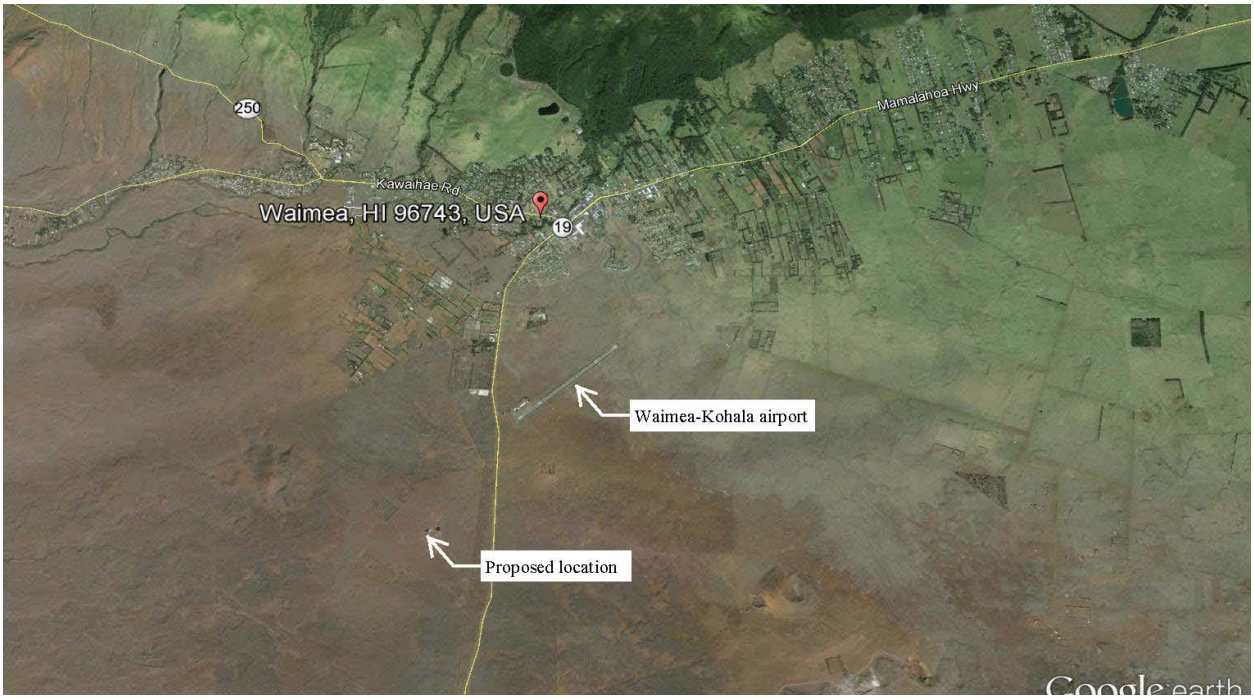


Figure 4-3: Detailed location of Alternate 1 site in relation to Waimea Town and the Waimea-Kohala Airport. The boundary is located 2000 feet west of Mamalahoa Highway.

Figure 4-4: Site Map of the Facility showing the alternate location parcel boundaries and existing wastewater treatment infrastructure. The Integrated Resource Recovery Facility site plans are superimposed on the photograph adjacent to the south side of the existing infrastructure.

4.2.3 ALTERNATE SITE 2: THE NATURAL ENERGY LABORATORY OF HAWAII (NELHA)

The applicant intended to place the facility at the Natural Energy Laboratory of Hawaii as early as 2008. A term sheet was developed with the NELHA Board of Directors and a lease agreement was pending approval of an EIS. In 2010 the EIS Preparation Notice was published, but by 2011 it became clear that NELHA did not have funds or authorization to allow for an access road to be constructed. The applicant began negotiations with the State Department of Transportation to install a new site access road, but was informed that the process for planning, design and authorization for access to the site would take many years. NELHA offered land that was not accessible during any reasonable period for business development, and for this reason efforts to place the facility at this site have been put on hold, pending guaranteed accessibility approvals and construction of necessary access roads. Figure 4-5 shows the site layout proposed for NELHA.

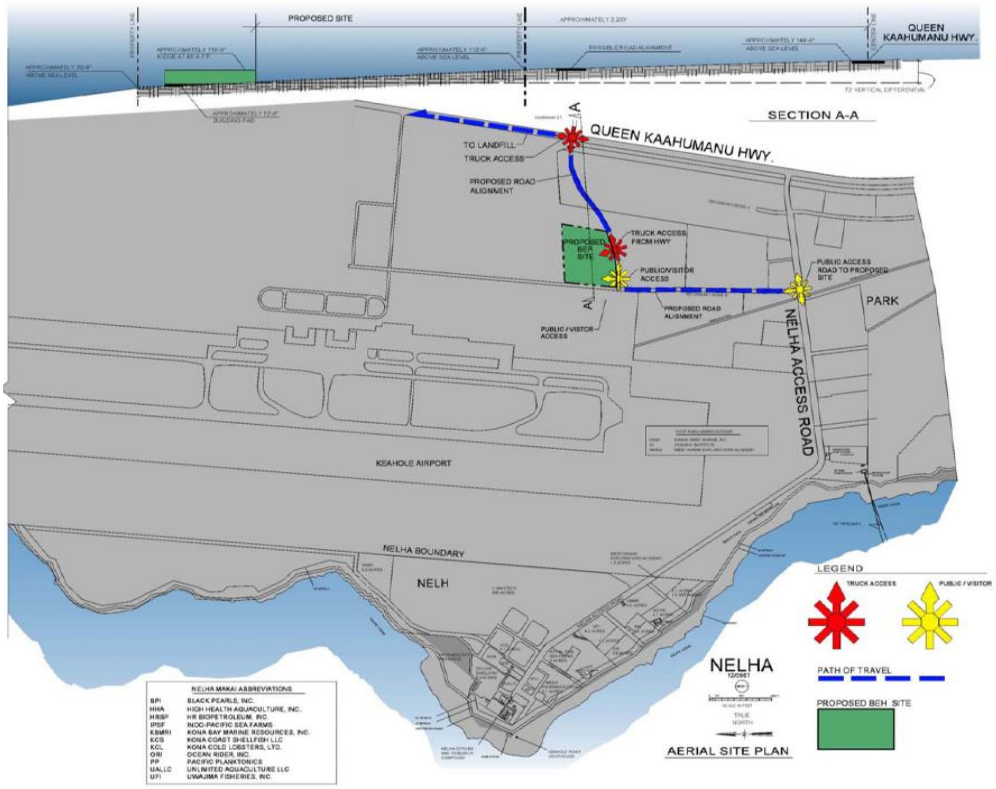


Figure 4-5: Proposed NELHA alternative 2 site showing the proposed access point from Kaahumanu Highway. The parcel offered by NELHA has no existing access and none can be derived within a reasonable period.

4.2.4 ALTERNATIVE SITE 3: WEST HAWAI`I SANITARY LANDFILL

The County of Hawai`i owns the WHSL, which is operated under a contract with Waste Management of Hawai`i. The site opened in 1993 and is approximately 300 acres, of which 149 acres are permitted for landfill activities. The landfill accepts approximately 360 tons per day or 130,000 tons per year. The estimated life of West Hawai`i Landfill is 55 years, based on current tonnage. Waste collected by west side commercial haulers is now disposed at this location. Tipping fees paid by commercial users are now set at $85/ton, a cost that is passed on to the consumer (http://www.hawaiizerowaste.org/facilities/).

The county has developed the non-landfill portions of the site for greenwaste composting, metal recycling, disaster debris management, and for alternative waste processing technologies. Either of these areas would be suitable for the proposed action. Lease acquisition for non-county development would be through a solicitation and bid process originated by the County Department of Environmental Management.

The WHSL currently has no access to potable water. Industrial brackish water could be derived from shallow wells installed on the site; however, anaerobic digestion is quite sensitive to salts

and makeup water for the AD processing would have to be trucked in to the site at some considerable expense. The WHSL is approximately 24 miles north of Kailua-Kona, the source of the majority of waste.

Alternative location No. 3 scores well on some points.

- It has the adequate amount of land available within a suitable parcel.
- At 24 miles from the center of waste generation it is the least haul distance
- It is close to the Waikoloa Resort, and any new waste management development at the WHSL site would generate resistance from the Waikoloa and the Kona Coast Resort Association.
- Manmade berms have protected the site from view from almost all angles, this practice would have to be extended to cover the alternative technology site.
- It has an existing access and egress easement, but the lack of potable water would likely result in a much higher cost of operation.

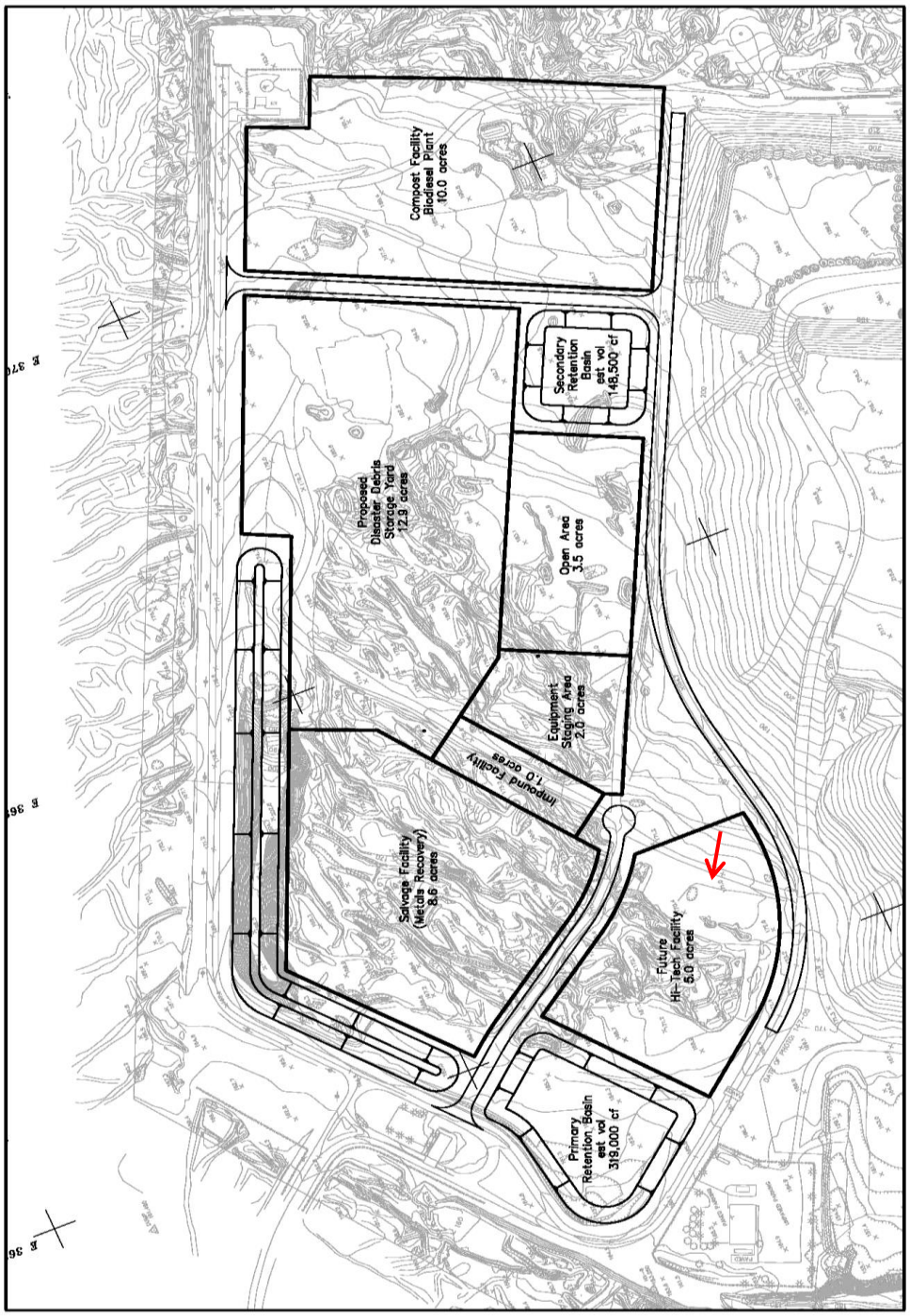


Figure 4-6: Alternative WHSL Site at Pu`uanahulu. Note the designated area for a future Hi-Tech facility. The WHSL site has no access to potable water which is a serious flaw for anaerobic digestion.

4.3 NO ACTION ALTERNATIVE

The no action alternative is to not build any resource recovery facility. The current waste management infrastructure in West Hawai`i utilizes a state of the art landfill that has sufficient capacity to last for more than 50 years at current rates. This capacity is quite long in comparison to other areas in Hawai`i. The 50-year life estimate for WHSL does not include accepting waste from east Hawaii. The South Hilo Sanitary Landfill (SHSL) is nearing capacity and one of the few alternatives remaining is for the County to haul waste from the East side to WHSL. The process has already begun with the County reshuffling the disposal location for a number of their transfer stations. Operation of the two landfills represents the largest single component of the County's general funds, and trucking will add to that cost.

The no action alternative does not support the objectives of the Integrated Solid Waste Management Plan which calls for source reduction and reuse as the preferred methods of waste management. It also does nothing to reduce our dependence on foreign oil.

Landfilling is traditionally considered the least cost waste management system; however, the proposed resource recovery facility will be comparable. Landfilling is the least environmentally-friendly method of waste management. There is no incentive to recycle wastes with a large capacity landfill available; many materials that could be cost-effectively recovered in a more advanced waste-processing system are buried and lost. Landfilling also releases the most greenhouse gasses of all waste management methods. All organic wastes decompose directly into carbon dioxide, methane or volatile organic carbons. Those which are not captured and flared by the landfill gas collection system are released directly to the atmosphere. The no action alternative is rejected because it does not meet the criteria for the proposed action and it does not support the County's planning objectives.

4.4 DECISION CRITERIA

The proposed action at the proposed location is selected because it is the least impacting, most feasible, and least cost alternative that is supported by the Planning objectives described in the County's Integrated Solid Waste Management Plan and elsewhere.

PART 5: DESCRIPTION OF THE AFFECTED ENVIRONMENT

5.1 PHYSICAL ENVIRONMENT, WATER AND AIR QUALITY

5.1.1 GEOGRAPHY AND TOPOGRAPHY

The project site is located on the western flank of Mauna Kea Volcano and is within the USGS stratigraphic formation identified as Hamakua Volcanics (hm) (Sherrod e.t al, 2007). The unit consists of intermittent lava flows mixed with wind-blown tephra fall and colluvial deposits. The parcel has a mild slope toward the west with elevation between 800 and 820 feet above mean sea level (msl). The site and surrounding areas do not have gulches or other natural drainage features that are commonly found at lower elevations.

5.1.2 SOILS

Soils in the State of Hawaii have been characterized by the Natural Resources Conservation Service (NRCS, 2014). The majority of soils at the project site are identified by NRCS as: A`a lava flow with characteristic described below:
Lava flows, `a`a, 2 to 20 percent slopes

MAP UNIT SETTING

- *National map unit symbol:* 2klfr
- *Elevation:* 0 to 13,680 feet
- *Mean annual precipitation:* 7 to 80 inches
- *Mean annual air temperature:* 41 to 86 degrees F
- *Frost-free period:* 180 to 365 days

MAP UNIT COMPOSITION

- *Lava flows, `a`a:* 100 percent

SETTING

- *Landform:* Aa lava flows
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear, convex
- *Parent material:* Aa lava

Typical profile

- *C - 0 to 39 inches:* extremely cobbly sand
- *R - 39 to 49 inches:* bedrock
-

PROPERTIES AND QUALITIES

- *Slope:* 2 to 20 percent

- *Percent of area covered with surface fragments:* 10.0 percent
- *Depth to restrictive feature:* 20 to 60 inches to lithic bedrock
- *Natural drainage class:* Excessively drained
- *Runoff class:* Very low
- *Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately low (0.00 to 0.06 in/hr.)
- *Available water storage in profile:* Very low (about 0.4 inches)

INTERPRETIVE GROUPS

- *Land capability classification (irrigated):* 8s

Land capability classification (nonirrigated): 8s

The parcel has also been classified by the University of Hawaii's Land Study Bureau (LSB), which is an agricultural productivity classification. "A" rated soils are the most productive while "E" classed soils are the least. Soils in the project areas all received a productivity rating of "E" signifying that the area is not suitable for extensive agriculture. Reasons for the poor classification include shallow rocky soils which hold water poorly and the lack of practically available irrigation water.

Because the soil is of marginal agricultural value there are few potential impacts on soils or agriculture resulting from the withdrawal of agricultural land from the available pool for the proposed project. Soil improvement using digestate are contemplated pending approval and receipt of permits. If these soil improvement demonstrations are successful, the project may exert positive impacts on the agricultural value of the surrounding areas.

5.1.3 SURFACE WATER AND GROUNDWATER

A hydrologic assessment of the surface and groundwater resources at the site was completed by Tom Nance Water Resources Engineering, Inc. in June 2015. The report summarizes current knowledge of groundwater conditions beneath, and in the general vicinity of the project site. Groundwater beneath the site and encompassing the area from the shoreline for at least seven (7) miles inland occurs as a basal lens which floats on saline groundwater beneath it and shows level fluctuations in response to ocean tides and longer-tern mean ocean level changes. For about five miles in land, including directly beneath the quarry site, the groundwater is brackish but generally suitable for landscape irrigation of salt tolerant grasses and plants. The groundwater beneath the site stands about four (4) feet above sea level. Ground elevation at the quarry varies from 680 to 920 feet above sea level. The intervening lava between ground level and the groundwater below consists of numerous flows comprising what is known as the vadose (unsaturated) zone. The WHC quarry site is located in the Anaehoomalu Aquifer System as delineated by the State Commission on Water Resource Management (CWRM). At the quarry site, the delineated aquifer is 5. 7 miles wide and the quarry is situated midway across that width. The CWRM has set the sustainable yield of the aquifer based on a calculated recharge of 69 million gallons per day (MGD) over its 291 square mile area (CW~M ' s 1990 Water Resources

Protection Plan). That is equivalent to about five (5) inches per year or 22 percent of the rainfall on the aquifer's total area. Since there are no operating wells upgradient of the WHC quarry site, it also translates to a flow on the order of 12 MGD per mile of width beneath the quarry site. Nance estimates the water quality beneath the site is brackish; with chlorides in the range of 250 – 350 mg/L. This water quality is suitable for irrigating salt tolerant species but not a wide range of landscape plants.

The report concludes that activities at the site are not likely to impact the groundwater quality of quantity. Although the USGS topographic maps show intermittent streams in the vicinity of the quarry, no surface features reflected overland flow. An assessment of the percolation rates of this relatively un-weathered A`a make it unlikely that any overland runoff could occur.

5.1.4 AIR QUALITY AND CLIMATE

The County of Hawai`i has very few sources of air pollutants, but one of them is quite significant. The largest source of air emission in the State is Kilauea Volcano located over 58 miles southeast of the project site in Kau. Air emissions from the volcano consist primarily of sulfur dioxide and particulate matter less than 2.5 microns. Despite this distance, the magnitude and the predominant northeasterly trades bring volcanic haze (VOG) to West Hawai`i on a regular basis. The project area is among the least impacted portions of the Big Island due to its location and topography, but VOG regularly reaches the Waikoloa area. Other sources of air emissions in West Hawaii are limited to one power generating station using fossil fuel, two airports and a few highways.

The proposed resource recovery activities and production of energy will involve point source emissions of regulated air pollutants. These point sources include RNG-fired engines, pressure release valves, storage tanks, thermal conversion emissions, and occasionally an emergency flare.

Anaerobic digestion captures gasses that are produced as a result of the decomposition of organic materials and refines them for use in energy production. Approximately 50% of the organic materials introduced are converted to methane (CH_4), which is the primary energy producing gas. The main byproduct of this process is carbon dioxide (CO_2), which is not a regulated air pollutant. Capturing the methane produced in anaerobic digestion results in a positive impact to the environment over alternative methods of disposal that release them to the atmosphere. Permits to operate will be required from the Clean Air Branch of the Department of Health. Thermal conversion of the dry fraction of waste will create emissions from the gasification or pyrolysis processes. This equipment will include air-pollution control components to reduce the release of gasses and particulate matter to a level that is acceptable under the clean air act. All equipment will obtain the appropriate operating permits from the Hawaii Department of Health. West Hawaii's climate provides an international attraction for tourists because of its consistent weather patterns and mild climate. The annual average temperature range is between 65 and 85

degrees Fahrenheit. The average annual rainfall is around 25 inches, with rainfall more consistent than in the northerly islands of Hawai`i at around 2 inches per month. Tradewinds are somewhat mitigated by the mountains that lie windward of the project site, and are generally hidden beneath a diurnal convection pattern cause by differential heating of the land and sea.

5.1.5 NOISE AND ODOR

The project site is located in a rural area with no nearby neighbors. The nearest residence is 2.7 miles west in the Waikoloa Village. The nearest residence in Waikoloa town is 3.1 miles to the north. Even by Big Island standards the project site is relatively isolated. These distances are sufficient to dissipate any but the largest noises. Odors tend to dissipate faster, particularly of rough terrain that is often quite windy. Existing sources of noise and dust include blasting and rock crushing operations in the same quarry.
New sources of noise from the proposed action will include:

- vehicular noise from waste delivery trucks currently operating out of the old industrial area in Kailua-Kona
- Muffled Heavy equipment and generator noise coming from inside buildings
- Miscellaneous noise from electrical equipment such as pumps and fans

Noise is regulated by the Hawaii Department of Health under Hawaii Revised Statutes (HRS) Title 19-342F. In the agricultural district noise levels at the property line are restricted to levels below 70 Db both day and night. The majority of operations associated with the proposed resource recovery facility will occur inside closed buildings. Traffic will be restricted to business hours, however some of the mechanical systems will be operational at all times.
None of these sources are expected to reach levels nearing 70 Db at the property line.
Odors associated with MSW will be controlled using three different methods. Best Management practices will be developed and implemented as part of the solid waste management permit. Waste delivery will be in trucks that are required to cover their loads. Odors on delivery vehicles are minimized by restricting air circulation within the waste. Waste hauling vehicles arriving and departing the facility will be required to be completely enclosed.

The tipping floor is located inside a building with rapid roll-up doors. As a waste vehicle approaches the rollup door is opened and subsequently closed by an electric eye switch. Once inside the building odors are controlled by ventilating the structure through an odor filter. These filters are commonly available and effective at reducing odors. Different models may use compost or diatomaceous earth as the active filter media. The tipping floor will be washed at the end of each day to minimize bacterial degradation and resultant odors within the facility. No waste will be stored outdoors.

Gasses generated by anaerobic digestion and thermal conversion processes will be scrubbed and captured for use. The filter media from scrubbers captures volatile organic carbons that create the majority of odors. Standard Air pollution control equipment will be installed on emission sources as required by the clean Air Act. All required permits will be secured in advance of operation or, as required, construction.

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 FLORA AND FAUNA

A botanical survey of the entire quarry site was conducted in June 2015 by Ron Terry Ph.D. and Patrick Hart, Ph.D. of Geometrician Associates, LLC (Appendix B). The survey objectives were to Identify any threatened or endangered species on the subject property, Identify and report all species observed, determine the likelihood of the presence of threatened and endangered species, and identify the locations of any threatened or endangered species found on the property. Geometrician reported that the species observed were extremely non-diverse owing to the disturbance and lack of natural soil at the site. All eight plant species are listed in table 5-1. Of these only two were indigenous and they were poorly represented. None of the plant species were endemic, or otherwise rare or unique. During the survey 5 species of birds were observed. None were indigenous rare or unique (Table 5-2). No threatened or endangered species were observed.

The area may be frequented by Pueo (*Asio flammeus sandwichensis*) and Golden plover (*Pluvialis fulva*) both native but not threatened and protected under the Migratory Bird Treaty Act (MBTA).

5.2.2 THREATENED AND ENDANGERED SPECIES

No threatened or endangered species were observed or believed to be present at the site. Tree tobacco plants were observed. These are occasionally predated on by the endangered Blackburn's sphinx moth.

It is possible that small numbers of the endangered endemic Hawaiian Petrel (*pterodroma sandwichensis*), and the threatened Newell's Shearwater (*puffinus auricularis newelli*), over fly the project area between the months of May and November (Harrison 1990). Both of these pelagic species nest high on the slopes of Mauna Loa and in the saddle area between Mauna Loa and Mauna Kea (Henshaw 1902). Dr. Terry specifically searched for indications of the Blackburn's Sphinx Moth (BSM). Although there are scattered tree tobacco plants present, no indications of BSM colonization within the quarry.

Table 5-1: List of plant species observed at Waikoloa Quarry June 2015 (R. Terry and P.J. Hart, 2015)

Scientific name	Common name	Life form	Status*
Argemone glauca	Pua Kala	herb	I
Calotropis giantea	Crown flower	shrub	A
Cenchrus setaceus	Fountain grass	herb	A
Nicotianica glauca	Tree tobacco	shrub	A
Prosopis pallida	Kiawe	tree	A
Senna occidentalis	Coffee senna	herb	A
Waltheria indica	Uhaloa	herb	I
Verbascum thapsus	mullein	herb	A

* I= Indeginous, A= Alien

Table 5-2: list of animal species observed at Waikoloa Quarry June 2015.

Scientific name	Common name	Status
Acridotherese tristis	Common myna	Alien resident
Alauda arvensis	Eurasian skylark	Alien resident
Carpodacus mexicanus	House finch	Alien resident
Serinus mozambicus	Yellow fronted canary	Alien resident
Zenaida macroura	Mourning dove	Alien resident

(TERRY AND HART, 2015)

5.3 SOCIOECONOMIC AND CULTURAL ENVIRONMENT

5.3.1 PUBLIC VIEWS AND VIEWPLANES

The resource recovery facility structures will be warehouse-type steel building covering approximately one acre. Its maximum elevation is approximately 40 feet above ground level. The Anaerobic digesters and associated components will be located behind the receiving building when approaching from the Waikoloa Road. Anaerobic digestion tanks will be approximately 20 feet tall. Gas storage and cleanup equipment will also be below 40 feet above natural ground surface. None of the facilities or equipment will be visible from Waikoloa Road or other public right-of-ways (Figures 5-1 and 5-2).

Figure 5-1: The intersection of the WHC site access road with Waikoloa Road. The Resource recovery facility is more than 1 mile down this road and at a lower elevation. Camera elevation is approximately 8 feet above the roadway.

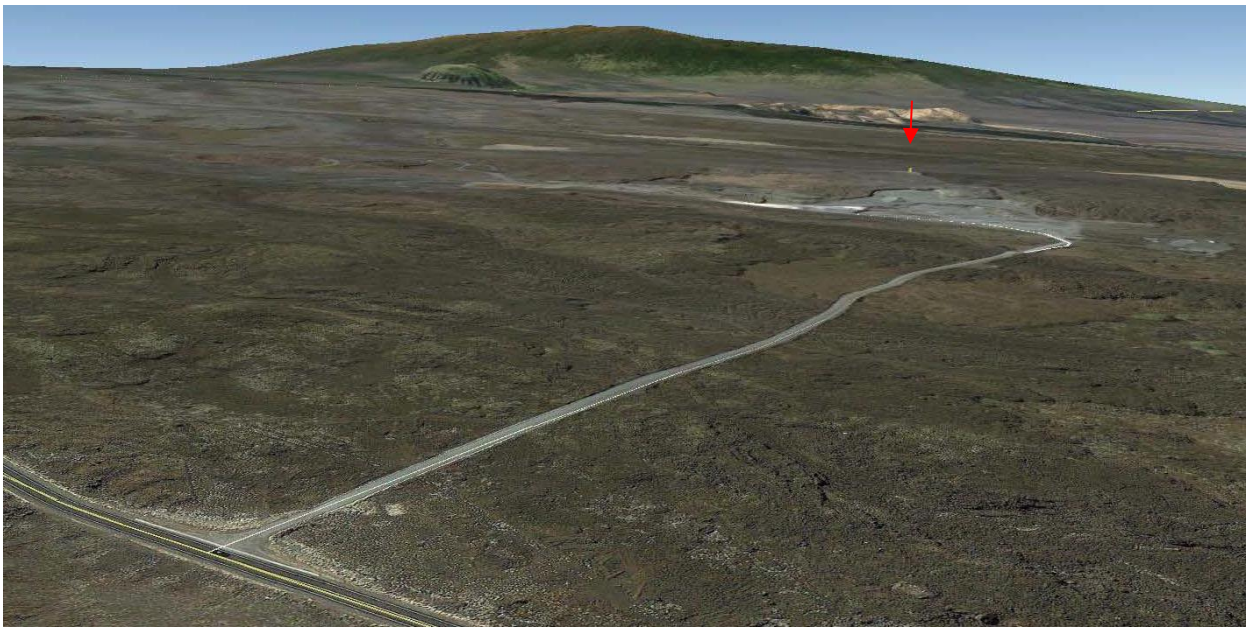


Figure 5-2: The intersection of the WHC site access road with Waikoloa Road from an elevation of approximately 1000 feet.

5.3.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

In 1991, the current project area was included in an archaeological inventory survey (Jensen and Burgett 1991) of a roughly 300-acre property conducted by Paul H. Rosendahl. Ph.D., Inc. (PHRI) for the then proposed quarry location. PHRI identified nineteen sites and established an archaeological preserve with a fifty-foot buffer zone. This led to the boundary definition of the current quarry parcel. The archaeological preserve located on TMK: (3) 6-8-001:067 is immediately to the north of the quarry. The nineteen sites were recorded along the top and around the margins of two *'a 'a* ridges located within the northern third of their study area. These sites appeared to be interconnected by a poorly defined trail system, which was likely only minimally used at the time the features were constructed and for limited access thereafter. No middens, artifacts, or other portable cultural material were detected on the surface of any of the features or in the subsurface testing of a rock shelter feature (SIHP Site 1505 I B). Although never excavated, the features at this site were mostly interpreted to be burials and as a result of the PHRI investigation, all nineteen sites were preserved "as is". The Waikoloa Development Company chose not to proceed with any additional data recovery or further evaluation at that time. A buffer zone of fifty feet was created around the area where the archaeological features were found, and an archaeological preserve was created. The preserve is on the parcel (TMK: (3) 6-8-00 :067) to the north of the subject property. In May of 1999, PHRI conducted archaeological monitoring for further development of the quarry site and associated access road. In a letter report, PHRI (Rechtman 1999) confirmed that the established buffer zone was maintained: the access road was well *makai* of the buffer boundary and the northern boundary of the quarry was placed an additional 50 meters south of the buffer zone.

An archaeological study was conducted by Gotay and Rechtman in June 2015 in support of Special Permit application (Appendix C). This study reports no archaeological sites were observed with the current project area and almost no natural landscape was present as prior and ongoing mechanical quarrying activity and the associated network of ungraded and graded access roads cover roughly ninety-five percent of the approximately 220-acre quarry area. Gotay and Rechtman conclude that there are no sensitive or valuable archeological sites within the quarry area. As the subject property is a subset of the larger parcel those conclusions can be extended to the 14. 99-acre parcel as well.

5.3.3 CULTURAL USES AND TRADITIONAL PRACTICES

In July 2015, Dr. Robert Rechtman completed an assessment of the cultural uses and traditional cultural practices in the vicinity of the project site (Appendix D). His report presents a quite interesting history of the area and in particular its transition from pre-contact to modern day uses by native Hawaiian people. His report is entitled a Ka Pa`akai Discussion after the Hawaii Supreme Court landmark decision *(Ka Pa 'akai 0 Ka 'iiina* v *Land Use Commission),* in which an analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities was created. The court decision

established a three-part process relative to evaluating such potential impacts: first, to identify whether any valued cultural, historical, or natural resources are present; and identify the extent to which any traditional and customary native Hawaiian rights are exercised; second, to identify the extent to which those resources and rights will be affected or impaired by the proposed action; and third, to specify the feasible action, if any, to be taken by the regulatory body to reasonably protect native Hawaiian rights if they are found to exist.

Rechtman's discussion summarizes information from known chants and oral traditions in the area from the time of its first known chief, Pili, arriving from Kahiki. The name Waikoloa refers to a cold north wind that was sent to destroy the canoes of Pili and his party. In another account the place name Waikoloa, literally translated to "water carried far" was from another legend where a heroic young girl was carrying sacred water in an Awa bowl when the wind: Waikoloa" picked it up from the bowl and transported it from Holoholoku to Waiki`i to form a new spring. A third derivation of the place name comes from a legend that of the several streams at the base of the Kohala mountains, one in particular was frequented my large numbers of wild ducks, and that the steam named Waikoloa was named duck water after that stream.
Another interesting story of the area contained in Rechtman's Ka Pa`akai discussion recounts the introduction of livestock to the Big Island.

"*In 1792, Captain George Vancouver, who had sailed with Cook during his 1778-1779 voyages, arrived in Kealakekua Bay with a small fleet of British ships, where he met with Kamehameha. Vancouver stayed only a few days during this first visit, but returned again in 1793 and 1794 to resupply his fleet. Vancouver introduced cattle and sheep to the Island of Hawai'i during his 1793 and 1794 visits, giving them a gifts to Kamehameha I, who immediately made them kapu, thus preventing them from being killed (Kamakau, 1992). Five cows, two ewes, and a ram brought by Vancouver in 1793 were set free to roam in the saddle area of Waimea between Mauna Kea, Mauna Loa, and Hualalai (Escott 2008). The ancestor of these 8 animals are still present in the vicinity of the project site."*

During one of his visits Vancouver anchored at Kawaihae and a member of his crew, Archibald Menzies, a surgeon and naturalist, trekked inland towards Waimea. Menzies' journal records the journey and describes the land in the vicinity of the project area as follows:
I travelled a few miles back ... through the most barren, scorching country I have ever walked over, composed of scorious dregs and black porous rock, interspersed with dreary caverns and deep ravines ... The herbs and grasses which the soil produced in the rainy seasons were now mostly in the shriveled state, thinly scattered and by no means sufficient to cover the surface from the sun's powerful heat, so that I met with few plants in flower in this excursion. (Menzies 1920:55)

Several additional descriptions are included in the report. All descriptions for the surrounding vicinity were of a hot, dry, inhospitable landscape that was poorly utilized if at all.

Rechtman concludes:
"*Upon collective review of these prior cultural studies, a pattern that emerges is that two types of significant cultural resources are regularly referenced in the historical and oral-historical literature. One of these types of resources are landscape features referred to as pu 'u (prominent hills) and the other are trails; both are highly traditionally valued and culturally significant. Pu'u not only mark the traditional landscape, but these natural features are almost always named and storied places with ancestral associations; while the network of trails on the traditional landscape provides a connection of both place and people. Numerous pu'u and trails are identified within Waikoloa, but none are within or in the proximity of the subject property area."*

"Given the culture-historical background presented above, along with the summarized results of prior archaeological and oral-historical studies in the general Waikoloa area, and combined with the twenty year history of intensive land use within the permit area, it is the finding of the current analysis that there are no specific valued natural and cultural resources within the current project area; and there has been no evidence identified of traditional and customary cultural practices having been exercised, nor have any such practices been documented as taking place in the past within this project area."

5.3.4 TRAFFIC AND TRANSPORTATION

Data obtained from the Hawaii Dept. of Transportation (DOT) shows the existing utilization of Queen Kaahumanu Highway (Queen K.) and the upper portions of Waikoloa Road as of March 2015.

Table 5-3: Current traffic volumes at (1) Queen K highway between Waikoloa Road and Waikoloa Beach Road, and along Waikoloa Road between Mamalahoa Highway and Pua Melia Street as of March 2015

Roadway and Direction	**AM Peak**	**PM Peak**	**24 hour totals**
Queen K. south	754	468	9436
Queen K. North	779	804	9456
Waikoloa Road east	149	193	2099
Waikoloa Road west	204	204	2071

Hawaii DOT personal communications 3/2016

This volume of traffic in both locations consists of 2.8% heavy truck traffic.

Roadway and traffic conditions in the study area were surveyed on June 26, and 27, 2007 by the Hawaii Department of Transportation, and revised for the Proposed Aina Le`a subdivision in 2010 (Planning Department 2010a). Based on historical traffic growth records the 2007 data was adjusted to estimate expected traffic volumes in 2020 at a rate of 1.5% annual increase.

The EIS included in the study prepared by SSFM include Queen Ka'ahumanu Highway, Waikoloa Road, and Mauna Lani Drive. Queen Ka'ahumanu Highway is the primary arterial highway on the west side of the island of Hawaii. The highway passes through the North Kona and South Kohala districts and connects Kailua Village with the Kona International Airport, the Kohala resort areas, and Kawaihae. It is a two lane Class I State Highway with limited access and a posted speed limit of 55 miles per hour. The intersections on this highway are fully channelized and signalized at the intersection of Queen Ka'ahumanu Highway at Waikoloa Road. Waikoloa Road is a two-lane undivided County roadway that runs between the Queen Ka'ahumanu Highway to the west and Mamalahoa Highway to the east. This intersection serves as an access point to the Waikoloa Village, mauka of Queen Ka'ahumanu Highway. Waikoloa Road is presently the only roadway running between Mamalahoa Highway and Queen Ka'ahumanu Highway for many miles. The posted speed limit is 55 miles per hour except the span within the Waikoloa Village urban district. In this area, Waikoloa Road becomes a four lane divided roadway with posted speed limits of 35 miles per hour. The intersection of Waikoloa Rd and Queen is designed to handle volumes of 1,900 vehicles per land per hour (Hawaii DOT, 2012).

Daily traffic volumes were derived from the 24-hour meter counts. Waikoloa Road had about 10,000 vehicles per day (in 2012). Turning movement counts were made during the peak periods of 6:00 to 8:30 a.m. and 3:00 to 5:30 p.m. The individual volume of traffic in each lane for the peak morning and afternoon peak hours are estimated until 2020 using data from proposed developments as well as annual increases in traffic density of 1.5%. Waikoloa Road, which generally serves residential traffic, shows a higher outbound flow in the morning peak hour and a higher inbound flow in the afternoon peak. Peak traffic volume estimates in 2020 without the Aina Le`a Development but with an additional 3040 single family homes from other developments are shown in Table 5-3.

Table 5-4: Peak traffic volumes in 2020 (SSSFM, 2012)

Roadway / Intersection	Morning Peak	Afternoon Peak
Queen Kaahumanu Hwy. northbound	536	944
Queen Kaahumanu Hwy. southbound	884	743
Queen K northbound turning east on Waikoloa	252	761
Queen K southbound turning east on Waikoloa	313	354
Waikoloa Rd turning north on Queen K	587	191
Waikoloa Rd turning south on Queen K.	1254	456

Source: FEIS Villages of Aina Le`a Appendix M (2010)

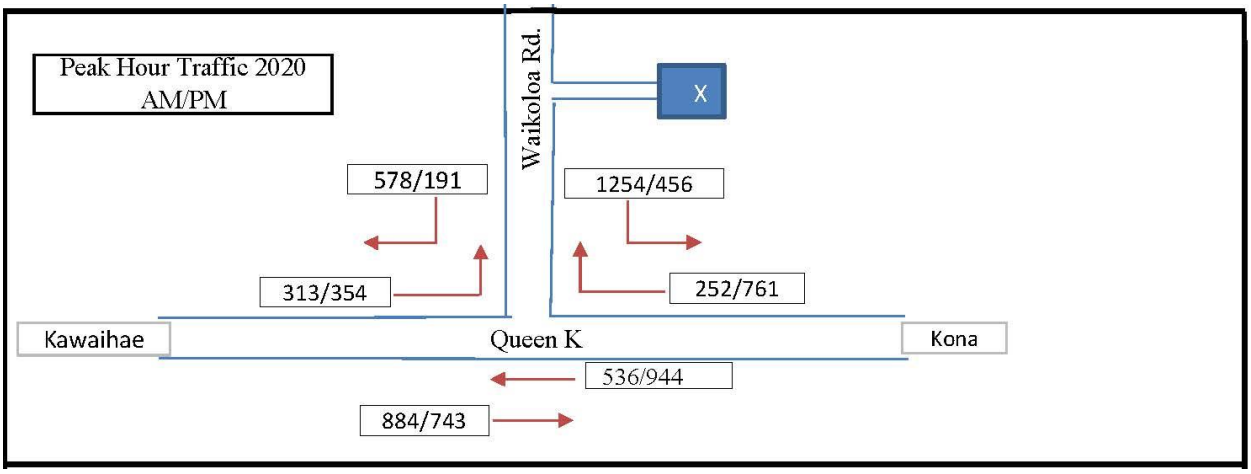


Figure 5-3: Peak hourly traffic estimates for 2020 from SSSM, 2012

If Aina Le`a is to be developed it will add a considerable amount of traffic but roadway improvements include two new intersections to Queen Kaahumanu Highway that are located north of the Waikoloa Road intersection and other roadway improvements to Waikoloa Road.

The level of service is generally quite good at the current time and continues until the large number of new residential units is built for Aina Le`a. The TIAR shows that levels of service are reduced by 2020 without the Aina Le`a project but maintained with the project improvements. The total intersection volume is estimated to be over 13,000 vehicles per day. The current contribution of waste-hauling vehicles from Pacific Waste averages 16 vehicles per day. The proposed action will require waste trucks to bypass the Landfill and travel up Waikoloa Road to the entrance for the Waikoloa Quarry site. This will result in an additional 34 vehicles passing through the intersection, the majority of which are turning east on Waikoloa Road.
Figures 5-3 and 5-4 show the existing and planned contribution of waste containing vehicles to the intersections in question in vehicles per day. Note that the current estimate of the intersection volume is 13,000 vehicles per day.

Access to the project site will be from Waikoloa Road. The existing West Hawaii Concrete (WHC) Access Road and intersection will be utilized without changes. The WHC access road is located 2.7 miles east of the intersection between Queen Kaahumanu Highway and Waikoloa Road and 9.2 miles west of the intersection between Waikoloa Road and Mamalahoa Highway. The Resource Recovery Facility will be located approximately 1-mile down the access road, south of Waikoloa Road intersection. At full development 6 - 8 waste collection vehicles (WCVs) per hour would be expected to arrive at the facility during business hours. WCVs will originate primarily in North Kona and to a lesser extent in the resort district of South Kohala.

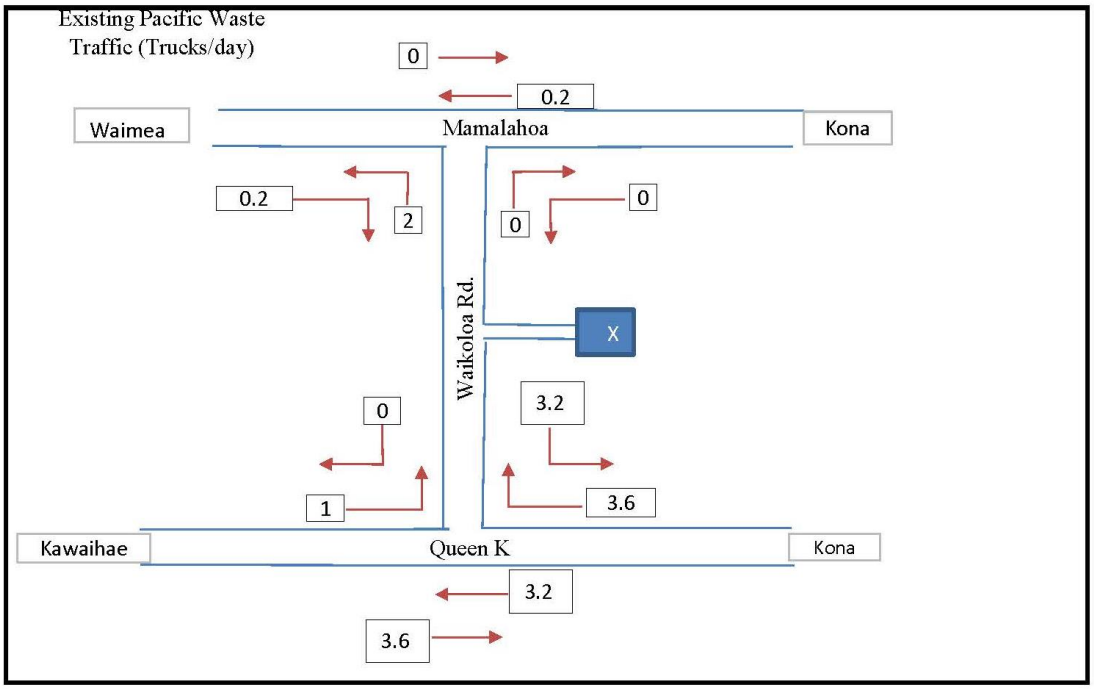


Figure 5-4: The number of waste containing vehicles currently using the ingersections at both ends of Waikoloa Road in Vehicles per day. Previous figure reports vehicles per hour.

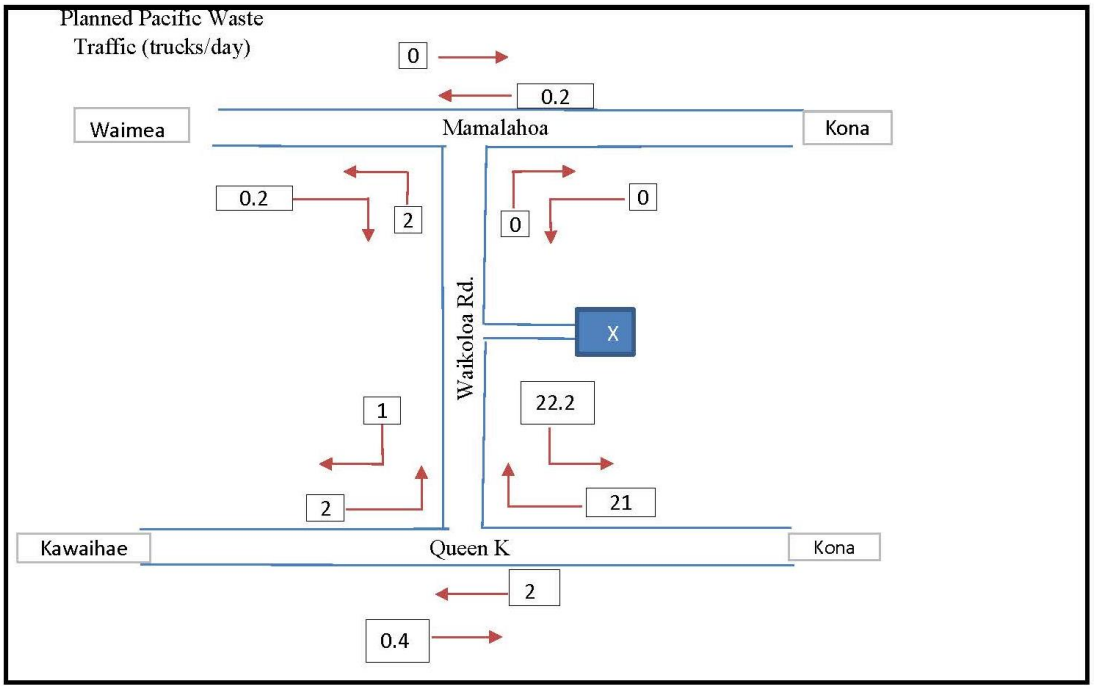


Figure 5-5 The number of waste containing vehicles (per day) expected as a result of the proposed action.

These vehicles now dispose of waste at the West Hawaii Sanitary Landfill (WHSL). Their destination would change to the Waikoloa Quarry site. The majority of WCVs now use Queen

Kaahumanu Highway between Kailua-Kona and The WHSL at Pu`uanahulu. By this analysis the proposed action will increase traffic within the intersection of Waikoloa Road and Queen Kaahumanu Highway by 0.23 %. Alternatively, and not shown above, some trucks departing Kailua-Kona may approach the Waikoloa Quarry site from Mamalahoa Highway, this would further reduce the number of Waste containing vehicles using the lower intersection. Working hours for the vast majority of waste collection routes do not coincide with peak traffic hours. These are commonly the hours that both drivers and dispatchers attempt to avoid.

5.3.5 ADJACENT LAND USE

The subject property is bounded on the south by a 20,000-acre agricultural parcel owned by the State of Hawaii. It stretches the entire distance between the two highways and surrounds the parcel used for the WHSL. Land on the east, west and north sides of the quarry are two parcels with a total area 2806 acres also zoned agriculture. These are owned by Waikoloa Mauka, LLC. The subject property is surrounded by thousands of acres of poor quality grazing land which are owned by large corporate or public entities. Land use on the surrounding lands Is low-density grazing. The proposed action is not expected to exert a significant impact on land uses on any of the surrounding properties. The waste Recovery Facility will be 3 miles from the nearest residence in Waikoloa Village and 2.7 miles from Waikoloa Resort. This compares with 1.3 miles between the WHSL and Waikoloa Resort.
The quarry operations have been ongoing since 1992. Neither waste recovery nor Quarry operations are visible from any public access due to distance and topography.

5.3.6 DEMOGRAPHICS AND SOCIOECONOMIC CONDITIONS

The project site is located within the Waikoloa Census Designated Place (CDP). As of the census of 2010, there were 6,362 people, 1,750 households, and 1,225 families residing in the CDP. The population density was 251.1 people per square mile (96.9/km^2). There were 2,057 housing units at an average density of 107.5 per square mile (41.5/km^2). The racial makeup of the CDP was 45.92% White, 0.48% African American, 0.21% Native American, 16.65% Asian, 9.20% Pacific Islander, 1.46% from other races, and 26.09% from two or more races. Hispanic or Latino of any race were 8.99% of the population.

There were 1,750 households out of which 41.2% had children under the age of 18 living with them, 51.5% were married couples living together, 13.0% had a female householder with no husband present, and 30.0% were non-families. 19.7% of all households were made up of individuals and 3.6% had someone living alone who was 65 years of age or older. The average household size was 2.74 and the average family size was 3.15.

In the CDP the population was spread out with 29.9% under the age of 18, 6.2% from 18 to 24, 34.2% from 25 to 44, 23.0% from 45 to 64, and 6.7% who were 65 years of age or older. The

median age was 35 years. For every 100 females there were 104.3 males. For every 100 females age 18 and over, there were 101.0 males.

The median income for a household in the CDP was $50,040, and the median income for a family was $55,222. Males had a median income of $36,134 versus $30,881 for females. The per capita income for the CDP was $21,328. About 8.6% of families and 10.4% of the population were below the poverty line, including 14.2% of those under age 18 and 1.8% of those age 65 or over

Table 5-5: Selected data from the US Census Bureau for Waikoloa CDP and the State of Hawaii

Waikoloa Village CDP	Hawaii	State
Population, 2014 estimate	X	1,419,561
Population, 2010 (April 1) estimates base	X	1,360,301
Population, percent change - April 1, 2010 to July 1, 2014	X	4.4%
Population, 2010	6,362	1,360,301
Persons under 5 years, percent, 2010	7.1%	6.4%
Persons under 18 years, percent, 2010	25.1%	22.3%
Persons 65 years and over, percent, 2010	9.6%	14.3%
Female persons, percent, 2010	49.9%	49.9%
White alone, percent, 2010 (a)	47.1%	24.7%
Black or African American alone, percent, 2010 (a)	0.7%	1.6%
American Indian and Alaska Native alone, percent, 2010 (a)	0.8%	0.3%
Asian alone, percent, 2010 (a)	16.1%	38.6%
Native Hawaiian and Other Pacific Islander alone, percent, 2010 (a)	11.3%	10.0%
Two or More Races, percent, 2010	21.6%	23.6%
Hispanic or Latino, percent, 2010 (b)	10.2%	8.9%
White alone, not Hispanic or Latino, percent, 2010	43.9%	22.7%
Living in same house 1 year & over, percent, 2009-2013	88.2%	84.9%
Foreign born persons, percent, 2009-2013	12.8%	17.9%
Language other than English spoken at home, pct. age 5+, 2009-2013	20.0%	25.4%
High school graduate or higher, persons age 25+, 2009-2013	97.0%	90.4%
Bachelor's degree or higher, percent of people age 25+, 2009-2013	26.9%	30.1%
Veterans, 2009-2013	595	112,625

5.3.7 PUBLIC FACILITIES AND SERVICES

As a result of the proposed action the following public services may be improved:

- Organics will be diverted from the waste stream and treated in order to produce energy and nutrient-rich soil amendment,
- Solid waste disposal costs may be reduced if haulers pass along savings to their customers,
- The proponent and subscribers will have clean-burning non-fossil fuel available for transportation fuel and stationary power. This will displace imported fossil fuel,
- Locally produced alternative fuels may become available to the general public,
- Alternative electric power generation may become available to subscribers,
- Resource recovery activities will conserve remaining landfill life and reduce greenhouse gas production, and
- Resource recovery activities will divert recyclable materials from landfill disposal to conserve resources.

Public facilities and services that will be negatively impacted include a minor increase in truck traffic along Waikoloa Road. In addition, the landfill tipping fee charged the County by Waste Management Inc. may increase due to the lower quantity of waste being disposed; While there may be a decrease to the total volume of waste being disposed in the WHSL it will not affect the minimum requirements for the validity or enforceability of the existing contract between Waste Management and The County.

Since 1992, various studies have recommended more than one alternative for the disposal of solid waste in Hawaii County. Among the recommendations in the 2002 Updated Integrated Resources and Solid Waste Management Plan (IRSWMP), two of the recommendations stated "*construct no new landfills in East Hawaii* ", and "*procure a waste reduction facility for the East Hawaii waste stream using either mass-burn waste-to-energy, thermal gasification, or anaerobic digestion technology*". The 2002 ISWMP also recommended hauling waste to the West Hawaii Sanitary Landfill (WHSL). The County permitted and built the East Hawaii Sort Station for that purpose, but never hauled waste due to pressure from the Council and the resort community in West Hawaii. Subsequent to adoption of the 2002 Updated IRSWMP, the County issued three (3) requests for proposals (RFP) for construction of a waste reduction facility. The first RFP issued in 2004 was cancelled by the County prior to award. The second RFP was issued in 2006 and later awarded to Wheelabrator Technologies for the construction of a mass -burn waste-to-energy facility at the County-owned South Hilo Sanitary Landfill (SHSL). In 2008, due to higher than anticipated costs, the County Council rejected the second RFP. A third RFP was issued in 2014, and withdrawn in 2015 prior to an award. The 2009 Updated IRSWMP made residual management strategy recommendations including evaluating the feasibility and cost-effectiveness of developing a new lined landfill adjacent to the SHSL site and long-hauling solid

waste to the WHSL site taking into account hauling operations, haul routes, traffic issues and equipment acquisition plans. In 2010-2011, the Department of Environmental Management executed a contracts to evaluate both alternatives. The Hilo Landfill Feasibility Study Report estimated the net cost for landfilling ranged from $70 /ton to $130 /ton depending upon the method of leachate treatment. The estimated net cost for long- hauling ranged from $53 /ton to $57 /ton. This also included the estimated savings derived from a lower disposal rate for increased volume of waste at WHSL. The actual costs for hauling wastes from SHSL to WHSL approximately $28 per ton based on County's estimates (DEM 2012).

The proposed action is scheduled to be completed in 2018. By that time both County costs and waste volumes should increase, SHSL will be once again nearing capacity, and there are no defined strategies ready for managing East Hawaii waste other than hauling waste to either the WHSL or the proposed Integrated Resource Recovery Facility. Environmental impacts to Hawaii County will be reduced by utilizing the Integrated Resource Recovery Facility in comparison to those associated with landfilling.

5.3.8 EMPLOYMENT

BEH will give hiring preference to local labor and management personnel. The facility is expecting to employ fifteen to twenty-four (15-24) full-time employees. The employees will consist of a variation of the following:

- Plant Manager (1)
- Technical Manager (1)
- Controller (1)
- Office personnel (2-3)
- Control Room Operator (2-3)
- Biogas Plant / Power Generation personnel (1-2)
- Waste Processing Facility Operators (3-6)
- Skilled Mechanics (2-3)
- General Labor and Maintenance (2-4)
- Compost operators (2-4)

PART 6: ENVIRONMENTAL CONSEQUENCES

6.1 DIRECT EFFECTS

Direct effects of the proposed action include an increase of traffic on average of 34 vehicles per day going through the intersection of Waikoloa Road and Queen Kaahumanu Highway. This amounts to a slightly over two-tenths of one percent increase (0.23%) through the intersection. These additional vehicles are not likely to affect the level of service through the intersection, and will not exert any significant impacts on traffic. Under normal circumstances the additional vehicles will avoid peak traffic hours, and most will not pass Waikoloa Village on their way to the Waikoloa Quarry site. Vehicles originating to the south will have an extra four miles to travel beyond the WHSL to the new site at the Waikoloa Quarry, however, a lesser number of waste vehicles originating north of Waikoloa Road will have a shorter distance to travel. Net fuel usage will increase slightly, however this fuel will be renewable natural gas instead of diesel or other fossil fuels. The proposed action will reduce the amount of fossil fuels burned on the Big Island by over 650,000 gallons per year at full operation. These will be replaced with renewable natural gas, which is not a fossil fuel and burns much cleaner than petroleum fuels.

The proposed action will reduce the amount of MSW entering the WHSL between 175 and 300 tons per day. The volume of waste diverted includes 21 tons per day of recyclable materials that will be returned to service rather than be buried. Diverting waste from the landfill reduces the amount of greenhouse gasses that would be released from the landfill by 96% (CO_2 equivalent) that would be released from this waste if buried in the landfill. The landfill is now equipped with a landfill gas collection system that captures some portion of the methane that would otherwise be released; however, this system is inefficient and gas is incinerated on site without energy recapture. The proposed action has a net positive effect on the release of greenhouse gasses and airborne contaminants resulting from burning petroleum fuels.

The models presented above indicate that the proposed action will not significantly change the amount of public funds expended for waste management.

There is a chance of accidents, fires or spill associated with any industrial facility. The facility design will comply with federal, State and County safety standards including those for secondary containment and fire prevention. During normal operations no release of petroleum or hazardous materials is expected from the proposed action.

An organic composting facility will be permitted on the site to produce valuable byproducts from digestate and greenwaste entering the resource recovery facility. Compost requires moisture for fermentation. The compost piles are expected to sit atop low permeable liner materials to reduce the amount of compost leachate from entering the subsurface; however, there may be small

amounts of organic liquids leaching from the greenwaste and digestate that percolates through the low permeable surface. The site sits above an aquifer that is not utilized due to its high flow rate of travel and lack of static head. It is difficult to extract fresh water from beneath this area and the majority of wells at this elevation or lower are brackish.

6.2 IRRETRIEVABLE COMMITMENT OF RESOURCES

As with any human endeavor there is a commitment of human and natural resources. Most projects utilize materials that cannot practically be recovered. The construction and operation of the Resource Recovery Facility requires an irretrievable commitment of resources during both construction and operation. The major commitments of resources that will not be recovered include:

Capital Expense: The cost of building and operating the facility and the required infrastructure is not publicly available, but can be estimated to be in the tens of millions of dollars. This commitment of resources by BEH and its investors does not come from public sources. The money will relieve the County of its requirement to build and operate waste treatment facilities, or at lease reduce the utilization and expense normally charged to the County General Fund. These capital resources are expected to be recouped over the operating life of the facility and therefore may not be irretrievable.

Human Resources: In addition to the money for construction BEH has spent the past 7 years developing the designs, selecting a location, retaining consultants and preparing plans for this facility. This represents thousands of hours of labor and related human resources that would otherwise be directed to other, probably similar, environmentally sensitive waste management projects.

Materials: Large amounts of steel, other metals, petroleum-derived plastics, concrete and other materials are mined, refined, molded, bent, welded and bolted together to form the components of a resource recovery facility. Many of these materials can be recycled at the end of the facility's service life, but recycling itself requires both energy and materials. A large fraction of the materials used for construction and operation of the facility and appurtenant infrastructure are not practically recoverable.

Fossil Fuels: Fossil fuels will be consumed in the construction and transportation of the machinery and materials to Waikoloa; however, the net use of fossil fuels will be reduced by a substantial amount in comparison to that used. During operation at a gross volume of 300 tons per day the facility will produce enough electric power and bio-CNG to displace over 844,000 diesel gallon Equivalents (DGE) per year.

6.3 SECONDARY AND CUMULATIVE EFFECTS

A secondary impact or secondary effect may also be called an indirect impact or indirect effect. The term categorizes effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

A cumulative impact is one which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The BEH Resource Recovery facility construction and operation will not result in measurable changes in community growth, land use patterns, population density, or natural systems. The site is within an area used as an industrial aggregate source for many years. The addition of a resource recovery facility synergistic with the currently approved mix of industries located or proposed for the quarry.

The proposed action will join and support a nationwide shift away from landfilling for the purpose of recovery valuable products from waste. In this sense there is a slow but irreversible shift toward recycling, reuse and conservation of materials. When taken on a larger scale it could be considered part of a positive cumulative impact; however, there are no additional facilities planned for Hawaii County.

PART 7: SUMMARY OF POTENTIAL IMPACTS AND MITIGATION MEASURES

Table 7-1 provides a summary of potential impacts and mitigation measures associated with the proposed action.

Affected Environment	**Impact Level of Concern**	**Impact and Mitigation**
Surface Water Resources and Drainage	None	*Impact:* Potential stormwater runoff during construction or operation *Mitigation:* None. No surface water runoff is anticipated, but use Best Management Practices
Groundwater Resources	Low	*Impact:* Potential release of contaminated water *Mitigation*: Wet work will be done on impervious concrete surface, composting on low permeable liner
Seismic and Geological	None	None: buildings to appropriate code
Soils and Agriculture	None	None: Site is covered by an SUP for quarry activities
Flora and Fauna	Low	*Impact:* habitat destruction of T&E species *Mitigation*: none. Area is previously disturbed and poor habitat for listed species
Air Quality	Positive	*Impact*: emission from waste handling/treatment will be offset by reduction is use of petroleum fuels. *Mitigation*: equipment to be operated under requirements of Clean Air Act.
Visual Character	None	None: Facility cannot be seen from outside
Noise	None	None: Facility cannot be heard from public areas
Odor	None	None: Facility cannot be smelled from public areas
Social	Positive	*Impact:* recovery of materials, job creation
Historical and Archaeological	None	None: No resources identified
Economic	Positive	*Impact:* increased materials recovery/sales, reduction is tip fees,
Cultural	None	Traditional practices and important cultural sites will be preserved
Public Facilities and Services	Positive	Reduced demand for County-owned landfills.
Roads and Traffic	Low	Very small increase in traffic at key intersections
Consistency with Govt. Plans and Policies	Consistent	Materials recovery supported by Federal, State and Local Plans
Irretrievable Resources	Positive	*Impact:* Reduced demand on natural resources through materials recovery

8.0 DETERMINATION OF SIGNIFICANCE

In determining whether an action may have a significant effect on the environment under HRS 11-200, the proponent must consider every phase of a proposed action, the expected consequences, both primary and secondary, and the cumulative as well as the short-term and long-term effects of the action.

An action shall be determined to have a significant effect on the environment if it:

1. *Involves an irrevocable commitment to loss or destruction of any natural or cultural resource*;

The proposed action would not result in an irrevocable commitment, loss or destruction of any protected natural resource. No threatened or endangered species were identified within the development area. Previous archeological studies concluded that there is no evidence of traditional practices or cultural artifacts within the footprint of the proposed action.

2. Curtails the range of beneficial uses of the environment;

No new natural areas will be developed in the proposed action, but unused and low quality agriculture land will be used for non-agricultural purposes. The use of agricultural land for waste management requires a Special Permit in the County of Hawaii. This permit is designated for unusual but reasonable land uses on agricultural land. It will fall to the County Planning Commission to determine whether the loss of this agricultural land is justified by the proposed resource recovery facility.

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 proposed action is consistent with the County General Plan, and the West Hawaii Functional Plan.

4. Substantially affects the economic welfare, social welfare, and cultural practices of the community or State;

The proposed action has beneficial impacts on the social and economic welfare of the County. It obviates the need for the County taxpayers to support an expensive waste reduction technology and displaces imported petroleum from local sources.

5. Substantially affects public health;

The proposed action benefits public health by reducing emissions to air, soil and water over current waste management methods.

6. *Involves substantial secondary impacts, such as population changes or effects on public facilities;*

The secondary and cumulative impacts from the proposed action are to reduce the impacts of landfilling at the West Hawaii Sanitary Landfill and displace imported fuel.

7. *Involves a substantial degradation of environmental quality;*

Temporary impacts associated with construction will include minor amounts of dust and noise, neither of which will be perceptible above background levels in a rock quarry. Other emissions are expected to be well within acceptable levels and less than those for landfilling waste. Environmental quality impacts are net positive.

8. *Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;*

The proposed action is not part of any other development and no commitment for larger actions is required.

9. *Substantially affects a rare, threatened, or endangered species, or its habitat;*

The area in the vicinity of the subject property is a rock quarry. Much of the area surrounding the project site is previously disturbed bare rock. Special status species that depend on the parcel were not identified.

10. *Detrimentally affects air or water quality or ambient noise levels*;

The proposed action is not expected to result in degradation of the quality of air, water or soil at the site, above it or beneath it, however the proposed action may reduce the amount of greenhouse gasses, leachate and dust at the West Hawaii Sanitary landfill. The site location ensures that noise generated by the facility is imperceptible from publicly accessible areas.

11. *Affects 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*;

The site is not within an environmentally sensitive area.

12. *Substantially affects scenic vistas and view planes identified in county or state plans or studies; or,*

The scenic vistas and unique view planes, and unique community character will be preserved by the proposed action. The facility will not be visible from any nearby areas accessible to the public.

13. *Requires substantial energy consumption*.

The objective of the proposed action is to recover and reuse waste materials through bioconversion to methane. In reusing the methane to prevent it from being released to the

atmosphere. The proposed action will not reduce energy consumption, but will displace fossil fuels that are now used for electrical energy and transportation fuels.

8.1 ANTICIPATED FINDING

Based on analysis of the 13 significance criteria listed above, the proposed action is not expected to result in significant adverse environmental impacts when conducted within the constraints of the required plans and permits. Comments received from the public and various agencies during this DEA review period, will provide new information, which will be considered in the final conclusion of this assessment. Pending receipt of these comments from agencies and interested parties, this assessment anticipates reaching a Finding of No Significant Impact.

9.0 CONSULTED PARTIES, PUBLIC PARTICIPANTS AND CONTRIBUTORS

9.1 LIST OF PREPARERS

This EISPN has been prepared by North Shore Consultants, LLC. David Robichaux, Project Manager, is primarily responsible for its content. Invaluable assistance with technical content and editorial review has been obtained from:

Clint Knox, Vice President, BioEnergy Hawaii
Ron Terry Geometrician Associates
Bob Rechtman, ASM Affiliates, Inc.
Charles Jencks, Second & Peck Real Estate, LLC
Goodfellow Brothers Inc.

9.2 LIST OF AGENCIES AND ORGANIZATIONS AND OTHER CONSULTED PARTIES

Parties consulted during preparation of the DEA represent some of those who have direct influence on planning and permitting for the proposed project. Agencies and individuals consulted to this point include:

State of Hawaii

DOH Office of Environmental Quality Control
DOH –Solid Waste Management Office
DBEDT – Energy
DOT- Highways Division
Land Use Commission

County of Hawaii

Office of the Mayor
Department of Environmental Management
Planning Department

Interested Parties

WQJ2008 Investment, LLC
Ukumehame Quarry Company, LP
WHC, Ltd (d.b.a. West Hawaii Concrete)
Hawaii Island Economic Development Board
Aha Moku State Board

Agencies and interested parties who have been provided copies and are requested to provide comments during the comment period include:

Federal Agencies:
US Army Corps of Engineers
US Department of Agriculture
Federal Emergency Management Agency
US Department of Interior, Fish and Wildlife Service
US Department of Transportation - Federal Aviation Administration

State Agencies:
State Land Use Commission
DBEDT- Office of Planning
Department of Health-All
DLNR Forestry and Wildlife
DLNR-Land Division
DLNR-State Historic Preservation Division
Department of Transportation

County Agencies:
Civil Defense
Department of Environmental Management
Planning Department
Public Works
Department of Research and Development
Department of Water Supply
Police Department
Fire Department

Interested Parties
Kona Coast Resort Association
Hawaii Gas
HIEDB
Waikoloa Community Association
Waikoloa Resort
Aha Moku

PART 10 BIBLIOGRAPHY

County of Hawaii Planning Department (2010) Final EIS for the Villages at Aina Lea, Volume 1 http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Hawaii/2010s/2010-11-08-HA-FEIS-Villages-Aina-Lea-Vol1.pdf

County of Hawaii Planning Department (2010) Final EIS for the Villages at Aina Lea, Volume 2 http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Hawaii/2010s/2010-11-08-HA-FEIS-Villages-Aina-Lea-Vol2.pdf

Department of Business Economic Development and Tourism, 2009. Energy Resources Coordinator Annual Report, 2009

Department of Business Economic Development and Tourism, 2013. State of Hawaii Databook, 2009. http://files.hawaii.gov/dbedt/economic/databook/2013-individual/17/170713.pdf

Department of Environmental Management (2012) Letter Report: Pilot Study on Long-Hauling Waste to the West Hawaii Sanitary Landfill. http://records.co.hawaii.hi.us/WebLink8/DocView.aspx?id=62282&dbid=1

Doris, E., J McLaren, V. Healey, and S. Hockett, (2009) State of the States 2009:

Energy Recovery Council (2015) "Waste-to-Energy is a Climate-Friendly, Renewable Energy Source." Energy Recovery Council, http://www.energyrecoverycouncil.org/userfiles/file/ERC%202009%20climate-renewable%20paper.pdf.

Hansen J., (2004). Riscaldamento globale: una bomba da disinnescare. (Global warming: a bomb to be defused). Le Scienze, No. 428, p. 76.

Hawai`i County, 2005 Hawai`i County General Plan. ww.co.hawaii.hi.us/la/gp/2005/main.html

R.W. Beck (2012) Hilo Landfill Feasibility Study, Prepared for the County of Hawaii Department of Environmental Management. http://records.co.hawaii.hi.us/Weblink8/1/doc/62056/Page1.aspx

University of California at Riverside. (2009) Evaluation of Emissions from Thermal Conversion Technologies Processing Municipal Solid Waste and Biomass. Prepared for Bioenergy Producers Association. 42pp

US Department of Energy (2016) Renewable Energy Development and the Role of Policy http://apps1.eere.energy.gov/states/state_of_the_states.cfm

US EPA**, (**2006). Global anthropogenic non-CO2 greenhouse gas emissions: 1990-2020. Office of Atmospheric Programs, Climate Change Division.

US EPA, (2016a) Overview of Greenhouse Gasses: Methane. http://www3.epa.gov/climatechange/ghgemissions/gases/ch4.html

US EPA, (2016b). Draft US Greenhouse Gas Inventory Report 2009 - 2014, Chapter 7: Waste http://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Chapter-7-Waste.pdf

US Department of Energy, 2014. Alternative fuels used in Transportation. Curriculum for Grades 5 – 8. http://energy.gov/sites/prod/files/2014/07/f17/transportation_alternativefuels.pdf

Appendices

A. Comments Received prior to Publication
B. Flora and Fauna Survey
C. Archeological Survey
D. Ka Pa`Akai Discussion (Cultural Impacts)

Appendix A

Comments Received Prior to Publication

William P. Kenoi
Mayor

Duane Kanuha
Director

Joaquin Gamiao-Kunkel
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
PLANNING DEPARTMENT

East Hawai'i Office
101 Pauahi Street, Suite 3
Hilo, Hawai'i 96720
Phone (808) 961-8288
Fax (808) 961-8742

June 22, 2016

Mr. David Robichaux
North Shore Consultants
2333 Kapiolani Blvd., Suite 2111
Honolulu, HI 96826

Dear Mr. Robichaux:

SUBJECT: Comments for Pre-Draft Environmental Assessment for the Hawai'i Integrated Resource Recovery Facility
TMK: (3) 6-8-001:Portion of 066

The following are comments for the pre-draft environmental assessment for the Hawai'i Integrated Resource Recovery Facility proposed for a 14.99-acre portion of a 243.794-acre parcel situated within Waikoloa, South Kohala, Hawai'i. Please include the following changes:

1. Please include "portion of 066" when referring to the subject property until the property is subdivided and is a separate parcel.

2. Please include a section in the Draft EA that clearly outlines the "Land Use" policies of the property, including County Zoning (A-5a), State Land Use Boundary designation (Agricultural), General Plan LUPAG designation (Urban Expansion), County of Hawai'i plans and controls, including consistency with the General Plan's goals, policies and objectives, consistency with South Kohala Community Development Plan's goals, policies and objectives, and consistency with the Coastal Zone Management Area's policies and objectives.

3. Under "Special Permit from County of Hawai'i" on Page 31, besides the two criteria mentioned, there a number of additional criteria for approval that should be listed and addressed in the draft EA.

4. There are a number of reports mentioned in the draft EA, including the botanical survey, the archaeological survey and the cultural assessment. Please include these reports in the draft EA.

5. FUDS Information needed: FUDS stands for "Formerly Use Defense Sites." The subject property is located within an area that has the possibility of the existence of unexploded ordinance within its boundaries. The project site has not been formerly cleared. Please contact the US Army Corps of Engineers to provide information and a possible timeframe that the area may be cleared.

6. The list of agencies and organizations consulted on Page 72 is minimal and needs to include many other Federal, State and County agencies, and organizations and individuals. These should include, but not be limited to the following:

Federal Agencies:

- US Army Corps of Engineers
- US Department of Agriculture
- Federal Emergency Management Agency
- US Department of Interior, Fish and Wildlife Service
- US Department of Transportation-Federal Aviation Administration

State Agencies

- State Land Use Commission
- DBEDT-Office of Planning
- Department of Health- All Divisions
- DLNR-Divisions of Forestry and Wildlife
- DLNR-Land Division
- DLNR-State Historic Preservation Division
- Department of Transportation

County Agencies

- Civil Defense
- Department of Environmental Management
- Planning Department
- Department of Public Works
- Department of Research and Development
- Department of Water Supply
- Police Department
- Fire Department

Agencies/Organizations

- Hawaiian Electric and Light Company (HELCO)
- Sierra Club
- Waikoloa Community Association
- Hawai'i Island Chamber of Commerce
- Kona-Kohala Chamber of Commerce

Elected Officials

- Governor
- Mayor
- U.S. Senators
- US Congresspersons
- State Senator
- State Representative
- County Council Chair and
- County Council District Representative

Upon resubmittal, please include the draft EA (2 copies), a completed OEQC Publication Form, and the Draft EA and Project Summary on disk. If you have any questions, please feel free to contact Jeff Darrow at 961-8158.

Sincerely,

DUANE KANUHA
Planning Director

JWD:mad
P\wpwin60\Jeff\Letters\OEQC\LRobichaux-EAcomments.doc

Appendix B

Flora and Faunal Assessment

General Botanical Survey and Vertebrate Fauna Assessment, Waikoloa Quarry Waikoloa, South Kohala District, Island of Hawai'i

By Ron Terry, Ph.D. and Patrick J. Hart, Ph.D.
Geometrician Associates, LLC
July 2015

Introduction

This biological survey was prepared for West Hawaii Concrete, which leases land and operates a rock quarry on 219.990 acres of land at Waikoloa within TMK (3) 6-8-001:066 (Figure 1) ("the property").[1] A Special Permit to allow for the operation of the quarry operation at the property was approved by the County of Hawaii Planning Commission in September 1992, and the Special Permit was issued by the State Land Use Commission in January 1993. West Hawaii Concrete has operated a rock quarry at the property since 1995. This survey was prepared as part of information for an amendment to the Special Permit to extend the life of the permit to run the quarrying operation to 2043 or longer, to add approval of West Hawaii Concrete's composting operation to the Special Permit, and to enable processing and recycling of Portland cement concrete (PCC) and asphalt concrete pavement (ACP) on the site. According to the quarry operators, the top five feet of rock has been removed from 95% of the approximately 220-acre quarry property as part of quarrying activities, and very little natural surface exists. This is evident in aerial and ground photos of the property (Figures 2 and 3).

The objectives of the botanical component of this survey were to 1) describe the vegetation; 2) list all species encountered; 3) determine the likelihood of the presence of rare, threatened or endangered (T&E) plant species; and 4) identify the locations of any T&E individuals found. The area was surveyed by Ron Terry and Patrick Hart (résumés for whom are attached to the end of this report) in June 2015. Plant species were identified in the field and, as necessary, collected and keyed out in the laboratory. Special attention was given to the possible presence of any federally listed T&E plant species (USFWS 2015), although the habitat did not indicate a strong potential for their presence.

The survey also included a limited faunal survey restricted to providing a list of birds and introduced mammals, reptiles, or amphibians observed during the botanical survey. Also considered in this report is the general value of the habitat for native birds and the Hawaiian hoary bat. Not included in the survey were invertebrates or aquatic species or habitat.

---

[1] Since December 2008 the property has been owned by WQJ2008 Investment LLC and Ukumehame Quarry Company LP.

Vegetation Type and Influences

The geology of the property consists of Mauna Loa ʻaʻa lava flows of various ages between 1,500 and 3,000 years old (Wolfe and Morris 1996). These black, rugged, nearly unvegetated lava flows in Waikoloa and adjacent Puʻuanahulu are known as the Kanikū lava flows. Elevations range from about 680 to 920 feet above sea level. The natural slope perpendicular to the sea (prior to grading) is on the order of 5 percent. Like most ʻaʻa flows, the surface is highly irregular, with local relief of more than 20 feet and steep slopes around boulders and rock outcrops. The area receives an average annual rainfall of about 10 inches (Giambelluca et al 2013).

The natural, pre-human vegetation of this part of the Kanikū Lava Flow was likely very sparse native herbs and grasses, perhaps including *pili* grass (*Heteropogon contortus*) and *ilima* (*Sida fallax*). The types of dry grasslands and shrublands described by Gagne and Cuddihy (1990) for other parts of low-elevation Waikoloa do not occur because soil has simply not had time to develop in this young substrate. Typical vegetation in older areas surroundings the Kanikū lava flow in which at least some soil has formed likely consisted of *ʻilima* and *pili* grass along with *kawelu* grass (*Eragrostis variabilis*) and vines such as *pāʻū-o-Hiʻiaka* (*Jacquemontia ovalifolia*), with a perhaps diverse but fairly sparse cover of native dry-forest trees and shrubs including *ʻaʻaliʻi* (*Dodonaea viscosa*), sandalwood or *iliahi* (*Santalum ellipticum*), *lama* (*Diospyros sandwicensis*), *wiliwili* (*Erythrina sandwicensis*) and *uhiuhi* (*Mezoneuron kavaiensis*).

Small remnants of now-endangered species such as *uhiuhi* and rare species such as *wiliwili* that were formerly fairly widely distributed still persist in some areas. Other endangered species such as red *ʻilima* (*Abutilon menziesii*) have been completely extirpated by cattle grazing and feral goat browsing.

Previous Surveys of the Property

Botanist Winona Char conducted several botanical surveys of the quarry site in 1992 as part of the original permitting documentation for the quarry (Char 1992 and 1992b). In a May 1992 survey, she found that fountain grass covered 30 to 50% of older lava flows, but less than 3% on younger lava flows, although it was still the dominant species. A few *kiawe* trees and indigo plants were present. The only natives were *ʻuhaloa* (*Waltheria indica*) and the fern *iwaʻiwa* (*Doryopteris decipiens*).

Although she made an intensive search for pololei fern (*Ophioglossum concinnum*), which at the time was considered endemic and a category 1 candidate endangered species, none were located. She noted that the plant might emerge after the first heavy downpour, after which it would likely quickly die off, with only its invisible underground rhizomes remaining until the next large rain. She then resurveyed the area after heavy rains in October 1992 associated with Hurricane Iniki. This time, she did find some ferns within a small gully in the pahoehoe, along with seedlings of a number of weeds not previously observed. Since that time, the *O. concinnum* has been included in species *O. polyphyllum*, an indigenous fern that is widespread around the world. Although cryptic, it

is locally abundant on a seasonal basis, and is no longer considered endangered or even rare (Palmer 2003).

Results: Vegetation

Our survey in 2015 was of a landscape that had been heavily scraped and quarried, but with a vegetation that did not differ markedly from that of 25 years ago. Vegetation over the property is still fairly sparse, as shown in Figures 2 and 3. It consists of two types:

1. Graded and actively used areas, with sparse vegetation of fountain grass (*Cenchrus setaceus*), a non-native, fire-promoting grass, and tree tobacco (*Nicotiana glauca*), a weed that springs up heavily in this part of the island when lava is disturbed. Very few other species are present. This occupies nearly all of the property.
2. Undisturbed areas, which vary from unvegetated to very sparse fountain grass.

Flora

The flora of the quarry as of June 2015 is extremely non-diverse. All plant species found on the property during the survey are listed in Table 1. Of the eight species detected, only two were native. There were a few individuals of the indigenous (native to the Hawaiian Islands and elsewhere) *'uhaloa* and *puakala* (*Argemone glauca*). There were no endemic (found only in the Hawaiian Islands) plants. All other plants were weeds, and no rare or unusual plant species were present. The only tree present was the non-native *kiawe* (*Prosopis pallida*), of which we only observed four individuals. Given enough time without further disturbance, a larger variety of non-native weeds common in the Waikoloa area would undoubtedly begin to invade.

Threatened and Endangered Plant Species and Critical Habitat

No threatened or endangered plant species as listed by the U.S. Fish and Wildlife Service appear to be present on the property, nor are there uniquely valuable habitats. No existing or proposed federally designated critical habitat is present on the property.

Botanical Impacts and Recommended Mitigation Measures

The history of heavy, continuous disturbance coupled with the lowland context has resulted in a flora and vegetation on the property that has little value in terms of conserving native vegetation or threatened or endangered plant species. As such, no adverse botanical impacts on the property are expected as a result of the continuing and proposed uses.

Fauna

During the survey we observed five bird species, all of them common non-natives (see Table 2). Birds were generally sparse due to the sparse vegetation.

We would expect the migratory resident Golden Plover (*Pluvialis fulva*) to be present at least occasionally, as it is frequently seen in the area and throughout the State of Hawai'i during its residence here from August to April each year. The Golden Plover is not a threatened, endangered or candidate species. Similarly, the Short-eared Owl or *pueo* (*Asio flammeus sandwichensis*), which is an endemic (i.e., native and unique to Hawai'i), sub-species of this near cosmopolitan species, likely hunts in the area. It is unlikely that any native forest birds would make much use of the property because of the lack of forest within five miles.

Although they would likely never be seen, it is possible that small numbers of the endangered endemic Hawaiian Petrel (*Pterodroma sandwichensis*) and the threatened Newell's Shearwater (*Puffinus auricularis newelli*) over-fly the property between the months of May and November. The Hawaiian Petrel was formerly common on the Island of Hawai'i. This pelagic seabird reportedly nested in large numbers on the slopes of Mauna Loa and in the saddle area between Mauna Loa and Mauna Kea, as well as at the mid-to-high elevations of Hualālai. It has within recent historic times been reduced to relict breeding colonies located at high elevations on Mauna Loa and, possibly, Hualālai. Hawaiian Petrels were first listed as an endangered species by the USFWS in 1967 and by the State of Hawai'i in 1973.

Newell's Shearwaters were also once common on the Island of Hawai'i. This species breeds on Kaua'i, Hawai'i, and Moloka'i. Newell's Shearwater populations have dropped precipitously since the 1980s (Banko 1980, Day et al., 2003). This pelagic species nests high in the mountains in burrows excavated under thick vegetation, especially *uluhe* (*Dicranopteris linearis*) fern. Newell's Shearwater was listed as a threatened species by the USFWS in 1975 and by the State of Hawai'i in 1973.

The primary cause of mortality in both Hawaiian Petrels and Newell's Shearwaters in Hawai'i is thought to be predation by alien mammalian species at the nesting colonies. Collision with man-made structures is considered another significant cause. 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. There is no suitable nesting habitat within or close to the property for either species.

Various mammals would be expected on the property, including feral goats (*Capra hircus*), small Indian mongoose (*Herpestes a. auropunctatus*), mice (*Mus* spp.), rats (*Rattus* spp.), and perhaps feral cats (*Felis catus*). None of these alien mammals have conservation value and all are deleterious to native flora and fauna. During the survey, only goats were observed. Goat browsing on young, green fountain grass was evident, and it also appeared that goats may have been browsing on young tree tobacco leaves. Although tree tobacco is somewhat poisonous to goats, they are known to browse on it when little else is available (Green and Newell 1982).

Although not detected in the survey, which took place in daylight, the only native Hawaiian land mammal, the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*), may also

be present in the general area, as it is present in many areas on the island of Hawai'i. They may forage for flying insects on the property on a seasonal basis. Bats roost in trees and very tall shrubs, only one of which was present on the property.

There are no native terrestrial reptiles or amphibians in Hawai'i. No reptiles and amphibians were detected during the survey, but it is likely that various geckoes (Family Gekkonidae) are present.

As discussed above, this report does not cover invertebrates, which a separate faunal specialist is studying because of the potential presence of the endangered Blackburn's sphinx moth, the larval stage of which is known to feed on tree tobacco.

Impacts and Mitigation Measures for Fauna

We offer the following recommendations in order to avoid impacts to endangered but widespread native birds and the Hawaiian hoary bat:

- To minimize impacts to the endangered Hawaiian hoary bat, we recommend that trees taller than 15 feet should not be removed or trimmed during the bat birthing and pup rearing season (June 1 through September 15). At the present time, only one such tree, a *kiawe*, appears to be present.
- If any activities incorporate outdoor lighting, they may attract endangered Hawaiian Petrels and Newell's Shearwaters, which may become disoriented by the lighting, resulting in birds being downed. To avoid the potential downing of Hawaiian Petrels and Newell's Shearwaters by their interaction with outdoor lighting, we recommend no construction or unshielded equipment maintenance lighting after dark between the months of April and October. All permanent lighting should be shielded in strict conformance with the Hawai'i County Outdoor Lighting Ordinance (Hawai'i County Code Chapter 9, Article 14), which requires shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting.

Report Limitations

No biological survey of a large area 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. Thick brush can obscure even large, healthy specimens. Birds utilize different patches of habitat during different times of the day and seasons, and only long-term study can determine the exact species composition. Although this survey was conducted in accordance with accepted practice, the findings of this survey should be interpreted with proper caution; in particular, there is no warranty as to the absence of any particular species. However, the property is not a likely habitat for rare, threatened or endangered plant or animal species.

Literature Cited

Banko, W. E. 1980. "Population Histories – Species Accounts Seabirds: Newell's Shearwater ('A'o)." Cooperative National Park Resources Studies Unit, University of Hawai'i at Manoa, Department of Botany, Technical Report #5A.

Char, W. 1992a. *Botanical Assessment, Waikoloa Quarry Site South Kohala District, Island of Hawai'i.* Prep For. Belt Collins & and Waikoloa Development Company.

_____. 1992b. *Resurvey for Ophioglossum Concinnum, Waikoloa Quarry Site South Kohala District, Island of Hawai'i.* Prep For. Belt Collins & and Waikoloa Development Company.

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

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.

Giambelluca, T.W., Q. Chen, A.G. Frazier, J.P. Price, Y.-L. Chen, P.-S. Chu, J.K. Eischeid, and D.M. Delparte, 2013. Online Rainfall Atlas of Hawai'i. Bull. Amer. Meteor. Soc. 94, 313-316, doi: 10.1175/BAMS-D-11-00228.1.

Green, L.R., and Newell, L.A. 1982. *Using Goats to Control Brush Regrowth on Fuelbreaks.* Forest Service, Pacific Southwest Forest and Range Experiment Station General Technical Report PSW-59. Berkeley, CA.

Palmer, D.D. 2003. *Hawai'i's Ferns and Fern Allies.* Honolulu: University of Hawai'i Press.

U.S. Fish and Wildlife Service (USFWS). 2015. *USFWS Threatened and Endangered Species System (TESS).* Washington: GPO. http://ecos.fws.gov/tess_public/

University of Hawai'i at Hilo, Dept. of Geography. 1998. *Atlas of Hawai'i.* 3rd ed. Honolulu: University of Hawai'i Press.

Wolfe, E.W., and J. Morris. 1996. *Geologic Map of the Island of* Hawai`i. USGS Misc Investigations Series Map i-2524-A. Washington, D.C.: U.S. Geological Survey.

Figure 1. Property Map

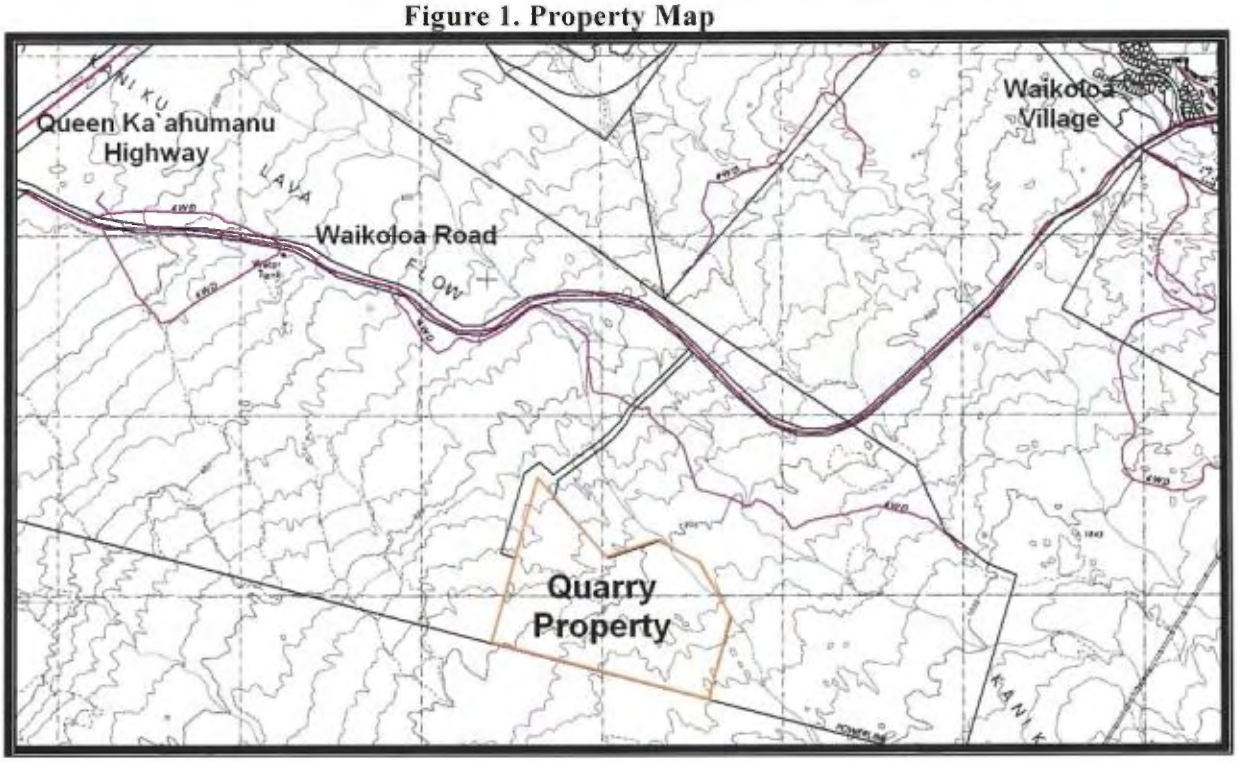


Figure 2. Aerial Image

Base Map © Google Earth

Figure 3. Property Photos

3a. Active Rock Crushing Area▲ ▼ 3b. Typical Scraped Area

Figure 3. Property Vegetation Photos

3c. Landscape on Older Lava Flow Pre Quarry ▲

▼ 3d. Scraped Area Left, Natural Surface Right, Younger Lava Flow

Table 1. List of Plant Species Detected at Waikoloa Quarry

Scientific Name	Family	Common Name	Life Form	Status*
Argemone glauca	Papaveraceae	Pua kala	Herb	I
Calotropis gigantea	Asclepiadaceae	Crown flower	Shrub	A
Cenchrus setaceus	Poaceae	Fountain grass	Herb	A
Nicotiana glauca	Solanaceae	Tree tobacco	Shrub	A
Prosopis pallida	Fabaceae	Kiawe	Tree	A
Senna occidentalis	Fabaceae	Coffee senna	Herb	A
Waltheria indica	Malvaceae	ʻUhaloa	Herb	I
Verbascum thapsus	Scrophulariaceae	Mullein	Herb	A

A = alien, E = endemic, I = indigenous, End = Federal and State listed Endangered Species
Several plants were either sterile or unidentifiable, including a non-native composite.

Table 2. Bird Species Observed at Waikoloa Quarry

Scientific name	Common name	Status
Acridotheres tristis	Common Myna	Alien Resident
Alauda arvensis	Eurasian Skylark	Alien Resident
Carpodacus mexicanus	House Finch	Alien Resident
Serinus mozambicus	Yellow-Fronted Canary	Alien Resident
Zenaida macroura	Mourning Dove	Alien Resident

BIOGRAPHICAL SKETCH

PATRICK J. HART

Associate Professor, Department of Biology
University of Hawaii at Hilo
200 W. Kawili St.
Hilo HI. 96720

email:pjhart@hawaii.edu
phone: 808-974-7645

EDUCATION

Ph.D. Zoology (Ecology, Evolution, and Conservation Biology), 2000
University of Hawai'i, Manoa

B.A. Biology, 1985
University of California, Santa Barbara

PROFESSIONAL EXPERIENCE

2005- present	Assistant/Associate Professor, Department of Biology, University of Hawaii at Hilo
2002-2005	Post-Doctoral Researcher, USGS-BRD, Kilauea Field Station
2001	Lecturer, Department of Zoology, University of Hawaii, Manoa
2000-2001	Lecturer, Department of Biology, University of Hawaii, Hilo
1993-1999	Research Assistant, Department of Zoology, University of Hawaii, Manoa
1991-1993	Teaching Assistant, Department of Zoology, University of Hawaii, Manoa
1992	Instructor, School for Field Studies
1989-1990	Volunteer, United States Peace Corps

RECENT PUBLICATIONS (last five years)

Wu, J. X., D. M. Delparte, and P. J. Hart. 2014. Movement patterns of a native and non-native frugivore in Hawaii and implications for seed dispersal. Biotropica 46:175-182.

VanZandt, M., D. DelParte, P. Hart, F. Duvall, and J. Penniman. 2014. Nesting characteristics and habitat use of the endangered Hawaiian Petrel (*Pterodroma sandwichensis*) on the Island of Lanai. Waterbirds 37:43-51.

Hart, Patrick, M.F. Ramos-Ordoñez, C. Rodríguez-Flores, C. Soberanes-González, B. Behrstock, M.C. Arizmendi, and D. Mehlman. 2013. Orange-billed Sparrow (Arremon aurantiirostris), Neotropical Birds Online (T. S. Schulenberg, Editor). Ithaca: Cornell Lab of Ornithology; retrieved from Neotropical Birds Online

Sridhar, H., U. Srinivasan, R.A. Askins, J. Canales-Delgadillo, C. Chen, D. N. Ewert, G. A. Gale, E. Goodale, W. K. Gram, P. J. Hart, K. A. Hobson, R. L. Hutto, S. W. Kotagama, J. L. Knowlton, T. M. Lee, C. A. Munn, S. Nimnuan,

B. Z. Nizam, G. Peron, V. V. Robin, A. D. Rodewald, P. G. Rodewald, R. L. Thomson, P. Trivedi, S. L. Van Wilgenburg, and K. Shanker. 2012. Positive relationships between association strength and phenotypic similarity characterize the assembly of mixed-species bird flocks worldwide. American Naturalist 180:777-790.

Hart, P.J. 2012. Patterns of tree mortality in a monodominant tropical forest. Tropical Forests. P. Sudarshana (Ed.) ISBN: 978-953-51-0255-7.

Samuel, M. D., P. H. F. Hobbelen, F. DeCastro, J. A. Ahumada, D. A. LaPointe, C. T. Atkinson, B. L. Woodworth, **P. J. Hart**, and D. C. Duffy. 2011. The dynamics, transmission, and population impacts of avian malaria in native Hawaiian birds: a modeling approach. Ecological Applications 21(8): 2960-2973.

Hart, P. J., B. L. Woodworth, R. Camp, K. Turner, K. McClure, K. Goodall, Henneman, C. Spiegel, J. LeBrun, E. Tweed, and M. Samuel. 2011. Bird and resource variability across an elevational gradient in Hawaii. The Auk 128:113-126.

Hart, P.J. 2010. Tree growth and age in an ancient Hawaiian wet forest: vegetation dynamics at two spatial scales. Journal of Tropical Ecology 25:1-11.

Tucker-Mohl, K., **P. J. Hart**, and C. Atkinson. 2010. Can lowland dry forests represent a refuge from avian malaria for native Hawaiian birds? Pacific Conservation Biology 16:181-186.

Flaspohler, D.J., C. Giardina, G.P. Asner, **P.J. Hart**, J. Price, C.K. Lyons*, and X. Castaneda*. 2009. Long-term effects of fragmentation and fragment properties on bird species richness in Hawaiian forests. Biological Conservation 143:280-288.

Gaudioso, J.M., D.A. LaPointe, and **P.J. Hart**. 2009. Knemidokoptic mange in Hawai`i `Amakihi (*Hemignathus virens*) on the Island of Hawai`i. Journal of Wildlife Disease 45:497-501.

Eggert, L.S., L.A. Terwilliger, B.L. Woodworth, **P.J. Hart**, D. Palmer, and R.C. Fleischer. 2008. Genetic structure along an elevational gradient in Hawaiian Honeycreepers reveals contrasting evolutionary responses to avian malaria. BMC Evolutionary Biology 8:315.

<u>14</u> TCBES GRADUATE STUDENTS MENTORED AS PRIMARY ADVISOR (INCLUDING 5 HAWAIIAN/ PACIFIC ISLANDERS) DURING LAST 5 YEARS AT UH HILO:

- Jackie Gaudioso, Bobby Hsu, Samuel Brooks, Chris Todd, Seth Judge, Stephan Kropidlowski, Thomas Jones, Kainana Francisco, Christina Cornett, Tony Kovach, Ann Tanimoto, Joshua Pang-Ching, Tishanna Ben, James Akau

GRANTS RECEIVED (LAST FIVE YEARS)

Price, D.P., P.J. Hart, E. Stacy, and M. Takabayashi.. Understanding Biotic Response to Environmental Change in Tropical Ecosystems Through a Place-Based Context ($4,999,999)

Hart, P. J., P. Banko, and A. Timmermann. 2013. UH Climate Science Center grant Reconstructing pre-historic climate variability in Hawaii and the tropical Pacific ($81,000)

Hart, P. J. 2012. National Park Service. Vegetation inventory and mapping support. ($270,000)

Hart, P. J. 2010. National Park Service. Landbird inventory and monitoring ($300,426)

Price, D.P., P.J. Hart, E. Stacy, and M. Takabayashi. 2008. CREST center in tropical ecology and evolution in marine and terrestrial environments ($4,999,995)

PROFESSIONAL ASSOCIATIONS

American Ornithologists Union

Cooper Ornithological Society

Wilson Ornithological Society

Geometrician Associates LLC

Integrating Geographic Science and Planning
PO Box 396, Hilo Hawai'i 96721
PHONE: 808-969-7090 e-mail: rterry@hawaii.rr.com
website: geometricianassociates.com

CHIEF PERSONNEL:

Ron Terry, Ph.D.	Principal	Environmental Assessment, Botany, Vegetation Remote Sensing
Patrick Hart, Ph.D.	Associate	Terrestrial and Aquatic Botany and Zoology
Layne Yoshida, B.S.	Associate	Botany, Forestry

CONSULTING SPECIALTIES:

Environmental Analysis:	Preparation of NEPA & State Environmental Assessments, Environmental Impact Statements, and Other Government Permit-Related Impact Documents.
Flora & Fauna:	Flora and Fauna Studies, Section 7 Consultation, Remote Sensing of Vegetation

RECENT BIOLOGICAL ASSESSMENT PROJECTS:

- Biological surveys/training sessions (8 to date) for Environet, Waikoloa Maneuver Area (2013-15)
- Biological surveys of County Open Space Properties (6 to date) (HI County P&R 2014-15)
- Botanical survey Kilauea-Kauai Proposed Bicycle Path (Private 2013)
- Ka'ū Forest Reserve Management Plan Environmental Assessment (DLNR 2012)
- Hilo Hillside Subdivision Section 7 ESA Consultation, FEMA (Private 2011)
- Monk Seal Recovery Facility Environmental Assessment (Marine Mammal Center 2011)
- Biocontrol of Strawberry Guava Environmental Assessment (U.S. Forest Service 2010)
- Kea'au Pahoa Highway Improvements Botany Report (SSFM/Dept. of Trans. 2010)
- Ha'ena State Park Biological Report (PBR Hawaii/DLNR 2009)
- La'i'ōpua Endangered Species Preserve Management Plan (DHHL 2008)
- Environmental Assessment for Hakalau Forest NWR, Kona Forest Unit (USFWS 2008)
- Waikoloa Makai Botany Report (SSFM 2008)
- Aina Haina Conservation District Parcel Botany Report (Private 2007)
- Mohouli Drainage Botany Report (SSFM 2006)
- La'aloa D-Bar Ranch Botany Report (Private 2005)
- Environmental Assessment for State Kahikinui Forest Restoration, Maui (DLNR 2004)
- Botanical Report for Koa Timber (2002)
- Flora and Fauna Reports, Cellular Towers (5 reports, 1998-2004)
- Flora and Fauna Reports, Parker Ranch Quarry Sites (6 reports, 1999-2004)

QUALIFICATIONS OF RON TERRY, PH.D.:

Ron Terry, Ph.D., earned a B.A. in Geography in 1980 from the University of Hawai'i at Hilo. Supported by a National Science Foundation grant, he earned a Ph.D. from Louisiana State University, also in Geography, in 1988. He was Assistant Professor of Geography at the University of Hawai'i at Hilo from 1987-1992. During his professorship he began his consulting business, and began full-time consulting in 1992. He remains an Affiliate Professor at UH-Hilo. He has been a board member of several State boards and commissions related to environmental management.

Appendix C

Archaeological Assessment Survey

An Archaeological Assessment Survey of West Hawaii Concrete Waikōloa Quarry

TMK: (3) 6-8-001:066 (por.)

Waikōloa Ahupua'a
South Kohala District
Island of Hawai'i

ASM affiliates

EXECUTIVE SUMMARY

At the request of Jennifer Lim of Carlsmith Ball LLP, on behalf of West Hawaii Concrete, ASM Affiliates conducted an archaeological assessment survey of a roughly 220 acre portion of TMK: (3) 6-8-001:066 within the West Hawaii Concrete Waikōloa Quarry Property, Waikōloa Ahupua'a, South Kohala District, Island of Hawai'i. The current study area is located along the boundary between the districts of South Kohala and North Kona and surrounded by undeveloped *'a'ā* lava flows on all sides. West Hawaii Concrete has been operating a concrete quarry within the study area since at least 1995. West Hawaii Concrete intends to seek approval from the Leeward Planning and State Land Use Commissions to extend the duration of the Special Permit and expand the permitted uses to include the following activities in addition to the currently permitted concrete quarrying: green waste processing and composting, cement concrete recycling and asphalt concrete recycling.

This survey was undertaken in accordance with Hawai'i Administrative Rules 13§13–284, and was performed in compliance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports as contained in Hawai'i Administrative Rules 13§13–276. According to 13§13-284-5 when no archaeological resources are discovered during an archaeological survey the production of an Archaeological Assessment report is appropriate. Compliance with the above standards is sufficient for meeting the historic preservation review process requirements of both the Department of Land and Natural Resources–State Historic Preservation Division (DLNR–SHPD) and the County of Hawai'i Planning Department.

PHRI (Jensen and Burgett 1991) previously prepared an archaeological inventory survey of a roughly 300-acre parcel of land that included the 220 acre parcel which constitutes the current study area. PHRI recorded an absence of cultural resources within the current study area and the presence of nineteen sites in an area adjacent to the current study parcel. Intensive archaeological survey for the current study was conducted on May 20, 2015 by Teresa Gotay, M.A. and Layne Krause, B.A. under the direction of Robert B. Rechtman, Ph. D. Archaeological survey focused on the limited undeveloped sections around the periphery of the quarry site within the study area. Walking north-south transects spaced approximately 25 meters apart, fieldworkers did not encounter any archaeological resources.

Given the negative findings of the prior study and the similar findings of the current study, it is concluded that the proposed extension and amendment of the existing Special Permit will not impact any known historic properties. It is therefore recommended that no further historic preservation work is needed.

CHAPTERS

Page

FIGURES

Page

Page

TABLE

Page

1. INTRODUCTION

At the request of Jennifer Lim of Carlsmith Ball LLP, on behalf of West Hawaii Concrete, ASM Affiliates conducted an archaeological assessment survey of a roughly 220 acre portion of TMK: (3) 6-8-001:066 within the West Hawaii Concrete Waikōloa quarry site, Waikōloa Ahupua'a, South Kohala District, Island of Hawai'i (Figures 1, 2, and 3). West Hawaii Concrete intends to obtain approval from the Leeward Planning Commission and the State Land Use Commission to extend and amend the existing Special Permit, which allows for the operation of a quarry, to include the following activities: green waste processing and composting, cement concrete recycling and asphalt concrete recycling. This project area was subject to an archaeological inventory survey (Jensen and Burgett 1991) conducted in 1991 prior to the establishment of the quarry operation. As the Special Permit process dictates compliance with HRS Chapter 6E, and in an abundance of caution, the landowner decided to provide an updated archaeological study to verify that no historic properties would be affected by the proposed expanded operations.

This survey was undertaken in accordance with Hawai'i Administrative Rules 13§13–284, and was performed in compliance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports as contained in Hawai'i Administrative Rules 13§13–276. According to 13§13-284-5 when no archaeological resources are discovered during an archaeological survey the production of an Archaeological Assessment report is appropriate. Compliance with the above standards is sufficient for meeting the historic preservation review process requirements of the Department of Land and Natural Resources–State Historic Preservation Division (DLNR–SHPD), the State Land Use Commission (LUC), and the County of Hawai'i Planning Department with respect to the issuance of permits for land use and ground-altering activities. This report contains background information outlining the current study area's environmental and cultural contexts, a review of the findings from one previous archaeological study conducted within the current study area, and survey expectations based on the culture-historical context and previous investigation. An explanation of the current survey methods and findings will also be presented in addition to conclusions and recommendations based on the results of the current study.

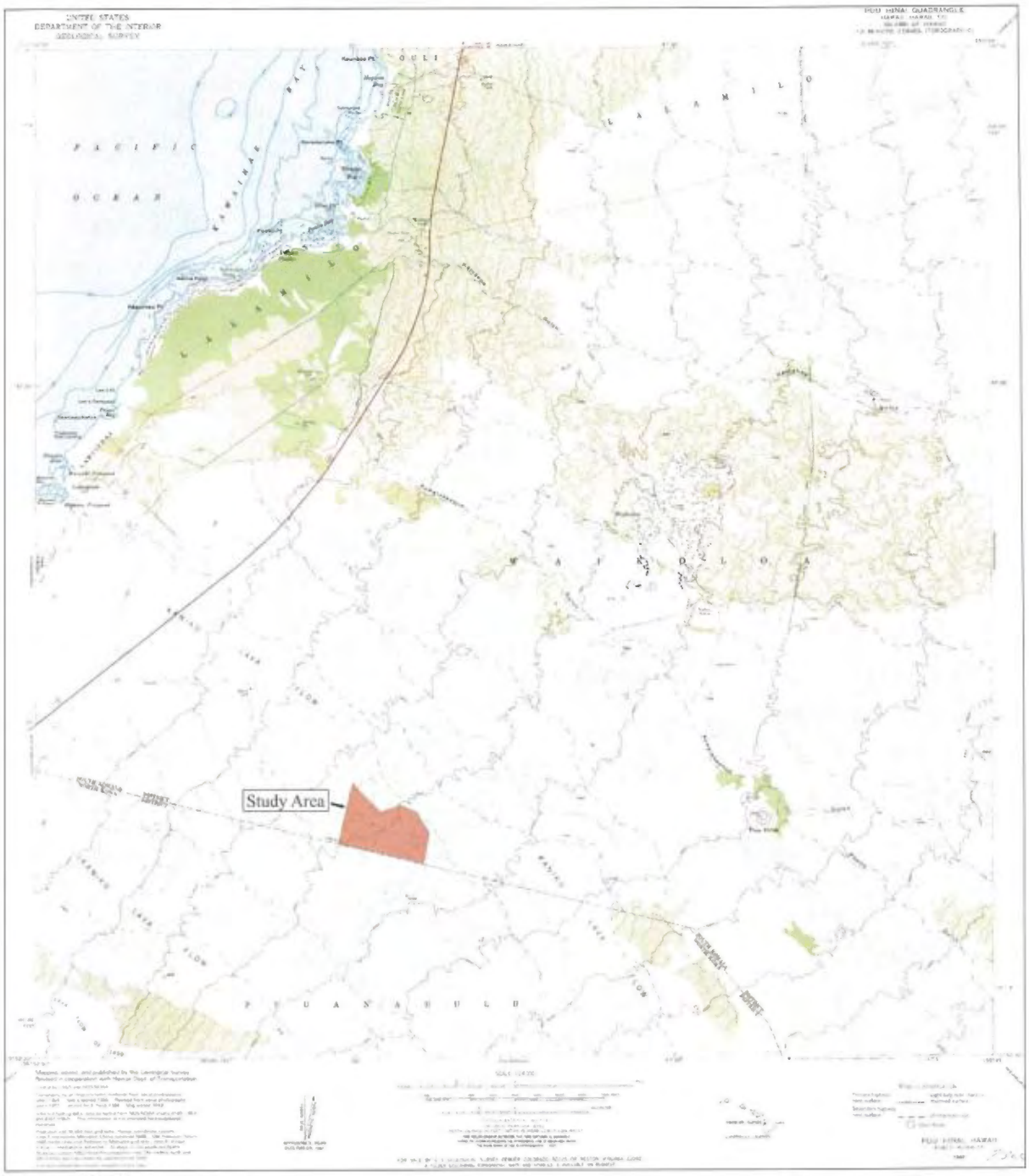


Figure 1. Study area location.

Figure 2. Tax Map Key (TMK) (3): 6-8-001 showing location of current study area (portion of Parcel 066).

Figure 3. Google Earth™ satellite image showing location of current study area outlined in red.

STUDY AREA DESCRIPTION

The current study area consists of 219.990 acres of land within a portion of TMK: (3) 6-8-001:066 located in Waikōloa Ahupua'a, South Kohala District, Hawai'i Island. The study area is situated roughly 4 miles *mauka* of the beachfront at 'Anaeho'omalu Bay, and is located along the South Kohala/North Kona boundary (see Figure 1). The study area is bounded at its south end by a transmission line corridor and unpaved access road (Figure 4), while the east, west, and north sides of the project area terminate in undeveloped land corresponding with the following TMK parcels: (3) 6-8-001:005 (west) and (3) 6-8-001:067 (north and east). Bordering the study area to the north, on TMK (3) 6-8-001:067, is an archaeological preserve containing nineteen sites within a roughly 30 acre area.

A gated access road enters the northwest corner of the study area from Waikōloa Road. This access road leads directly into a graded area with a weigh station (Figure 5) that marks the northwest boundary of the quarry site. Evidence of prior and current mechanical quarrying activity was observed during the field investigation (Figures 6 and 7). These quarried areas and the associated network of ungraded and graded access roads extend south-southeast from the northwest corner of the study area and cover roughly ninety-five percent of the approximately 220 acre property (Figure 8). The study area lands have been operated as a quarry by West Hawaii Concrete since 1995; Figure 9 shows a comparison of aerial photos of the study area taken 14 years apart, which highlights the mechanical alterations to the terrain over time.

The study area is situated at elevations ranging between 694 and 925 feet (211 and 282 meters) above sea level, within two lava flows that emanated from Mauna Loa known as the Kanikū Lava Flow (see Figure 1). Both flows within the study area are rugged expanses of *'a'ā* with near complete absence of soil. The earliest flow dates from between 3,000 and 5,000 years ago while the more recent flow occurred between 1,500 to 3,000 years ago (Wolfe and Morris 1996). Most of the Kanikū flow within the current study area has been altered by the ground disturbance associated with the quarry operations (see Figure 8).

Figure 4. Transmission line and access road marking the southern boundary of study area, view to the east.

Figure 5. Weigh station and graded access road near the entrance to study area, view to the northwest.

Figure 6. Mechanical quarrying activity within the current study area, view to the east.

Figure 7. Quarrying activity within the central portion of the study area, view to the northeast.

Figure 8. 2015 Google Earth aerial of study area showing network of access roads and quarried areas.

Figure 9. Aerial comparison showing quarry activity within study area: a. April 2000, b. August 2014.

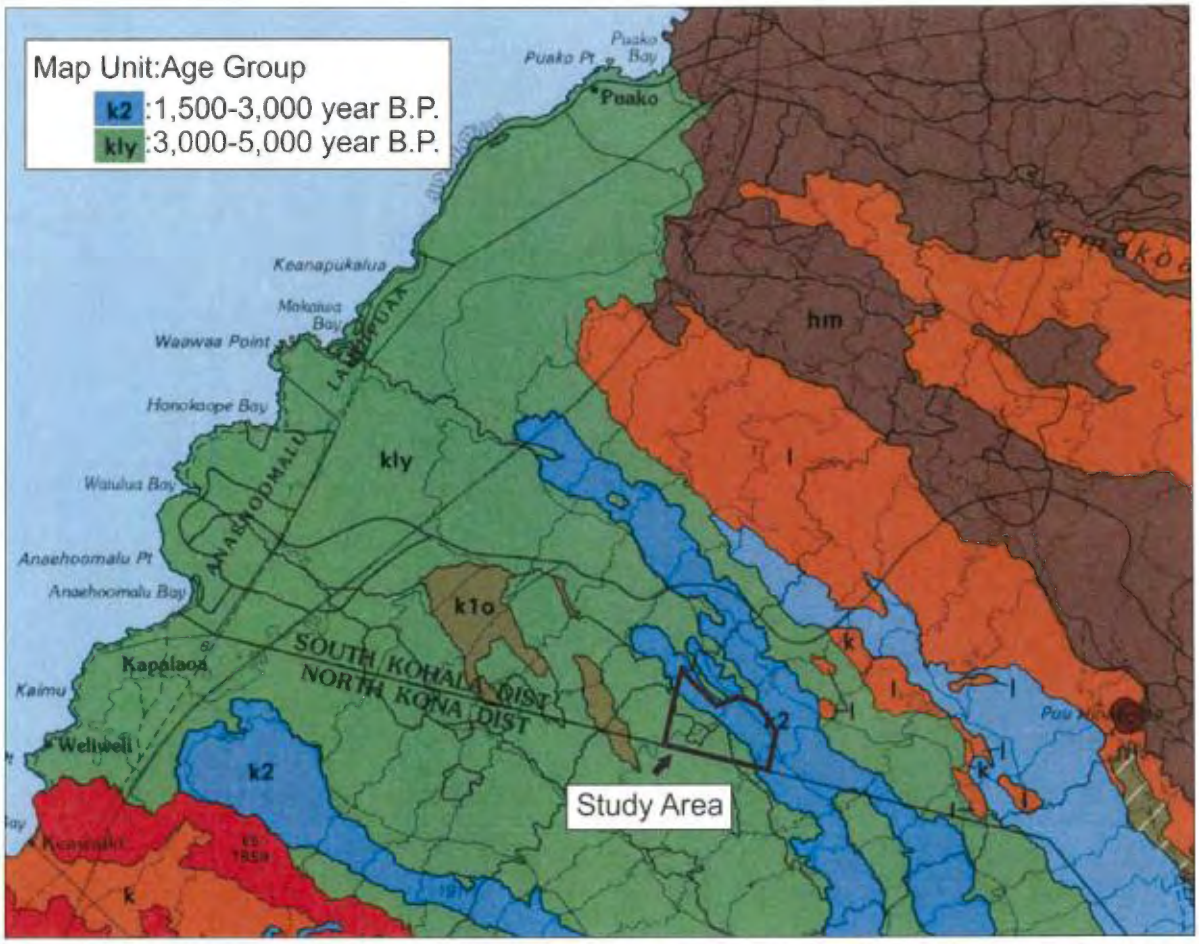


Figure 10. Geologic map (Wolfe and Morris 1996) showing study area within lava flows and corresponding dates.

The mean annual rainfall within the project area is 290.4 millimeters, with most of the rain (39-47 millimeters) falling during the wettest winter months of December and January, and very little rainfall (9-12 millimeters) during the driest summer months of June, July, and August (Giambelluca et al. 2013). As a result of the arid conditions, vegetation is sparse (see Figure 4), consisting primarily of scattered tufts of fountain grass (Pennisetum *setacaeum*). Fauna in the study environment is also limited by the harsh climate; however, fieldworkers did observe the droppings and skeletal remains of feral goats (*Capra* sp.).

2. BACKGROUND

To generate a set of expectations regarding the types of archaeological resources that might be encountered within the study area, and to establish an environment within which to assess the function, age, and significance of any such resources, a general cultural-historical background for the region is presented. The following section consists of a synthesis of Precontact settlement patterns and historically documented land use combined with a review of the findings of a prior archaeological investigation conducted in the current study area.

CULTURE-HISTORICAL CONTEXT

As previously discussed, the current project area is situated in what is today referred to as the *ahupua'a* of Waikōloa in South Kohala District on the leeward side of the Island of Hawai'i (Figure 11). It is within this context that the following discussion of the history and culture of the study area is framed. The chronological summary presented below begins with the peopling of the Hawaiian Islands and includes the presentation of a generalized model of Hawaiian prehistory containing specific legendary references to the vicinity of the study area and a discussion of the general settlement patterns for the district of South Kohala. This is followed by a summary of events in South Kohala after European contact, which includes a discussion of the changing lifeways and population decline of the early Historic Period, a review of land tenure in the study *ahupua'a* during the *Māhele 'Āina* of 1848, and ends with a summary of land use within the current study area during the late Historic Period.

A Generalized Model of Hawaiian Prehistory

The generalized cultural sequence that follows is based on Kirch's (1985) model, and amended to include recent revisions offered by Kirch (2011). The conventional wisdom has been that the first inhabitants of Hawai'i Island probably arrived by at least A.D. 300, and focused habitation and subsistence activity on the windward side of the island (Burtchard 1995; Kirch 1985; Hommon 1986). However, there is no archaeological evidence for occupation of Hawai'i Island (or elsewhere in the archipelago of Hawai'i) during this initial settlement, or colonization stage (A.D. 300 to 600). More recently, Kirch (2011) has convincingly argued that Polynesians may not have arrived to the Hawaiian Islands until at least A.D. 1000 and simply expanded rapidly thereafter. This revision would alter the timing of Kirch's (1985) Settlement, Developmental, and Expansion Periods, possibly shifting the Settlement Period to A.D. 1000 to 1100, the Developmental Period to A.D. 1100 to 1350, and the Expansion Period to A.D. 1350 to 1650.

The Settlement Period is believed to have been initiated by the arrival of settlers from the southern Marquesas Islands. This was a period of great exploitation and environmental modification, when early settlers adapted their familiar patterns and traditional tools into subsistence strategies suited to their new Hawaiian environment (Kirch 1985; Pogue 1978). Their ancient and ingrained philosophy of life tied them to their environment and kept order, which was maintained by the conical clan principle of genealogical seniority (Kirch 1984). According to Fornander (1969), the early Hawaiians brought from their homeland certain universal Polynesian customs: the major gods Kāne, Kū, and Lono; the *kapu* system of law and order; cities of refuge; the *'aumakua* concept; various epiphenomenal beliefs; and the concept of *mana*.

In the traditional district or *moku* of Kohala, the long ridge of the Kohala Mountains extends perpendicular to the predominant northeasterly trade winds, creating an orographic rainfall pattern that separates the district into two distinct environmental zones; a wetter windward zone on the eastern (Hāmākua) side, and a drier leeward zone on the western (Kona) side. The first settlers of Kohala likely established a few small communities, primarily in the windward valleys and gulches, near sheltered bays with access to fresh water and had an occupational focus on the collection of marine resources. Evidence of the earliest occupation of leeward Kohala has been collected from Kapa'anui, where Dunn and Rosendahl (1989) recovered radiocarbon samples with a potential early date (A.D. 461), and from 'Anaeho'omalu where Barrera (1971) reported A.D. 900 as the initial date for settlement. These early dates should be viewed with suspicion (see Kirch 2011), but it is possible that they represent the earliest establishment of small, short-term camps to exploit seasonal, coastal resources in leeward Kohala. Data recovered from Māhukona, along the leeward coast of North Kohala, suggest initial occupation taking place there by about A.D. 1280 (Burgett and Rosendahl 1993:36); while Cordy (2000) reported on sites in windward Kohala that are believed to have been utilized in the early thirteenth century. Permanent settlement in Kohala has been reported as early as A.D. 1300 at Koai'e, a coastal settlement, with subsistence primarily derived from marine resources and likely supplemented by small-scale agriculture (Tomonari-Tuggle 1988).

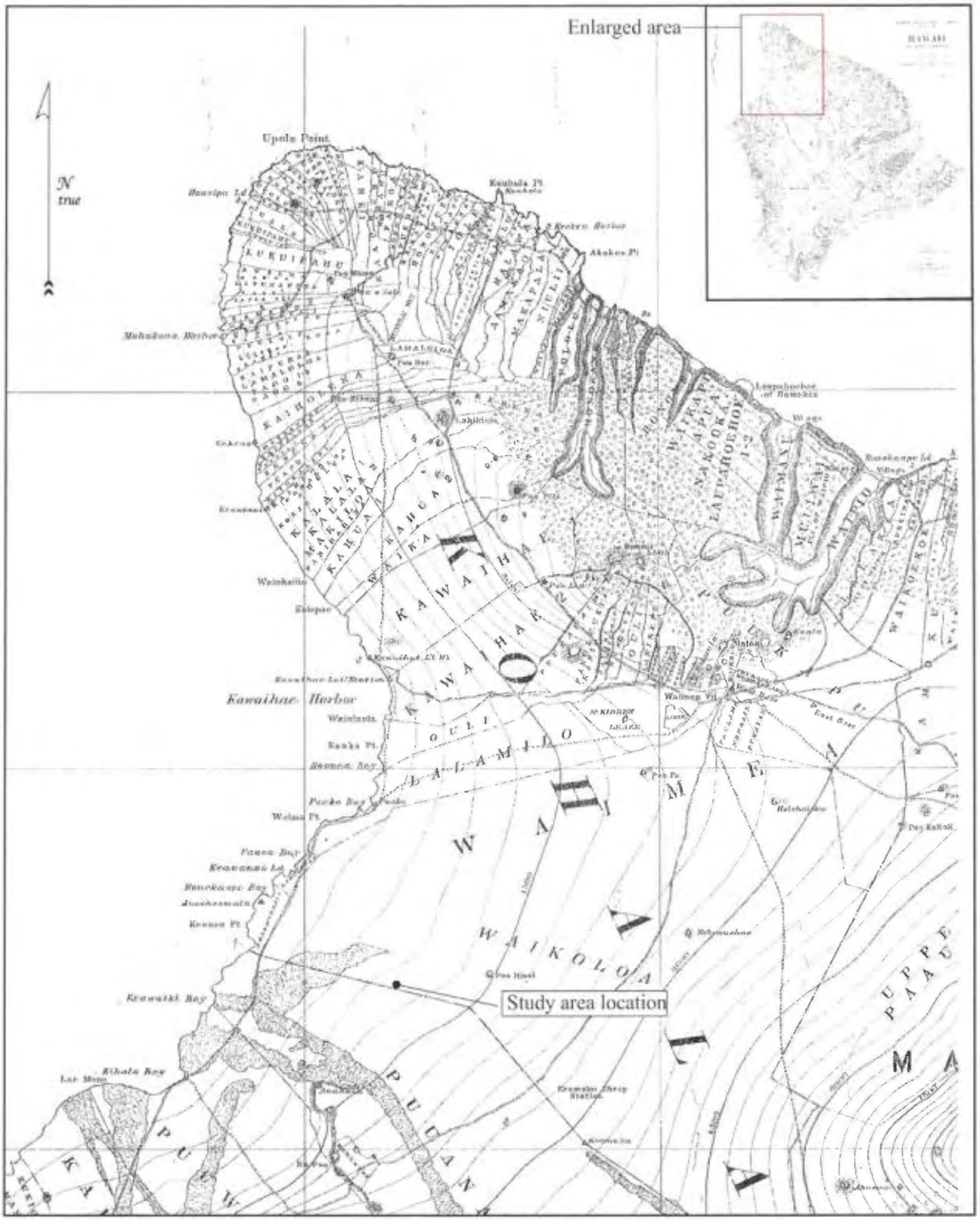


Figure 11. Portion of Hawai'i Registered Map No. 2124 showing Waikōloa Ahupua'a ca. 1901 and current study area location.

During the Developmental Period, a uniquely Hawaiian culture emerged. The portable artifacts found in archaeological sites of this period reflect not only an evolution of the traditional tools, but some distinctly Hawaiian innovations. The two-piece fishhook and the octopus-lure breadloaf sinker are Hawaiian inventions of this period, as are *'ulu maika* stones and *lei niho palaoa*. The latter was a status item worn by those of high rank, indicating a trend toward greater status differentiation. The very standard Hawaiian rectangular quadrangular tanged adze (*ko'i*) evolved from the typical Polynesian variations of plano-convex, trapezoidal, and reverse-triangular cross-sections (Kirch 1985). A few areas in Hawai'i produced quality basalt for adze production including a well-known quarry on Mauna Kea on the island of Hawai'i. As the island reached its maximum carrying capacity, the limited resources resulted in social stress and hostility that lead to wars between neighboring groups (Kirch 1985). Soon, large areas of Hawai'i were controlled by a few powerful chiefs.

The Expansion Period of Hawaiian prehistory is characterized by extreme social stratification, major socioeconomic changes, and intensive land modification, which included expanded efforts to intensify upland agriculture. During this period, most of the ecologically favorable zones of the windward and coastal regions of all major islands were settled and the more marginal leeward areas were being developed. The greatest population growth occurred during this time, which included a second major migration to Hawai'i from Tahiti, in the Society Islands. One of the earliest specific references to Waikōloa appears in the work of Samuel Mānaiakalani Kamakau who recounted the chants and legendary traditions of Hawaiian prehistory in his writings. According to Kamakau (1976) the priest Pā'ao arrived in the Hawaiian Islands during the 13th century from Kahiki, which has since been interpreted as Tahiti. Pā'ao was the keeper of the god Kū'kā'ilimoku, who had fought bitterly with his older brother, the high priest Lonopele, who expelled him from his homeland (Kamakau 1991).

Lonopele did not let Pā'ao leave peacefully, but instead called on the cold north winds to sink his canoes; one of the winds was named "Waikōloa" (Kamakau 1991:5). Despite Lonopele's best efforts, Pā'ao's canoe was not destroyed and he and his companions (thirty eight men, two stewards, his sister, chief Pili and his wife and the prophet Makuaka'ūmana) arrived safely in Hawai'i after their perilous journey. Kamakau (1991) recounts the following details of Pā'ao and Pili's arrival in Hawai'i:

> It is thought that Pā'ao came to Hawai'i in the time of the *ali'i* La'au because Pili ruled as *mo'i* after La'au. You will see Pili there in the line of succession, the *mo'o kū'auhau*, of Hanala'anui. It is said that Hawai'i Island was without a chief, and so a chief was brought from Kahiki; this is according to chiefly genealogies. Hawai'i Island had been without a chief for a long time, and the chiefs of Hawai'i were *ali'i maka'āinana* or just commoners, *maka'āinana*, during this time.
>
> . . . There were seventeen generations during which Hawai'i Island was without chiefs—some eight hundred years. . . . The lack of a high chief was the reason for seeking a chief in Kahiki, and that is perhaps how Pili became the chief of Hawai'i. He was a chief from Kahiki and became the ancestor of chiefs and people of Hawai'i Island. (1991:100–102)

The *moku* of Kohala appears in several versions of the Pili ruling line's origin story; such as a version discussed by Beckwith (1976) in which Mo'okini and Kaluawilinau, two *kāhuna* of Moikeha, decide to stay on at Kohala. In addition, Kamakau (1964) recounts that

> In the burial cave of Pu'uwepa in Kohala, Hawaii are deposited the bones of Pa'ao, the famous kahuna who built the heiau of Mo'okini at Kohala, and who lived a span of 15 generations before he died. Its entrance is said to be beneath the sea (1964:41)

The Pili chiefs initial ruling center was likely in Kohala too, but Cartwright (1933) suggests that Pili later resided in and ruled from Waipi'o Valley in the Hāmākua District.

Rosendahl (1972) has proposed that settlement in leeward Kohala during the Expansion Period was related to seasonal, recurrent occupation. Coastal sites were occupied in the summer to exploit marine resources, while upland sites were occupied during the winter months with a primary focus on agriculture. According to Hommon (1976), an increasing reliance on agricultural products may have caused a shift in social networks as well; kinship links between coastal settlements disintegrated as those links within the *mauka-makai* settlements expanded to accommodate the exchange of agricultural products for marine resources. This shift is believed to have resulted in the establishment of the *ahupua'a* system. The implications of this model include a shift in residential patterns from seasonal/temporary occupation to permanent, dispersed occupation of both coastal and upland areas.

According to Kirch's (1985) model, the concept of the *ahupua'a* was established sometime during the A.D. 1400s, adding another component to a well-stratified society. This land unit became the equivalent of a local community, with its own social, economic, and political significance. *Ahupua'a* were ruled by *ali'i 'ai ahupua'a* or lesser chiefs;

who, for the most part, had complete autonomy over this generally economically self-supporting piece of land, which was managed by a *konohiki*. *Ahupua'a* were usually wedge or pie-shaped, incorporating all of the eco-zones from the mountains to the sea and for several hundred yards beyond the shore, assuring a diverse subsistence resource base (Hommon 1986). This form of district subdividing was integral to early Hawaiian life, and was the product of strictly adhered to resource management planning. In this system, the land provided fruits and vegetables and some meat for the diet, and the ocean provided a wealth of protein resources (Rechtman and Maly 2003). The *ali'i* and the *maka'āinana* (commoners) were not confined to the boundaries of their *ahupua'a;* when there was a perceived need, they also shared with their neighbor *ahupua'a 'ohana* (Hono-ko-hau 1974). The *ahupua'a* were further divided into smaller sections such as the *'ili, mo'o'aina, pauku'aina, kihapai, koele, hakuone*, and *kuakua* (Hommon 1986, Pogue 1978). The chiefs of these land units gave their allegiance to a territorial chief or *mō'ī* (king).

Traditionally, Waikōloa was an *'ili* of the *kalana* (or *'okana*) of Waimea (Figure 12), a land division that in ancient times was treated as a sub-district, smaller than a district (*moku o loko*), but comprised of several other land divisions that contributed to its wealth (Maly and Maly 2002). The lands within the *kalana* of Waimea were those that form the southern limits of present day South Kohala District including 'Ōuli, Wai'aka, Lālāmilo, Puakō, Kalāhuipua'a, 'Anaeho'omalu, Kanakanaka, Ala'ōhi'a, Paulama, Pu'ukalani, Pu'ukapu, and Waikōloa, where the current study area is located (Figure 13).

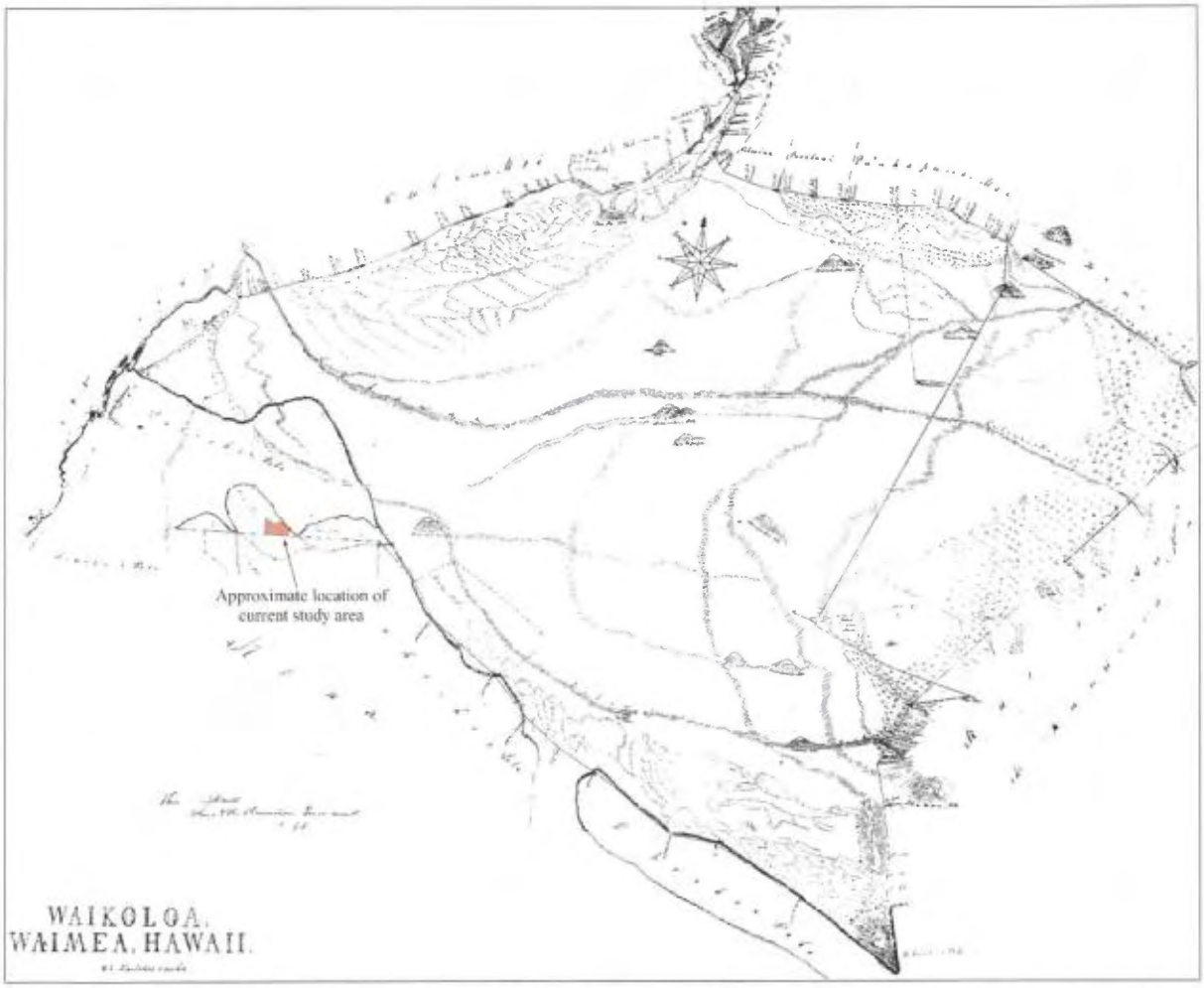


Figure 12. Registered Map No. 574 showing Waikōloa, the *kalana* of Waimea and the approximate location of the current study area (prepared by Kaelemakule, n.d.).

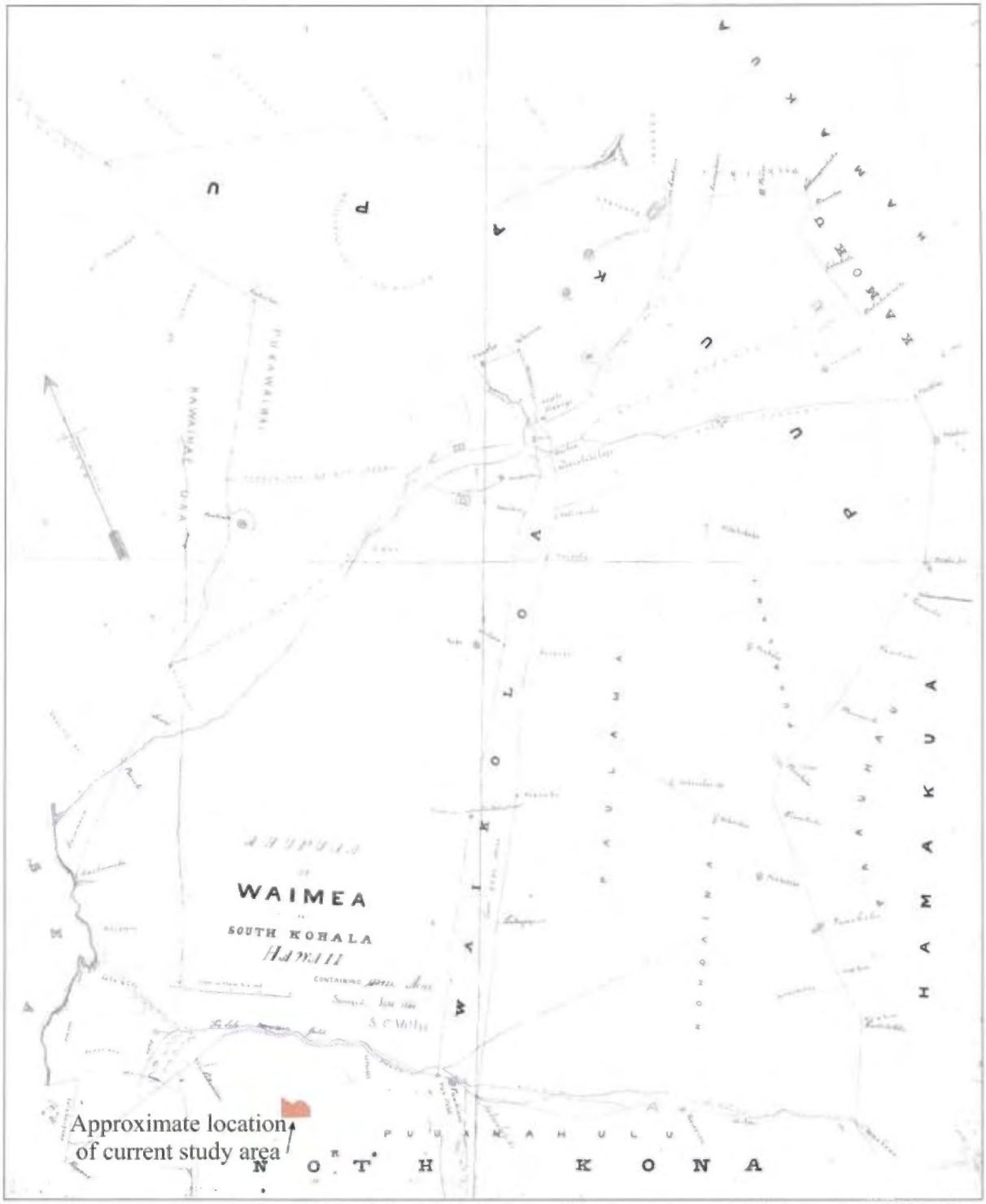


Figure 13. Hawai'i Registered Map No. 712 showing the *kalana* of Waimea and associated *ahupua'a* ca. 1866 with approximate location of the current study area.

Bernice Judd, a former librarian at the Hawaiian Mission Children's society, explains that:

> In the early days Waimea meant all the plateau between the Kohala Mountains and Mauna Kea, inland from Kawaihae. This area is from eight to ten miles long and from three to five miles wide. There was no running water on Mauna Kea, so the inhabitants lived at the base of the Kohala Mountains, where three streams touched the plain on their way towards the sea. . . The middle stream, which was famous for wild ducks, was named Waikoloa, or Duckwater. This and the most westerly stream, called Kahakohau, went towards Kawaihae, but neither reached the sea, except in times of flood. (Judd 1932:14)

In some early accounts, Waikolōa Ahupua'a was referred to as Waikōloa Nui, and the neighboring *ahupua'a* of Lālāmilo as Waikōloa Iki (Maly 1999). Unlike the early maps of Waimea prepared by Kaelemakule (see Figure 12) and S.C. Wiltse in 1866 (see Figure 13), Hawaiian Government Survey maps prepared by John M. Donn in 1901 (see Figure 11) and by C.J. Lyons in 1928 (Figure 14) both show the *ahupua'a* of Waikōloa as it appears today.

Heiau construction flourished during the Expansion Period as religion became more complex and embedded in a sociopolitical climate of territorial competition. Monumental architecture "played a key role as visual markers of chiefly dominance" (Kirch 1990:206). This pattern continued to intensify from A.D. 1500 until contact (A.D. 1778), and archaeological evidence suggests that substantial revisions were made to the political system as well. Within Kohala, the Great Wall complex at Koai'e is organized with platforms in the complex set apart from contemporaneous features; Griffin et al. (1971) interpret this separation within the complex as symbolic of class stratification.

During the Expansion Period agricultural intensification occurred primarily in the uplands of South Kohala. Although most of the taro and sweet potato fields of South Kohala were located in the rainier uplands near the present day town of Waimea (where there was also a sizable permanent population),Handy and Handy relate that:

> the coastal section of Waimea, now called South Kohala, has a number of small bays with sandy shores where fishermen used to live, and where they probably cultivated potatoes in small patches… Puako near the Kona border was a sizable fishing village at one time where there were undoubtedly many sweet potato patches" (1991:532)

In addition to taro and sweet potato fields, *kō kea* (white cane), the most common variety of sugarcane (*Saccharum officinarum*) was often planted near Hawaiian homes and was utilized for a variety of medicinal and culinary purposes (Handy and Handy 1991). Sugar cane was also used as thatch for houses when *pili* grass (*Heteropogon contortus*) or *lau hala* (*Pandanus odortissimus*) were in short supply (Malo 1903). The name of the village of Puakō, literally translates as "sugarcane blossom" (Pukui et al. 1974). Pukui (1983) cites the following ancient proverb that references the sugar cane in Kohala:

> *I 'ike 'ia no o Kohala i ka pae kō, a o ka pae kō ia kole ai ka waha.*
> One can recognize Kohala by her rows of sugar cane which can make the mouth raw when chewed.

Pukui stresses that Hawaiian proverbs have layers of meaning that are best left to the imagination of the reader and offers the following interpretation of this proverb:

> When one wanted to fight a Kohala warrior, he would have to be a very good warrior to succeed. Kohala men were vigorous, brave, and strong. (1983:127)

Another Hawaiian legend, the Legend of Kanikū and Kanimoe, two *mo'o* or water-spirits with lizard bodies, is worth mentioning as part of the current investigation because the study area is located within the lava flow (Figure 15) that bears the water spirit's name. According to an interview documented by Wolforth et al., these two *mo'o* took the form of beautiful women and lived in the "large coastal fishpond of Wainānāli'i in Pu'uanahulu" (2005:6). According to the legend, Kanikū and Kanimoe were turned to stone when a lava flow covered the fishpond and as a result, their bodies still lie side by side in the middle of the *'a 'ā* flow, which is how the Kanikū Lava Flow got its name (Wolforth et al 2005).

Figure 14. Hawai'i Registered Map No. 1080 showing *kalana* of Waimea with Waikōloa Ahupua'a as it is appears today.

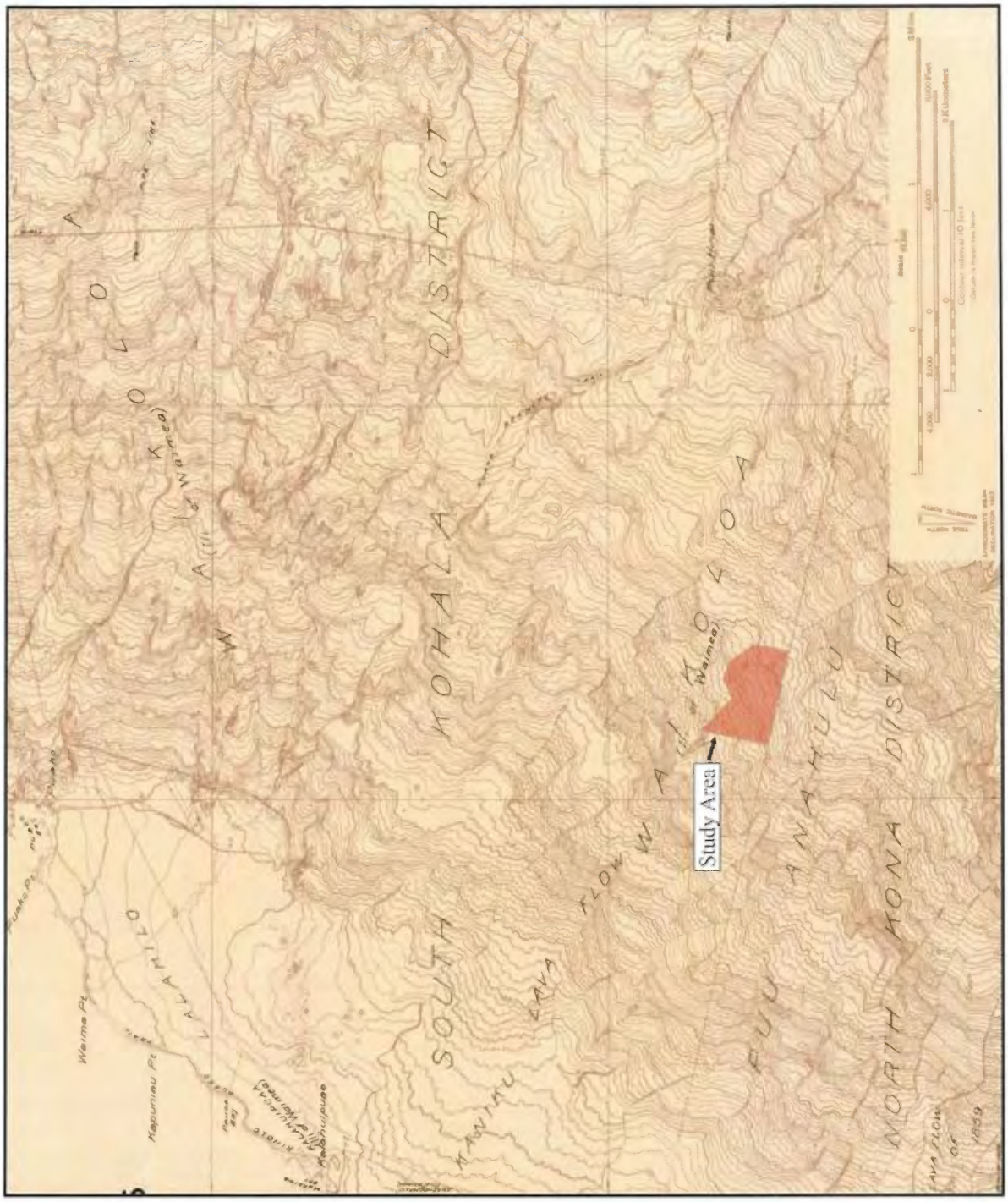


Figure 15. Portion of the 1923 U.S.G.S. Pu'u Hinai quadrangle showing the current study area within Kanikū Lava Flow.

By the seventeenth century, large areas of Hawai'i Island (*moku āina* – districts) were controlled by a few powerful *ali'i 'ai moku*. There is island-wide evidence to suggest that growing conflicts between independent chiefdoms were resolved through warfare, culminating in a unified political structure at the district level. It has been suggested that the unification of the island resulted in a partial abandonment of portions of leeward Hawai'i, with people moving to more favorable agricultural areas (Barrera 1971; Schilt and Sinoto 1980). 'Umi a Līloa, a renowned *ali'i* of the Pili line who ruled from Waipi'o Valley, is often credited with uniting the island of Hawai'i under one rule (Cordy 1994). According to Kamakau (1992) 'Umi was a skilled fisherman, and fishing for *aku*, his favorite fish, often brought him to the beaches of South Kohala from Kalahuipua'a to Makaula, where he also fished for *'ahi* and *kala* with many other famed fishermen and all the chiefs of the kingdom. 'Umi's reign lasted until around ca. A.D. 1620, and was followed by the rule of his son, Keawenui a 'Umi, and then his grandson, Lonoikamakahiki (Cordy 1994).

Kirch (1985) places the beginning of the Proto-Historic Period (A.D. 1650–1795) during the rule of Lonoikamakahiki. This period was marked by both political intensification and continual conquest by the reigning *ali'i*. Wars occurred regularly between intra-island and inter-island polities during this period, and included battles that transpired in the vicinity of the current study area. One such battle was fought between Lonoikamakahiki (Lono) and his older brother, Kanaloakua'ana, who rebelled against him. According to Fornander, Kanaloakua'ana and his rebel forces were situated at:

> . . . the land called Anaehoomalu, near the boundaries of Kohala and Kona. The rebel chiefs were encamped seaward of this along the shore. The next day Lono marched down and met the rebels at the place called Wailea, not far from Wainanalii, where in those days a watercourse appears to have been flowing. Lono won the battle, and the rebel chiefs fled northward with their forces. At Kaunooa [Kauna'oa], between Puako and Kawaihae, they made another stand, but were again routed by Lono, and retreated to Nakikiaianihau, where they fell in with reinforcements from Kohala and Hamakua. Two other engagements were fought at Puupa [on the plain north of Waikōloa] and Puukohala, near the Heiau of that name, in both of which Lono was victorious. . . (Fornander 1996:120-121)

Later, Lonoikamakahiki battled the forces of Maui led by Kamālālawalu (Kama) on the plain of Waikōloa below Pu'u 'Ōā'oaka (Maly and Maly 2002). According to Kamakau:

> After Kama-Iala-walu's warriors reached the grassy plain, they looked seaward on the left and beheld the men of Kona advancing toward them. The lava bed of Kaniku and all the land up to Hu'ehu'e was covered with the men of Kona. Those of Ka'u and Puna were coming down from Mauna Kea, and those of Waimea and Kohala were on the level plain of Waimea [Waikōloa]. The men covered the whole of the grassy plain of Waimea like locusts. Kamalalawalu with his warriors dared to fight. The battlefield of Pu'oa'oaka was outside of the grassy plain of Waimea, but the men of Hawaii were afraid of being taken captive by Kama, so they led [Kamalalawalu's forces] to the waterless plain lest Maui's warriors find water and hard, waterworn pebbles. The men of Hawaii feared that the Maui warriors would find water to drink and become stronger for the slinging of stones that would fall like raindrops from the sky. The stones would fall about with a force like lightning, breaking the bones into pieces and causing sudden death as if by bullets . . .
>
> . . . The Maui men who were used to slinging shiny, water-worn stones grabbed up the stones of Pu'oa'oaka. A cloud of dust rose to the sky and twisted about like smoke, but the lava rocks were light, and few of the Hawaii men were killed by them. This was one of the things that helped to destroy the warriors of Kama-lala-walu: They went away out on the plain where the strong fighters were unable to find water . . . The warriors of Maui were put to flight, and the retreat to Kawaihae was long. [Yet] there were many who did reach Kawaihae, but because of the lack of canoes, only a few escaped with their lives ... Kamalalawalu, ruler of Maui, was killed on the grassy plain of Puako, and some of his chiefs were also destroyed. (Kamakau 1991:58-60)

By the 1700s, the rule of Hawai'i Island was divided amongst the chiefs of Kona and Hilo (Kamakau 1992). Keawe, a Pili line ruler and the son of Kanaloakapulehu, was the chief of Kohala, Kona, and Ka'ū. When Keawe died, he split the rule of his lands between two of his sons, further dividing the island's chiefdoms; Kalaninui'iamamao became the ruling chief of Ka'ū, and Ke'eaumoku became the ruling chief of Kona and Kohala (Kamakau 1992). Wars between the *ali'i* continued unabated through this transition.

During this time of warfare, and following the death of Keawe, Kamehameha was born in North Kohala District in the *ahupua'a* of Kokoiki, near the *heiau* of Mo'okini (Kamakau 1992). There is some controversy about the year of his birth, but Kamakau (1992) places the birth event sometime between A.D. 1736 and 1758, most likely nearer to the later date. Kamehameha's ancestral homeland was in Hālawa, North Kohala District (Williams 1919).

About A.D. 1759, Kalani'ōpu'u conquered East Maui and defeated his wife's brother, the Maui king Kamehamehanui, by using Hāna's prominent Pu'u Kau'iki as his fortress. He appointed one of his Hawai'i chiefs, Puna, as governor of Hāna and Kīpahulu. Following this victory, Ke'eaumoku, the son of Keawepoepoe who had originally supported Kalani'ōpu'u against Keawe'ōpala, rebelled against the Hawai'i chief. He set up a fort on a hill between Pololū and Honokāne Valleys in windward North Kohala, but Kalani'ōpu'u attacked him there and reigned victorious. Using ropes, Ke'eaumoku escaped to the sea and fled in a canoe to Maui where he lived under the protection of the Maui chiefs (Kamakau 1992).

In A.D. 1766 Kamehamehanui, the king of Maui, died following an illness and Kahekili became the new ruler of that island. Ke'eaumoku took Kamehamehanui's widow, Namahana, a cousin of Kamehameha I, as his wife, and their daughter, Ka'ahumanu, the future favorite wife of Kamehameha I, was born in a cave at the base of Pu'u Kau'iki, Hāna, Maui in A.D. 1768 (Kamakau 1992). In A.D. 1775 Kalani'ōpu'u and his Hāna forces raided and destroyed the neighboring district of Kaupō in Maui, and then launched several more raids on Moloka'i, Lāna'i, Kaho'olawe, and parts of West Maui. It was at the battle of Kalaeoka'ilio that Kamehameha, a favorite of Kalani'ōpu'u, was first recognized as a great warrior and given the name of Pai'ea (hard-shelled crab) by the Maui chiefs and warriors (Kamakau 1992). During the battles between Kalani'ōpu'u and Kahekili (1777–1779), Ka'ahumanu and her parents left Maui to live on the island of Hawai'i (Kamakau 1992). Kalani'ōpu'u was fighting on Maui when the British explorer Captain James Cook first arrived in the islands.

History After Contact

The arrival of Western explorers in Hawai'i marked the end of the Precontact Period and the beginning of the Historic Period. With the arrival of foreigners, Hawai'i's culture and economy were drastically altered. Demographic trends during this period indicate population reduction in some areas, due to war and disease, yet increases in others, with relatively little modification of material culture. There was a continued trend toward craft and status specialization, intensification of agriculture, *ali'i* controlled aquaculture, upland residential sites, and the enhancement of traditional oral history. The Kū cult, *luakini heiau*, and the *kapu* system were at their peaks, although Western influence was already altering the cultural fabric of the Islands (Kirch 1985; Kent 1983). Foreigners very quickly introduced the concept of trade for profit, and by the time Kamehameha I had conquered O'ahu, Maui and Moloka'i, in 1795, Hawai'i had seen the beginnings of a market system economy (Kent 1983). Some of the work of the commoners shifted from subsistence agriculture to the production of foods and goods that they could trade with early visitors. Introduced foods often grown for trade with Westerners included yams, coffee, melons, potatoes, corn, beans, figs, oranges, guava, and grapes (Wilkes 1845). Later, as the Historic Period progressed, Kamehameha I died, the *kapu* system was abolished, Christianity established a firm foothold in the islands, and introduced diseases and global economic and political forces began to have a devastating impact on traditional Hawaiian lifeways. This marked the end of the Proto-Historic Period and the decline of the uniquely innovative Hawaiian culture.

The Arrival of Captain James Cook and the End of Kalani'ōpu'u's Reign (1778-1782)

British explorer Captain James Cook, in command of the ships *H.M.S. Resolution* and *H.M.S. Discovery*, first landed in the Hawaiian Islands on January 18, 1778. The following January, Cook returned to Kealakekua Bay in South Kona District during the annual *Makahiki* festival. According to John Ledyard, a British marine on board Cook's ship, more than 15,000 inhabitants were present at the bay at that time, and as many as 3,000 canoes came out to greet the ships (Jarves 1847). It has been suggested that Captain Cook was mistaken for the returned god Lono himself, as men would not normally be allowed to paddle out during the *Makahiki* without breaking the *kapu* and forfeiting all of their possessions (Kamakau 1992). Cook set sail shortly thereafter but a storm forced him to return to return to Kealakekua Bay for repairs. Cook's return set off a series of unfortunate events that ended in Cook's death along with four of his men and several natives on the shores of Ka'awaloa (Kamakau 1992).

After Captain Cook was struck down, the British ships fired cannons into the crowd at the shore and several more natives were killed. Kalani'ōpu'u and his retinue retreated inland, bringing the body of Cook with them. Kamakau writes:

> . . . The bodies of Captain Cook and the four men who died with him were carried to Ka-lani-'opu'u at Maaunaloia, and the chief sorrowed over the death of the captain. He dedicated the body of Captain Cook, that is, he offered it as a sacrifice to the god with a prayer to grant life to the chief (himself) and to his dominion. Then they stripped the flesh from the bones of Lono. The palms of the hands and the intestines were kept; the remains (*pela*) were consumed with fire. The bones Ka-lani-'opu'u was kind enough to give to the strangers on board the ship, but some were saved by the kahunas and worshiped. (1992:103)

After the death of Captain Cook and the departure of the *H.M.S. Resolution* and *Discovery*, Kalani'ōpu'u moved to Kona (Kamakau 1992). When famine struck in Kona District, Kalani'ōpu'u ordered that all the cultivated products in Kona be seized. He then set out on a circuit of the island; his first stop was Hinakahua in Kapa'au, North Kohala. During his stay in Kohala, Kalani'ōpu'u proclaimed that his son Kiwala'ō would be his successor, and he gave the guardianship of the war god Kūka'ilimoku to Kamehameha. However, Kamehameha and a few other chiefs were concerned about their land claims, which Kiwala'ō did not seem to honor (Fornander 1996; Kamakau 1992). The *heiau* of Moa'ula was erected in Waipi'o at this time (ca. 1781), and after its dedication Kalani'ōpu'u set out for Hilo to quell a rebellion by a Puna chief named Imakakolo'a.

Imakakolo'a was defeated in Puna by Kalani'ōpu'u's superior forces, but he managed to avoid capture and hide from detection for the better part of a year. While the rebel chief was sought, Kalani'ōpu'u "went to Ka-'u and stayed first at Punalu'u, then at Waiohinu, then at Kama'oa in the southern part of Ka-'u, and erected a heiau called Pakini, or Halauwailua, near Kama'oa" (Kamakau 1992:108). Imakakolo'a was eventually captured and brought to the *heiau*, where Kiwala'ō was to sacrifice him. "The routine of the sacrifice required that the presiding chief should first offer up the pigs prepared for the occasion, then bananas, fruit, and lastly the captive chief" (Fornander 1996:202). However, before Kiwala'ō could finish the first offerings, Kamehameha, "grasped the body of Imakakolo'a and offered it up to the god, and the freeing of the tabu for the heiau was completed" (Kamakau 1992:109). Upon observing this single act of insubordination, many of the chiefs believed that Kamehameha would eventually rule over all of Hawai'i. After usurping Kiwalao's authority with a sacrificial ritual in Ka'ū, Kamehameha retreated to his home district of Kohala. While in Kohala, Kamehameha farmed the land, growing taro and sweet potatoes (Handy and Handy 1972). Kalani'ōpu'u died in April of 1782 and was succeeded by his son Kiwala'ō.

The Rule of Kamehameha I (1782-1819)

After Kalani'ōpu'u died, several chiefs were unhappy with Kiwala'ō's division of the island's lands, and civil war broke out. Kiwala'ō, Kalani'ōpu'u's son and appointed heir, was killed in July of 1782 at the battle of Moku'ōhai in South Kona. Supporters of Kiwala'ō, including his half-brother Keōua and his uncle Keawemauhili, escaped the battle of Moku'ōhai with their lives and laid claim to the Hilo, Puna, and Ka'ū Districts. According to 'I'i (1963), nearly ten years of almost continuous warfare followed the death of Kiwala'ō, as Kamehameha endeavored to conquer the islands of Maui and O'ahu and unite the island of Hawai'i under one rule. Keōua became Kamehameha's main rival on the island of Hawai'i, and he proved difficult to defeat (Kamakau 1992). Keawemauhili would eventually give his support to Kamehameha, but Keōua never stopped resisting. Around 1790, in an effort to secure his rule, Kamehameha began building the *heiau* of Pu'ukoholā at Kawaihae, which was to be dedicated to the war god Kūka'ilimoku (Fornander 1996).

When construction of Pu'ukoholā Heiau was completed in the summer of 1791, Kamehameha sent two of his counselors, Keaweaheulu and Kamanawa, to offer peace to Keōua. Keōua was enticed to the dedication of the Pu'ukoholā Heiau by this ruse and when he arrived at Kawaihae he and his party were sacrificed to complete the dedication (Kamakau 1992). The assassination of Keōua gave Kamehameha undisputed control of Hawai'i Island by about 1792 (Greene 1993). Between 1792 and 1796 Kamehameha mostly resided at Kawaihae and worked the lands of the Waikōloa-Waimea region (Maly and Maly 2002). By 1796, Kamehameha had conquered all the island kingdoms except for Kaua'i. It wasn't until 1810, when Kaumuali'i of Kaua'i gave his allegiance to Kamehameha, that the Hawaiian Islands were unified under one ruler (Kuykendall and Day 1976).

In the twelve years following the death of Captain Cook, sixteen foreign ships (all British and American) visited Hawaiian waters (Restarick 1927). In 1790, two sister ships, the *Eleanora* and the *Fair American*, were trading in Hawaiian waters when a skiff was stolen from the *Eleanora* and one of its sailors was murdered. The crew of the *Eleanora* proceeded to slaughter more than 100 natives at Olowalu on Maui. After leaving Maui, the *Eleanora* sailed to Hawai'i Island, where one of its crew, John Young, went ashore and was detained by Kamehameha's men. The other vessel, the *Fair American,* was captured by the forces of Kamehameha off the coast of North Kona, and in an

act of retribution for the Olowalu massacre, they slaughtered all but one crew member, Isaac Davis. Guns and a cannon (later named "Lopaka") were recovered from the *Fair American*, and were kept by Kamehameha as part of his fleet (Kamakau 1992). Kamehameha made John Young and Isaac Davis his advisors.

In 1792, Captain George Vancouver, who had sailed with Cook during his 1778-1779 voyages, arrived in Kealakekua Bay with a small fleet of British ships, where he met with Kamehameha. Vancouver stayed only a few days during this first visit, but returned again in 1793 and 1794 to resupply his fleet. Vancouver introduced cattle to the Island of Hawai'i during his 1793 and 1794 visits, giving them as gifts to Kamehameha I, who immediately made the cattle *kapu*, thus preventing them from being killed (Kamakau 1992). Five cows, two ewes, and a ram brought by Vancouver in 1793 were set free to roam in the saddle area of Waimea between Mauna Kea, Mauna Loa, and Hualālī (Escott 2008).

During one of his visits Vancouver anchored at Kawaihae and a member of his crew, Archibald Menzies, a surgeon and naturalist, trekked inland towards Waimea. Menzies' journal records the journey and describes the land in the vicinity of the current study area as follows:

> I travelled a few miles back…through the most barren, scorching country I have ever walked over, composed of scorious dregs and black porous rock, interspersed with dreary caverns and deep ravines…The herbs and grasses which the soil produced in the rainy seasons were now mostly in the shriveled state, thinly scattered and by no means sufficient to cover the surface from the sun's powerful heat, so that I met with few plants in flower in this excursion. (Menzies 1920:55)

Around the turn of the century, Kamehameha gave control of present day Waikōloa then Waikōloa Nui Ahupua'a (excluding the coastal *'ili* of 'Anaeho'omalu and Kalāhuipua'a) to Isaac Davis (Rosendahl 2000). Although the land of Waikōloa Nui gifted to Davis encompassed a large area, it lacked extensive resources, and was primarily a place for catching birds and gathering *pili* grass. When Davis died in 1810 without naming an heir, John Young took control of the land and protected it for Davis' children, who were at that time too young to take on the responsibility (Rosendahl 2000).

Waikōloa Nui would eventually become a favored pasture for the cattle given by Vancouver to Kamehameha. By the early nineteenth century the *kapu* cattle quickly multiplied in the region to the extent that they became a scourge for the native planters of the Waimea area. In order to protect the upland agricultural fields from the overwhelming number of grazing cattle, sometime between 1813 and 1819, Kamehameha ordered the construction of a wall extending from the northern boundary of Waikōloa Nui to near Pu'u Huluhulu (Barrère 1983). The wall was designed to keep wild cattle in Waikōloa Nui and out of the more agriculturally productive areas on the Waimea side. The wall was called *Pā* of Kauliokamoa after the *konohiki* who oversaw its construction (Wolforth 2000).

During the first part of the nineteenth century, Hawaiian culture and economy continued their radical transformation as capitalism and industry established a tight grip on the islands. The sandalwood (*Santalum ellipticum*) trade, established by Euro-Americans in 1790 and turned into a viable commercial enterprise by 1805, was flourishing by 1810 (Oliver 1961). This added to the breakdown of the traditional subsistence system, as farmers and fishermen were ordered to spend most of their time logging, which resulted in food shortages and famine and eventually led to population decline. Kamehameha, who resided on the Island of O'ahu at this time, did manage to maintain some control over the trade on Hawai'i Island (Kuykendall and Day 1976; Kent 1983).

Upon returning to Kailua in 1812, Kamehameha ordered men into the mountains of Kona to cut sandalwood and carry it to the coast, paying them in cloth, *tapa* material, food and fish (Kamakau 1992). Kamakau indicates that:

> this rush of labor to the mountains brought about a scarcity of cultivated food . . . The people were forced to eat herbs and tree ferns, thus the famine [was] called Hi-laulele, Haha-pilau, Laulele, Pualele, 'Ama'u, or Hapu'u, from the wild plants resorted to. (1992:204)

Once Kamehemeha realized that his people were suffering, he declared all the sandalwood to be government property and ordered the people to return to their cultivation of the land and devote only part of their time to sandalwood production (Kamakau 1992). In the uplands of Kailua, a vast plantation named Kuahewa was established where Kamehameha himself worked as a farmer. Kamehameha enacted the law that anyone who took one corm of taro or one stalk of sugarcane must plant one cutting of the same in its place (Handy and Handy 1991). While in Kailua, Kamehameha resided at Kamakahonu, from where he continued to rule the islands for another nine years. He and his high chiefs participated in foreign trade, but also continued to enforce the rigid *kapu* system.

The Death of Kamehameha I and the Abolition of the Kapu System (1819-1820)

Kamehameha I died on May 8, 1819 at Kamakahonu in Kailua-Kona, and the changes that had been affecting the Hawaiian culture since the arrival of Captain Cook in the Islands began to accelerate. Following the death of a prominent chief, it was customary to temporarily eliminate all of the regular *kapu* that maintained social order through the strict separation between men and women; elite and commoner. Thus, following Kamehameha's death, a period of *'ai noa* (free eating) was observed along with the relaxation of other traditional *kapu*. It was the responsibility of the new ruler and *kahuna* to re-establish *kapu* and restore social order, but at this point in history traditional customs were significantly altered:

> The death of Kamehameha was the first step in the ending of the tabus; the second was the modifying of the mourning ceremonies; the third, the ending of the tabu of the chief; the fourth, the ending of carrying the tabu chiefs in the arms and feeding them; the fifth, the ruling chief's decision to introduce free eating (*'ainoa*) after the death of Kamehameha; the sixth, the cooperation of his aunts, Ka-ahu-manu and Ka-heihei-malie; the seventh, the joint action of the chiefs in eating together at the suggestion of the ruling chief, so that free eating became an established fact and the credit of establishing the custom went to the ruling chief. This custom was not so much of an innovation as might be supposed. In old days the period of mourning at the death of a ruling chief who had been greatly beloved was a time of license. The women were allowed to enter the heiau, to eat bananas, coconuts, and pork, and to climb over the sacred places. You will find record of this in the history of Ka-ula-hea-nui-o-ka-moku, in that of Ku-ali'i, and in most of the histories of ancient rulers. Free eating followed the death of the ruling chief; after the period of mourning was over the new ruler placed the land under a new tabu following old lines. (Kamakau 1992: 222)

Immediately upon the death of Kamehameha I, his son and would be successor, Liholiho was sent away to Kawaihae to keep him safe from the impurities in Kamakahonu brought about by his father's death. After purification ceremonies Liholiho returned to Kamakahonu:

> Then Liholiho on this first night of his arrival ate some of the tabu dog meat free only to the chiefesses; he entered the *lauhala* house free only to them; whatever he desired he reached out for; everything was supplied, even those things generally to be found only in a tabu house. The people saw the men drinking rum with the women *kahu* and smoking tobacco, and thought it was to mark the ending of the tabu of a chief. The chiefs saw with satisfaction the ending of the chief's tabu and the freeing of the eating tabu. The *kahu* said to the chief, "Make eating free over the whole kingdom from Hawaii to Oahu and let it be extended to Kauai!" and Liholiho consented. Then pork to be eaten free was taken to the country districts and given to commoners, both men and women, and free eating was introduced all over the group. Messengers were sent to Maui, Molokai, Oahu and all the way to Kauai, Ka-umu-ali'i consented to the free eating and it was accepted on Kauai. (Kamakau 1992: 225)

The indefinite period of free-eating initiated by Liholiho and his failure to reinstate the *kapu* system from Hawai'i to Kaua'i made the traditional religion of Hawai'i vulnerable to the Christian missionaries who began to arrive shortly thereafter. As a result, within one year after Kamehameha I's death Christianity had officially replaced the native Hawaiian religious practices. By December of 1819, Kamehameha II had sent edicts throughout the kingdom renouncing the ancient state religion, ordering the destruction of the *heiau* images, and ordering that the *heiau* structures be destroyed or abandoned and left to deteriorate. He did, however, allow the personal family religion, the *'aumakua* worship, to continue (Oliver 1961; Kamakau 1992). With the end of the *kapu* system, modifications in the social and economic patterns began to affect the lives of the common people.

Kohala 1820-1848: A Land in Transition

In October of 1819, seventeen Protestant missionaries set sail from Boston to Hawai'i and arrived in Kailua-Kona on March 30, 1820. Many of the *ali'i*, who were already exposed to western material culture had adopted their dress and religion and welcomed the opportunity to become educated in a western style. Soon they were rewarding their teachers with land and positions in the Hawaiian government. During this period, the sandalwood trade wreaked further havoc on the lives of the commoners, as they weakened from the heavy production, exposure, and famine just to fill the coffers of the *ali'i*, who were no longer under any traditional constraints (Oliver 1961; Kuykendall and Day 1976). The lack of control of the sandalwood trade was to soon lead to the first Hawaiian national debt as promissory notes and levies were initiated by American traders and enforced by American warships (Oliver 1961). The Hawaiian culture

was well on its way towards Western assimilation as industry in Hawai'i went from the sandalwood trade, to a short-lived whaling industry, and gave way to the more lucrative, but environmentally destructive sugar industry.

Some of the earliest written descriptions of Kohala come from the accounts of the first Protestant Missionaries that visited the island. In 1823 the Reverend William Ellis described Waimea as a fertile, well watered land "capable of sustaining many thousands of inhabitants" (Ellis 1969:399). Ellis notes that another missionary, Asa Thurston, had counted 220 houses in the area, and estimated the population at between eleven and twelve hundred. During his travels along the coast of North Kohala Ellis noted that most of the villages were empty as the men of the region had been ordered to the mountains by the King to collect sandalwood. He writes:

> About eleven at night we reached Towaihae [Kawaihae], where we were kindly received by Mr. Young. . . . Before daylight on the 22nd, we were roused by vast multitudes of people passing through the district from Waimea with sandal-wood, which had been cut in the adjacent mountains for Karaimoku, by the people of Waimea, and which the people of Kohala, as far as the north point, had been ordered to bring down to his storehouse on the beach, for the purpose of its being shipped to Oahu. There were between two and three thousand men, carrying each from one to six pieces of sandal-wood, according to their size and weight. It was generally tied on their backs by bands of ti leaves, passed over the shoulders and under the arms, and fastened across their breasts. (Ellis 2004:405-406)

The population of South Kohala continued to reside either near the shore or in the uplands of Waimea throughout the first half of the nineteenth century, but as previously discussed, the arrival of foreigners, their introduction of a western economy, and the rise of the sugar and cattle industries had a profound impact on daily life in Kohala. Even the landscape of Waimea was substantially altered; initially through deforestation associated with the sandalwood trade, followed by the effects of countless grazing cattle (Rechtman and Prasad 2006). A network of stone walls began to appear as a way for people to keep feral cattle out of their gardens and house lots. Commercial ventures soon replaced traditional agricultural practices and introduced crops (Irish potatoes, watermelons, cabbage, onions, tomatoes, mulberries, figs, and beans) were grown to replenish the cargo ships at Kawaihae Harbor; and in the late 1840s many of the potatoes grown in the Waimea area were shipped to California to help feed the gold rush (Haun et al. 2003). In addition, a sugar mill operated in the Waimea area from the 1820s until the 1840s.

The 1835 missionary census lists 6,175 people living in Kohala and another 1,396 people, including 500 men, 510 women, and 386 children, living in Waimea (Schmitt 1977). In 1837 there were sixty foreigners in Waimea employed as mechanics and bullock hunters (Brundage 1971); and in his report to the American Board of Commissioners to Foreign Missions in 1840, Lorenzo Lyons stated "in my field are sixty or seventy foreigners, from seven or eight different nations. They are beef catchers, sugar manufacturers, shoe makers, merchants, masons, doctors, formers, and what not" (Doyle 1953:118). By 1840, bullock hunting had drastically reduced the population of wild cattle on Hawai'i Island, so much so that a five year *kapu* was placed on hunting them solely for their hides and tallow (Bergin 2004). This lead to further efforts to tame, brand, fence, and herd privately owned cattle (Wilkes 1845). The decline of the whaling industry in Hawaiian waters during this time, combined with the *kapu* on killing wild cattle, lead to a period of economic hardship and population decline in the Waimea area (Escott 2008).

By the mid-nineteenth century, the agriculturally marginal areas of leeward Kohala were abandoned in favor of more productive and wetter lands in windward Kohala. According to Tomonari-Tuggle (1988), the remnant leeward population was concentrated into a few small coastal communities (such as Puakō, located roughly 5 miles northwest of the current study area) and dispersed upland settlements. These settlements were no longer based on traditional subsistence patterns, largely because of the loss of access to the full range of necessary resources. As a result, the windward slopes of North Kohala and the Waimea plain eventually became the population centers for the district. Tomonari-Tuggle clarifies some of the reasons for this migration:

> Outmigration and a demographic shift from rural areas to growing urban centers reflected the lure of a larger world and world view on a previously isolated community. Foreigners, especially whalers and merchants, settled around good harbors and roadsteads. Ali'i and their followers gravitated towards these areas, which were the sources of Western material goods, novel status items which would otherwise be unavailable. Associated with the emergence of the market, cash-based economy, commoners followed in search of paying employment. (1988:33)

The population of the district of Kohala declined rapidly as native populations were decimated by disease and a depressed birth rate. Postcontact epidemics in 1848 and 1849 killed more than 10,000 people in twelve months

throughout the Hawaiian Islands (Tomonari-Tuggle 1988). In 1848 in North Kohala, Rev. Bond reported that 100 people had died within a three week period, and in October of that year he reported that a measles epidemic had nearly every resident of the district in the hospital (Damon 1927). Following these epidemics, the population of the district had been reduced to nearly half of the more than 6,000 people reported in the 1835 census (Schmitt 1977). The number of coastal residents soon dwindled and most of the coastal villages were inhabited by only a few solitary residents. An 1848 description of the town of Waimea cited by McEldowney stated that "it can scarcely be said that there is any native population at all."(1983:432). This statement seems to sum up the devastating demographic changes that were taking place as the native population had been reduced by disease, displacement, and ongoing revisions in land tenure.

Legacy of the Great Māhele (1848-1895)

By the middle of the nineteenth century, the ever-growing population of Westerners forced socioeconomic and demographic changes that promoted the establishment of a Euro-American style of land ownership in the Hawaiian Islands, and the Great *Māhele* became the vehicle for determining ownership of native lands. During this period, land interests of the King (Kamehameha III), the high-ranking chiefs, the *ali'i*, and the low-ranking chiefs, the *konohiki,* were defined. The chiefs and *konohiki* were required to present their claims to the Land Commission to receive awards for lands provided to them by Kamehameha III. They were also required to provide commutations to the government in order to receive royal patents on their awards. The lands were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be surveyed. This process expedited the work of the Land Commission (Chinen 1961:13).

During the *Māhele,* all lands were placed in one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and *Konohiki* Lands. All three types of land were subject to the rights of the native tenants therein. In 1862, the Commission of Boundaries (Boundary Commission) was established in the Kingdom of Hawai'i to legally set the boundaries of all the *ahupua'a* that had been awarded as part of the *Māhele*. Subsequently, in 1874, the Boundary Commission was authorized to certify the boundaries for lands brought before them. The primary informants for the boundary descriptions were elderly native residents of the land. The boundary information was collected primarily between 1873 and 1885 and was usually given in Hawaiian, but transcribed in English.

The disposition and distribution of the lands of Waimea was rather complicated and was under dispute between the Boundary Commissioners, *kama'āina* informants, and land petitioners. Waimea was a discrete land unit (see Figure 13) considered to be a *kalana* (county) or *'okana* (subdistrict) as opposed to an *ahupua'a* (Pukui and Elbert 1986). To further confound the issue, some of the land units within Waimea were considered *ahupua'a* while others were considered *'ili kūpono*, defined by Puhui and Elbert as "A nearly independent *'ili* land division within an *ahupua'a* paying tribute to the ruling chief and not the chief of the *ahupua'a*. Transfer of the *ahupua'a* from one chief to another did not include the *'ili kūpono* located within its boundaries" (1986:98). As a result of the *Māhele* and Boundary Commission testimonies, many smaller *ahupua'a* names were dropped and the *'ili kūpono* were given *ahupua'a* status; the majority of the Waimea area was retained as Crown Lands, with the exception of a portion of Waikōloa Ahupua'a that was awarded as *Konohiki* Lands. Over 140 claims for Land Commission Awards (LCAw.) were made by native tenants within the Waimea area. Nearly all of these claims were for house lots or cultivated sections (Haun et al. 2003). Of the land commission awards reviewed by Kelly and Nakamura (1981:30), over twenty percent were issued to persons with non-Hawaiian surnames.

During the *Māhele*, Waikōloa (Nui) Ahupua'a was awarded to George Davis Hū'eu (LCA 8521-B; see Figure 2), son of Isaac Davis, one of Kamehameha I's trusted advisors. According to Wolforth et al. (2005), Kamehameha I had given Davis the land as a reward for his service, but after Davis died prematurely under suspicious circumstances in 1810, his friend John Young (another advisor to Kamehameha I) took it upon himself to make sure that Isaac Davis' children would receive their father's lands when they came of age. A portion of Young's Last Will and Testament read as follows (Cahill 1999:167):

> ... I give and bequeath to be equally divided between my surviving children and the surviving children of my departed friend, the late Isaac Davis, of Milford in England, in such manner as it may please His Majesty the King and his Chiefs; Provided always that each and all of the said children receive a just and equal portion. (reproduced in Wolforth et al. 2005:12)

As a result, John Young's lands were designated *'ina ho'oilina* or inherited lands, during the *Māhele*, a designation applied only to these lands that does not appear elsewhere in the *Māhele* records (Wolforth et al 2005).

Royal Patent number 5671 was issued to Isaac Davis that consisted of a large area of dry, non-arable terrain on

grassy slopes known as *pili* lands (after the pili plant that grew in abundance there), which extended to the *'a'ā* on the Kona District boundary; and did not include any portion of the fertile uplands or shoreline access (Wolforth et al. 2005). In 1865, George Hū'eu, Davis's only surviving heir, received Waikōloa as an unsurveyed Land Commission Award.

> We consider it clear that in making the grant the King intended to give, and did give to Isaac Davis, a tract of land of very great extent, although not of proportionate value, There were no cattle or sheep in this country when the grant was made, and the land given to Isaac Davis only yielded what revenue could be derived from wild birds and pili grass (Boundary Commission 1867 in Wolforth et al 2004:13)

In 1868, George Hū'eu leased his remaining lands in Waikōloa to the Waimea Grazing and Agricultural Company, which made them the largest ranching operation on the island (Escott 2008). Under the terms of the lease, the Hū'eu family was allowed to continue grazing their 1,000 head of cattle, 1,000 head of sheep, and 100 horses there (Escott 2008). By the late-1870s, largely due to persistent drought conditions within its grazing lands, the Waimea Grazing and Agricultural Company went out of business; Parker Ranch purchased their herd and acquired their lease for roughly 95,000 acres of Waikōloa. A sketch map prepared by J. S. Emerson in 1882 during the Hawaiian Government Survey of South Kohala (Figure 16), shows the Parker Ranch grazing lands and the network of trails that ran through them.

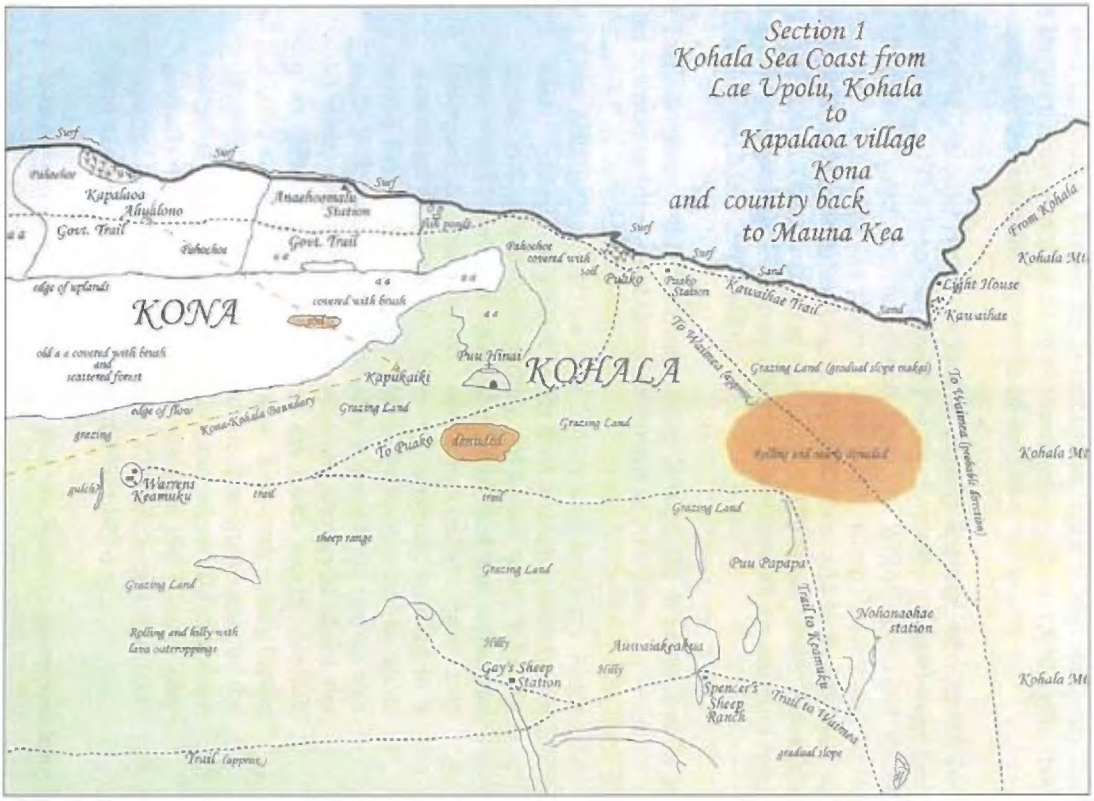


Figure 16. Emerson sketch map of South Kohala coast ca/ 1882 (from Escott 2008:43).

The coastal areas of Waikōloa, 'Anaeho'omalu and Kalāhuipua'a had been passed from Kamehameha I to Kamehameha II and then to Kamehameha III who retained them as Crown Lands until he passed them on to his wife Queen Kalama (LCA 4452; Wolforth et al. 2005). Only nine small residential *kuleana* were awarded in the uplands of Waikōloa near the town of Waimea and none were awarded within or in close proximity to the current study area (Maly 1999). Coastal residents in South Kohala, relied primarily on the ocean for sustenance, and they augmented their diet with produce procured through trade with the upland areas. In addition, according to testimony from 1865 Boundary Commission hearings, Waikōloa Ahupua'a was known as a place for bird catching; Ehu testified, "Waikōloa was the land that had the birds" (Maly 1999:88).

In the decades following the *Māhele* of 1848, the population along the Kohala coast continued to decline and the remnant inland agricultural fields were abandoned as they succumbed to the ravages of free-range cattle or were bought up by ranching and sugar interests. The remaining tenants built *kuleana* walls to enclose their homes, gardens, and domesticated animals in an effort to keep free-ranging animals out of their property and also to mark property boundaries as part of the new land tenure system (Tomonari-Tuggle 1988). The economy also transitioned, becoming cash based and taxes were collected. Foreigners controlled much of the land and most of the businesses, and the native population was largely dependent on these foreigners for food and money (Haun et al. 2003). By the early 1860's, Western Contact had made its inevitable mark on Kohala, but the community remained essentially Hawaiian in nature, and foreigners were still only a small minority in actual numbers (Tomonari-Tuggle 1988).

Oral histories indicate that a dry land planting area referred to as Makahonu was present in Waikōloa near the intersection of Waikōloa Road and Queen Ka'ahumanu Highway, *makai* of the current study area. There is no information in the oral histories of what was specifically cultivated in the planting area although 'Anaeho'omalu and other proximal locations were favorable areas for growing sweet potatoes (Handy and Handy 1991). According to Maly, Makahonu "was still used through the turn of the [twentieth] century" (1999:153).

The Study Area Vicinity during the Twentieth Century

Between the years of 1895 and 1913, the Puakō Sugar Plantation and Mill operated on 1800 acres along the bay in Puakō (Puakō Hisotrical Society). This short-lived operation was run by the Hinds who also founded the Hāwī Mill and Plantation in North Kohala and included leased portions of the Parker Ranch. The Plantation and Mill were forced to close as a result of damaging floods, the lack of freshwater and the high winds that plagued the area (John Hind n.d.). While operational, the Puakō Sugar Plantation led to an influx of population in the area and helped spur the development of roadways connecting Puakō with Kawaihae and Waimea. Upon cessation, the leased lands reverted back to Parker Ranch. The landholdings of Parker Ranch continued to grow as then manager Alfred W. Carter acquired thousands of acres in Waikōloa and neighboring *ahupua'a* that included the Pu'uloa Sheep and Stock Company, which encompassed over 3,700 acres and the Ke'amuku Sheep Station in Waikōloa. Over the next decade these lands were converted to cattle ranching. By 1932, Parker Ranch had grown to include over 325,000 acres of fee lands (Bergin 2004). With the expansion of ranching operations, population also expanded in Waimea.

In December of 1943, nearly 123,000 acres of land in the Waimea-Waikōloa area were leased by the U. S. War Department for use as a troop training area (Escott 2008). The U.S. Military's 91,000-acre Waikōloa Maneuver Area was the site of an artillery firing range on which live ammunition and other explosives were employed, with the remaining acreage utilized for troop maneuvers. The Waikōloa Manuever Area extended from the coast to present-day Pohakuloa Training Area, and from the Waimea-Kawaihae Road to south of Waikoloa Road, where the current study area is located. According to Escott:

> The military utilized portions of this property for troop maneuvers and weapons practice, while other areas served as artillery, aerial bombing and naval gun fire ranges. Troop exercises were conducted using 30 caliber rifles, 50 caliber machine guns, hand grenades, bazookas, flame throwers, and mortars. Larger ordnance and explosive (OE) or unexploded ordnance (UXO) items used included 37 millimeter (mm), 75 mm, 105 mm, and 155 mm high explosive (HE) shells, 4.2 inch mortar rounds, and barrage rockets. From 1943 through 1945 nearly the entire Waikoloa Maneuver Area was in constant use, as the Marine infantry reviewed every phase of training from individual fighting to combat team exercises

In September of 1946, the Waikōloa Maneuver Area, with the exception of the 9,141 acre Lālāmilo Firing Range, was returned to Parker Ranch (Haun et al. 2010). When the use permit was cancelled in December of that year, the lands once again reverted to leased cattle pasture administered by the Territory of Hawai'i. Following World War II, the lands in the vicinity of the current study area were once again used for cattle ranching and bird hunting; however, clean-up of unexploded ordnance within the Waikōloa Maneuver Area is still ongoing.

Since the 1950s modern development, concentrated along the coast and around the Villages of Waimea and Waikōloa, north of current study area. In 1949-50 the coastal lands of Puakō were divided into the Puakō Beach Lots and a road was built to Kawaihae, which brought many new residents to the area (Maly 1999). During the 1970s the current alignment of Queen Ka'ahumanu Highway (Highway 19), extending from Kailua to Kawaihae, was constructed across the coastal sections of Waikōloa *ahupua'a*; Waikōloa Road was built to connect the new lower highway with the upper highway (Highway 190); and Waikōloa Village was established about 3.5 miles northeast of the current study area. With the construction of the new highways and the shifting residential patterns, the older coastal roads and *mauka/makai* travel routes largely fell into disuse.

PRIOR ARCHAEOLOGICAL STUDY

The current study area was included in a 1991 archaeological inventory survey of a roughly 300-acre property conducted by PHRI (Jensen and Burgett 1991) for a then proposed quarry location. PHRI identified nineteen sites and established an archaeological preserve with a fifty foot buffer zone, which led to the definition of the current quarry parcel. The archaeological preserve is located on TMK: (3) 6-8-001:067 immediately to the north of the current study area (Figure 17).

The 1991 PHRI archaeological investigation consisted of 100 percent aerial survey at 30-50 feet altitude via helicopter augmented by pedestrian survey of 15-20 percent of the property in areas identified as high probability with respect to the presence of historic properties. Nineteen sites were recorded (Table 1) along the top and around the margins of two *ʻaʻā* ridges located within the northern third of their study area (to the north of the current study area). These sites appeared to be interconnected by a poorly defined trail system, which was likely only minimally used at the time the features were constructed and for limited access thereafter. No midden, artifacts, or other portable cultural material were detected on the surface of any of the features or in the subsurface testing of a rock shelter feature (SIHP Site 15051B).

Table 1. Sites in archaeological preserve north of the study area.*

SIHP Site No.	*# of Features*	*Feature Type*	*Function*
15030	2	(A) Mound (B) Paving	Possible burial
15031	1	Rock shelter	Temporary habitation
15032	1	Platform	Possible burial/ceremonial
15050	1	Platform	Possible burial/ceremonial
15051	4	(A)Platform (B) Rock shelter (C) Modified sink (D) Terrace	Temporary habitation with possible burial(s)
15052	4	(A-D) Platforms	Possible burial/ceremonial
15053	1	Platform	Possible burial
15054	1	Platform	Possible burial
15055	1	Platform	Possible burial
15056	1	Platform	Possible burial/ceremonial
15057	2	(A and B) Platforms	Possible burial/ceremonial
15058	1	Modified outcrop	Indeterminate
15059	1	Trail	Transportation
15060	1	Platform	Possible burial
15061	1	Platform	Possible burial
15062	1	Rock shelter	Temporary habitation
15063	1	Filled blister	Possible burial
15064	1	Terrace	Possible burial
15065	1	Rock shelter	Temporary habitation

*Data source is Jensen and Burgett (1991).

As a result of the PHRI investigation, all nineteen sites were preserved "as is". The Waikoloa Development Company chose not to proceed with any additional data recovery or further evaluation at that time. As previously discussed, a buffer zone of fifty feet was created around the area where the archaeological features were found, and an archaeological preserves was created on the parcel (TMK: (3) 6-8-001:067) to the north of the current study area.

In May of 1999, PHRI conducted archaeological monitoring for the development of the quarry site and associated access road. In a letter report, PHRI (Rechtman 1999) confirmed that the established buffer zone was maintained: the access road was well *makai* of the buffer boundary and the northern boundary of the quarry (the current study area) was placed an additional 50 meters south of the buffer zone.

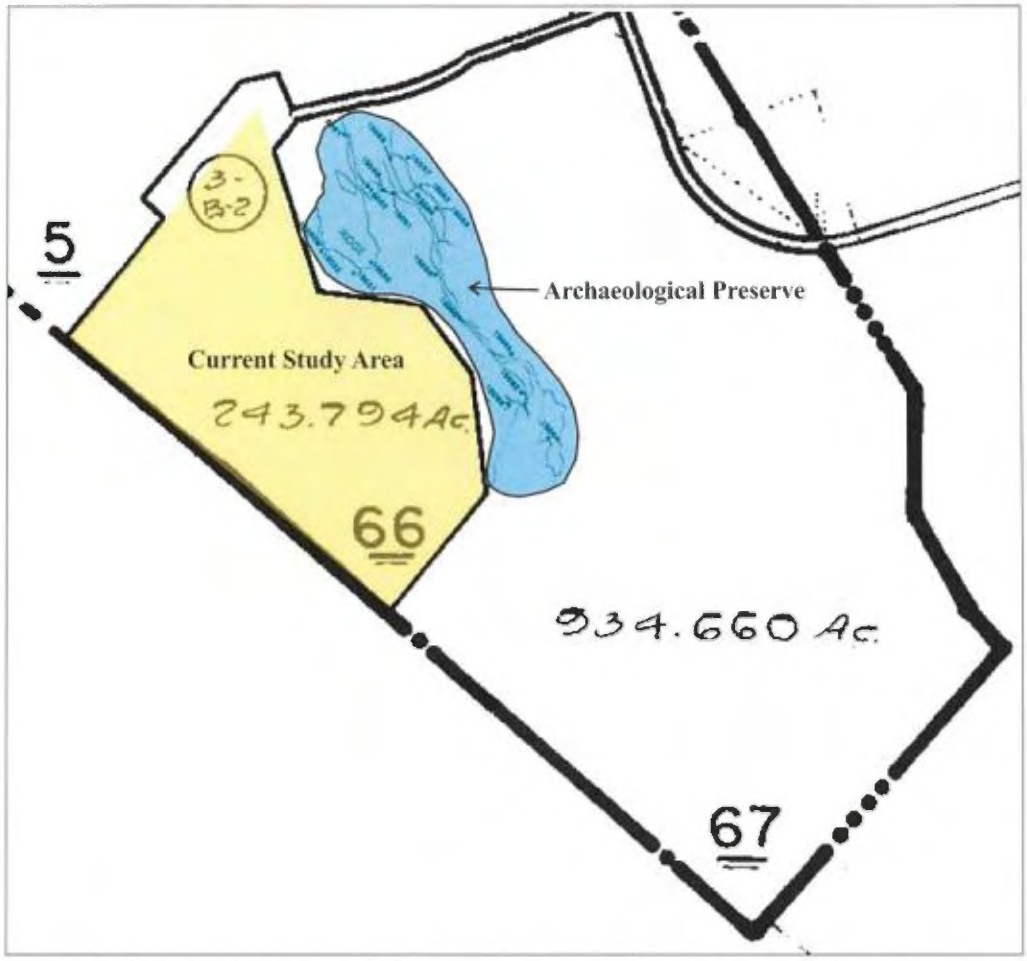


Figure 17. Portion of Tax Map (3) 6-8-001 showing archaeological preserve and current study area.

3. STUDY AREA EXPECTATIONS

Given the recent specific land use history (quarrying activity throughout roughly 95% of the study area), intact archaeological resources if extant could only be identified around the periphery of the land disturbance. Also given that the current study area was investigated for archaeological sites prior to the establishment of the quarry, with negative results, the expectation for finding archaeological sites is extremely low. Based on ethnohistoric and prior archaeological information, the types archaeological features that could exist in this area might be related to the procurement of specific resources, such as *pili* grass and birds (such features would include trails and temporary shelters), or related to burial activities (such features would include platforms, pavements, and trails). There is also the possibility of identifying Historic Period ranching features (trails and enclosures), and evidence of middle twentieth century military activity (enclosures and debris scatters).

4. FIELDWORK

On May 20, 2015, Robert B. Rechtman, Ph.D., Teresa Gotay, M.A. and Layne Krause, B.A. performed a field survey of the study area, which included a visual inspection of the existing quarried areas (roughly 95% of the study area) and a pedestrian survey of the limited undeveloped and minimally disturbed portions of the study area along the periphery of the quarry operation (Figures 18 and 19). In the undeveloped periphery of the study area, field investigators walked north-south transects approximately 25 meters apart; weather conditions and ground visibility were conductive for thorough observation of the terrain.

No archaeological features or portable cultural material was encountered during the pedestrian survey of the study area. A small amount of metal shrapnel was observed during the current fieldwork. This debris is likely related to the former use of the Waikōloa Maneuver Area (ca. 1943-1946) by the U.S. Military.

Figure 18. Minimally disturbed section in the northeastern portion of the current study area.

Figure 19. Small section of unquarried area in the southeastern portion of the study area.

5. CONCLUSION AND RECOMMENDATIONS

Given the negative findings of the current study, supported by similar findings of the prior archaeological study (Jensen and Burgett 1991) that included the current study area, it is concluded that the proposed extension and amendment to the existing Special Permit will not significantly impact any known historic properties. No further historic preservation work is recommended at this time.

REFERENCES CITED

Barrera, W., Jr.
1971 Archaeological Excavations and Survey at Keauhou, North Kona, Hawaii. *Departmental Report Series* 71-10. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Barrère, D.
1983 Report 2: Notes on the Lands of Waimea and Kawaihae. IN Clark and Kirch (editors) Archaeological Investigation of the Mudlane-Waimea-Kawaihae Road Corridor, Island of Hawaii, pp. 25-38. Prepared for State of Hawaii, Department of Transportation.

Beckwith, M.
1976 *Hawaiian Mythology*. New Haven: Yale University Press.

Bergin, B.
2004 *Loyal to the Land: The Legendary Parker Ranch, 750-1950*. University of Hawai'i Press, Honolulu.

Brundage, L.
1971 *Alfred W. Carter Hawai'i's Dean of Cattlemen and Notes on Hawaiian Livestock*. Privately printed, Kamuela, Hawai'i.

Burtchard, G.
1995 Population and Land Use on the Keauhou Coast, the Mauka Land Inventory Survey, Keauhou, North Kona, Hawai'i Island. Part I: Narrative Volume. International Archaeological Research Institute, Inc. (IARII). Prepared for Belt Collins and Associates and Kamehameha Investment Corporation, Honolulu.

Burgett, B., and P. Rosendahl
1993 Summary of Archaeological Inventory Surveys, Kapaanui Agricultural Subdivision and Mahukona Property, Lands of Kapaanui, Kou, Kamano, Mahukona 1st and 2nd, Hihiu, and Kaoma, North Kohala District, Island of Hawaii (TMK:3-5-7-02:11 and TMK:3-5-7-03:1-3,10-14,16-18). PHRI Report 743-020993. Prepared for Chalon International of Hawaii, Inc

Chinen, J.
1961 *Original Land Titles in Hawaii.* Honolulu: privately published.

Cordy, R.
1994 A Regional Synthesis of Hamakua District, Hawai'i Island. Historic Preservation Division, DLNR, State of Hawai'i.

2000 *Exalted Sits the Chief, The Ancient History of Hawai'i Island*. Mutual Publishing, Honolulu, Hawai'i.

Damon, E.
1927 Father Bond of Kohala. *The Friend*, Honolulu.

Doyle, E.
1953 *Makua Laiana: The Story of Lorenzo Lyons*. Compiled from the manuscript journals, 1832-1886. Honolulu, Honolulu Star Bulletin.

Dunn, A., and P. Rosendahl
1989 Archaeological Inventory Survey, Kapaanui Agricultural Subdivision, Lands of Kapaanui and Kou, North Kohala District, Island of Hawaii. PHRI Report 568-100289. Prepared for Ahualoa Development, Inc.

Ellis, W.
1969 *Polynesian Researches, Hawaii*. Rutland, Vermont: Charles E. Tuttle Company, Inc., 1831. Reprint.

2004 *Journal of William Ellis, A Narrative of an 1823 Tour Through Hawai'i*. Mutual Publishing.

Escott, G.
2008 Archaeological Monitoring Plan (AMP) for Munitions and Explosives of Concern (MEC) and Supporting Functions for Former Waikoloa Maneuver Area, Hawai'i on Portions (1,320.063 acres) of the Former Waikoloa Maneuver Area, Lālāmilo and 'Ōuli Ahupua'a, South Kohala District, Hawai'i [TMK: (3)-6-2-001:050, 051, 065; AND (3)-6-6-02:031, 032, 034, 035, 39-43]. SCS Project Number 970-1. Prepared for U.S. Army Engineer District: Honolulu.

Fornander, A.
1969 *An Account of the Polynesian Race: Its Origin and Migrations*. Tokyo: Charles E. Tuttle Co., Inc.

1996 *Ancient History of the Hawaiian People to the Times of Kamehameha I*. Mutual Publishing. Australia.

Giambelluca, T., Q. Chen, A. Frazier, J. Price, Y. Chen, P. Chu, J. Eischeid, and D. Departe
2013 Online Rainfall Atlas of Hawai'i. *Bull. Amer. Meteor. Soc.* 94, 313-316, doi: 10.1175/BAMS-D-11-00228.1

Greene, L.
1993 *A Cultural History of Three Traditional Hawaiian Sites on the West Coast of Hawai'i Island*. United States Department of the Interior, National Park Service, Denver Service Center.

Griffin, P., T. Riley, P. Rosendahl, and H. Tuggle
1971 Archaeology of Halawa and Lapakahi: Windward Valley and Leeward Slope. *New Zealand Archaeological Association Newsletter* 14(3):101–112.

Handy, E.S.C., and E.G. Handy
1991 Native Planters in Old Hawaii: Their Life, Lore and Environment. *B.P. Bishop Museum Bulletin* 223. Honolulu: Department of Anthropology, Bishop Museum Press. (Revised Edition).

Haun, A., D. Henry, and K. McGuire
2003 Archaeological Inventory Survey DHHL Residential Development at Lālāmilo (TMK: 3-6-6-01:10, 54 & 77 and 3-6-6-04:12-17). South Kohala District, Island of Hawai'i. Haun & Associates, Report 116-071203, Keaau, Hawaii. Prepared for PBR Hawaii, Hilo, Hawai'i.

Haun, A., S. Kailihiwa, and D. Henry
2010 Archaeological Assessment Portions of TMK: (3) 6-8-01:37 and (3) 6-8-02:19 Land of Waikoloa, South Kohala District, Island of Hawai'i. Haun and Associates Report 714-012610. Prepared for D W 'Aina Le'a Development, Waikoloa, Hawai'i.

Hind, J.
n.d. *Kohala in 1873 and During Twenty Years Thereafter*. Privately published.

Hommon, R.
1976 *The Formation of Primitive States in Pre-Contact Hawaii*. Ph.D. Dissertation (Anthropology), University of Arizona, Tucson. University Microfilms, Inc., Ann Arbor, Michigan.

1986 Social Evolution in Ancient Hawai'i. IN Kirch, P. (editor), *Island Societies: Archaeological Approaches to Evolution and Transformation*:55–88. Cambridge: Cambridge University Press.

Hono-ko-hau Study Advisory Commission
1974 *The Spirit of Ka-Loko Hono-Ko-Hau*. National Park Service, U.S. Department of the Interior.

I'i, J.
1963 *Fragments of Hawaiian History*. Bishop Museum Special Publication 70. Bishop Museum Press, Honolulu.

Jarves, J.
1847 History of the Hawaiian Islands: Embracing Their Antiquities, Mythology, Legends, Discovery by Europeans in the Sixteenth Century, Re-Discovery by Cook, With Their Civil, Religious and Political History, From the Earliest Traditionary Period to the Present Time. Honolulu: C.E Hitchcock.

Jensen, P. and B. Burgett
1991 Archaeological Inventory Survey Waikoloa Beach Resort Reserve Lands 300-Acre Quarry Site, Land of Waikoloa, South Kohala District, Island of Hawaii. PHRI report 1041-122091. Prepared for Waikoloa Development Company, Waikoloa, HI.

Judd, B.
1932 "Early Days of Waimea, Hawaii" Fortieth Annual Report of the Hawaiian Historical Society for the year 1831 with papers read at the annual meeting February 29, 1932.

Kamakau, S.
1976 The Works of the People of Old, *Na hana a ka Po'e Kahiko. B.P. Bishop Museum Special Publication* 61. Bishop Museum Press, Honolulu.

1991 *Tales and Traditions of the People of Old, Nā Mo'olelo a ka Po'e Kahiko*. Bishop Museum Press, Honolulu.

1992 *Ruling Chiefs of Hawaii*. The Kamehameha Schools Press, Honolulu (Revised Edition).

Kent, N.
1983 *Hawaii: Islands Under the Influence*. University of Hawai'i Press, Honolulu.

Kirch, P.
1984 *The Evolution of the Polynesian Chiefdoms*. New York: Cambridge University Press.

1985 *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*. Honolulu: University of Hawaii Press.

1990 Monumental Architecture and Power in Polynesian Chiefdoms: A Comparison of Tonga and Hawaii. *World Archaeology* 22(2).

2011 When did the Polynesians Settle Hawai'i? A Review of 150 Years of Scholarly Inquiry and a Tentative Answer. *Hawaiian Archaeology* Vol. 12:3-26.

Kuykendall, R., and A. Day
1976 *Hawaii: A History; From Polynesian Kingdom to American Statehood*. Englewood Cliffs: Prentice-Hall, Inc.

McEldowney, H.
1983 A Description of Major Vegetation Patterns in the Waimea-Kawaihae Region During the Early Historic Period. IN Clark, J., and P. Kirch (1983).

Maly, K.
1999 *Nā Ala Hele Ma Kai O Kohala Hema*. Kumu Pono Associates Report HiAla-17K (043099). Prepared for *Nā Ala Hele* Program State Division of Forestry and Wildlife, Hilo.

Maly, K, and Maly, O.
2002 *He Wahi Mo'olelo No Ka 'Āina A Me Nā 'Ohana O Waiki'i Ma Waikōloa (Kalana O Waimea, Kohala), A Me Ka 'Āina Mauna:* A Collection of Traditions and Historical Accounts of the Lands and Families of Waiki'i at Waikōloa (Waimea Region, South Kohala), and the Mountain Lands, Island of Hawai'i (TMK Overview Sheet 6-7-01). *Kumu Pono* Associates Report HiWaikii61-111202. Prepared for Waiki'i Ranch Homeowner's Association, Kamuela, Hawai'i.

Menzies, A.
1920 *Hawaii Nei, 128 Years Ago.* Edited by William F. Wilson. Honolulu: The New Freedom Press.

Oliver, D.
1961 *The Pacific Islands*. Honolulu: University of Hawaii Press.

Pogue, J.
1858[1978] *Mooleo Hawaii*. Hale Paipalapala Aupuni, Honolulu (Revised Edition).

Pukui, M.
1983 *'Olelo Noeau*, Hawaiian Proverbs & Poetical Sayings. *B.P. Bishop Museum Special Publication* 71. Bishop Museum Press, Honolulu.

Pukui, M., S. Elbert, and E. Mo'okini
1974[1966] *Place Names of Hawaii*. Revised and Expanded Edition. Honolulu: University of Hawaii Press, Honolulu.

Pukui M. and S. Elbert
1986 *Hawaiian Dictionary*. University of Hawaii Press, Honolulu.

Rechtman, R.
1999 Letter to Mel Macy, West Hawaii Concrete. PHRI Letter Report 98-1929.

Rechtman, R., and K. Maly
2003 Cultural Impact Assessment for the Proposed Development of TMK:3-7-3-9:22, 'O'oma 2nd Ahupua'a, North Kona District, Island of Hawai'i, Volume I and II. Rechtman Consulting Report RC-0154. Prepared for Helber Hastert & Fee, Honolulu, Hawai'i.

Rechtman, R., and U. Prasad
2006 An Archaeological and Cultural Assessment Survey of Pu'u Ne'ene'e Ranch (TMKs: 3-6-4-01:051,053, 156, 157, 158, 159), Pu'ukapu Ahupua'a, South Kohala District, Island of Hawai'i. Rechtman Consulting Report RC-0399. Prepared for Ken Russell, Kukulu Pono Construction LLC. Kamuela, Hawai'i.

Rosendahl, P.
1972 Archaeological Salvage of the Hapuna-Anaehoomalu Section of the Kailua-Kawaihae Road (Queen Kahumanu Highway), Island of Hawaii, Department Report Series 72-5. Department of Anthropology, B.P. Bishop Museum, Honolulu.

2000 Archaeological Inventory Survey of TMK 6-8-01:22, Land of Waikoloa, South Kohala District, Island of Hawai'i. Paul H. Rosendahl, Ph.D., Inc. Report 2017-072000. Prepared for White Sand Beach LP, Tinguely Development, Kailua-Kona, Hawai'i.

Schilt, R., and A. Sinoto
1980 Limited Phase I Archaeological Survey of Mahukona Properties, North Kohala, Island of Hawai'i. B.P. Bishop Museum, Honolulu. Prepared for Belt, Collins and Associates.

Schmitt, R.
1977 *Historical Statistics of Hawaii*. Honolulu: University of Hawaii Press.

Tomonari-Tuggle, M.
1988 North Kohala: Perception of a Changing Community. A Cultural Resource Management Study. Prepared for Division of State Parks, Outdoor Recreation, and Historic Sites, Department of Land and Natural Resources, State of Hawaii.

Wilkes, C.
1845 *Narrative of the United States Exploring Expedition During the Years 1838–1842, Under the Command of C. Wilkes, U.S.N.,* Volume 4. Philadelphia: Loa and Blanchard.

Williams, J.
1919 A Little Known Engineering Work in Hawaii. IN *Thrum's Hawaiian Almanac and Annual for 1919.* Thos. G. Thrum, Honolulu.

Wolfe E., and J. Morris.
1996 *Geologic Map of the Island of Hawai'i.* Geologic Investigations Series Map 1-2524-A. U.S. Department of the Interior, U.S. Geological Survey.

Wolforth, T.
2000 An Archaeological Inventory Survey of Approximately 15 Acres for a Proposed Quarry and Related Activity at Parker Ranch Within Waikōloa Ahupua'a, South Kohala District, Island of Hawai'i (TMK: 6-8-01:001). Scientific Consultant Services, Inc., Report 216-1, Honolulu, Hawai'i. Prepared for William L. Moore Planning, Hilo and Parker Ranch, Waimea.

Wolforth, T., G. Escott, and L. McGerty
2005 Inventory Survey for the Saddle Road Extension: Investigations into Resource Extraction in the Middle Elevations of Waikoloa Ahupua'a in Kohala and Pu'uanahulu Ahupua'a in Kona [TMK 6-7-01:3; 6-8-01:5 and 27; 6-8-02:13, 14, and 15, and 7-1-03:1]. SCS Report 173.2 prepared for DMT Consultant Engineers.

Appendix D

Ka Pa`Akai Discussion

WEST HAWAII CONCRETE WAIKŌLOA QUARRY
Ka Pa'akai Discussion

July 2015

Robert B. Rechtman, Ph.D.
ASM Affiliates

West Hawaii Concrete intends to continue and expand the currently permitted use of an approximately 220 acre portion of the existing West Hawaii Concrete Waikōloa Quarry Property (TMK: (3) 6-8-001:066) in Waikōloa Ahupua'a, South Kohala District, Island of Hawai'i (Figure 1). West Hawaii Concrete has been carrying out quarrying operations since at least 1995 and plans to extend their existing Special Permit beyond quarrying to include the following activities: green waste processing and composting, cement concrete recycling and asphalt concrete recycling. For this expansion of activities, West Hawaii Concrete must obtain approval from the County of Hawai'i Leeward Planning Commission and Hawai'i State Land Use Commission (LUC) in order to extend and modify their current Special Permit to include the proposed uses.

Article XII, section 7 of the Hawai'i Constitution obligates the State and its agencies, such as the LUC, "to protect the reasonable exercise of customarily and traditionally exercised rights of native Hawaiians to the extent feasible when granting a petition for reclassification of district boundaries." (*Ka Pa'akai O Ka'āina* v *Land Use Commission*, 94 Hawai'i 31, 7 P.3d 1068 [2000]). Under Article XII, section 7, the State shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by *ahupua'a* tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778, subject to the right of the State to regulate such rights. In the context of land use permitting, these issues are commonly addressed when the LUC is asked to approve a petition for the reclassification of district boundaries, as such an action most often initiates activities that precede initial intensive development. While the approval of a Special Use Permit for a green waste processing and concrete recycling project does not involve the reclassification of any lands, West Hawaii Concrete thought it prudent to provide a discussion of such rights to facilitate the Special Use Permit decision making processes for both the Leeward Planning Commission and the LUC.

In the September 11, 2000 Hawai'i Supreme Court landmark decision (*Ka Pa'akai O Ka'āina* v *Land Use Commission*), an analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities was created. The court decision established a three-part process relative to evaluating such potential impacts: first, to identify whether any valued cultural, historical, or natural resources are present; and identify the extent to which any traditional and customary native Hawaiian rights are exercised; second, to identify the extent to which those resources and rights will be affected or impaired by the proposed action; and third, to specify the feasible action, if any, to be taken by the regulatory body to reasonably protect native Hawaiian rights if they are found to exist.

In an effort to identify whether any valued cultural, historical, or natural resources are present within the proposed project area, and identify the extent to which any traditional and customary native Hawaiian rights are, or have been, exercised (the first part of the analytical process); historical archival information was investigated, and prior cultural studies that included consultation and oral-historical interviews were reviewed. A summary of this analysis is presented below.

One of the earliest specific references to Waikōloa appears in the work of Samuel Mānaiakalani Kamakau who recounted the chants and legendary traditions of Hawaiian prehistory in his writings. According to Kamakau (1976) the priest Pā'ao arrived in the Hawaiian Islands during the 13th century from Kahiki, which has since been interpreted as Tahiti. Pā'ao, who was the keeper of the god Kū'kā'ilimoku, had fought bitterly with his older brother, the high priest Lonopele, who expelled him from his homeland (Kamakau 1991). Lonopele did not let Pā'ao leave peacefully, but instead called forth a series of wind storms to sink his canoe; one of the winds, a cold north wind, was named "Waikōloa" (Kamakau 1991:5). Despite Lonopele's best efforts, Pā'ao's canoe was not destroyed and he and his companions (thirty eight men, two stewards, his sister, chief Pili and his wife and the prophet Makuaka'ūmana) arrived safely in Hawai'i after their perilous journey. Kamakau recounts the following details of Pā'ao and Pili's arrival in Hawai'i:

> It is thought that Pā'ao came to Hawai'i in the time of the *ali'i* La'au because Pili ruled as *mo'i* after La'au. You will see Pili there in the line of succession, the *mo'o kū'auhau*, of Hanala'anui. It is said that Hawai'i Island was without a chief, and so a chief was brought from Kahiki; this is according to chiefly genealogies. Hawai'i Island had been without a chief for a long time, and the chiefs of Hawai'i were *ali'i maka'āinana* or just commoners, *maka'āinana*, during this time.
>
> . . . There were seventeen generations during which Hawai'i Island was without chiefs—some eight hundred years. . . . The lack of a high chief was the reason for seeking a chief in Kahiki, and that is perhaps how Pili became the chief of Hawai'i. He was a chief from Kahiki and became the ancestor of chiefs and people of Hawai'i Island. (Kamakau 1991:100–102)

The *moku* of Kohala appears in several versions of the Pili ruling line's origin story; such as a version discussed by Beckwith (1976) in which Mo'okini and Kaluawilinau, two *kāhuna* of Moikeha, decide to stay on at Kohala. In addition, Kamakau (1964) recounts that

> In the burial cave of Pu'uwepa in Kohala, Hawaii are deposited the bones of Pa'ao, the famous kahuna who built the heiau of Mo'okini at Kohala, and who lived a span of 15 generations before he died. Its entrance is said to be beneath the sea (1964:41)

The Pili chiefs initial ruling center was likely in Kohala, but Cartwright (1933) suggests that Pili later resided in and ruled from Waipi'o Valley in the Hāmākua District.

In addition to the tales of legendary chiefs, the Legend of Kanikū and Kanimoe, two *mo'o* or water-spirits with lizard bodies, is relevant to the current analysis because the project area is located within the lava flow (Figure 2) that bears one of the water spirit's name (Kanikū). According to an interview documented by Wolforth et al. (2005:6), these two *mo'o* took the form of beautiful women and lived in the "large coastal fishpond of Wainānāli'i in Pu'uanahulu." According to the legend, Kanikū and Kanimoe were turned to stone when a lava flow covered the fishpond and as a result, their bodies still lie side by side in the middle of the *'a 'ā* flow, which is how the Kanikū Lava Flow got its name (Wolforth et al. 2005).

According to Maly (1999:25) the name Waikōloa literally translates to "water carried far" and he cites the origin of this translation to be a historical account entitled *Ka'ao Ho'oniua Pu'uwai No Ka Miki* (The Heart Stirring Story of Ka Miki) that was published as a serial in the Hawaiian Language newspaper *Ka Hōku o Hawai'i* between 1914-1917, and authored by John Wise and J.W.H.I. Kihe. As Maly translated, there was an event where Ka Miki (the hero of the story) was carrying sacred water in an *'awa* bowl when the wind Waikōloa lifted water out of the bowl and transported it a long distance (from Holoholokū to Waiki'i) to form a new spring.

Bernice Judd, a former librarian at the Hawaiian Mission Children's society, offered a different origin of the name Waikōloa and explained that:

> In the early days Waimea meant all the plateau between the Kohala Mountains and Mauna Kea, inland from Kawaihae. This area is from eight to ten miles long and from three to five miles wide. There was no running water on Mauna Kea, so the inhabitants lived at the base of the Kohala Mountains, where three streams touched the plain on their way towards the sea. . . The middle stream, which was famous for wild ducks, was named Waikoloa, or Duckwater. This and the most westerly stream, called Kahakohau, went towards Kawaihae, but neither reached the sea, except in times of flood. (Judd 1932:14)

Traditionally, Waikōloa was an *'ili* of the *kalana* (or *'okana*) of Waimea (Figure 3), a land division that in ancient times was treated as a sub-district, smaller than a district (*moku o loko*), but comprised of several other land divisions that contributed to its wealth (Maly and Maly 2002). The lands within the *kalana* of Waimea were those that form the southern limits of present day South Kohala District including 'Ōuli, Wai'aka, Lālāmilo, Puakō, Kalāhuipua'a,

'Anaeho'omalu, Kanakanaka, Ala'ōhi'a, Paulama, Pu'ukalani, Pu'ukapu, and Waikōloa, where the project area is located. In some early accounts, Waikolōa Ahupua'a was referred to as Waikōloa Nui, and the neighboring *ahupua'a* of Lālāmilo as Waikōloa Iki (Maly 1999).

By the seventeenth century, large areas of Hawai'i Island (*moku āina* – districts) were controlled by a few powerful *ali'i 'ai moku*. There is island-wide evidence to suggest that growing conflicts between independent chiefdoms were resolved through warfare, culminating in a unified political structure at the district level. It has been suggested that the unification of the island resulted in a partial abandonment of portions of leeward Hawai'i, with people moving to more favorable agricultural areas (Barrera 1971; Schilt and Sinoto 1980). 'Umi a Līloa, a renowned *ali'i* of the Pili line who ruled from Waipi'o Valley, is often credited with uniting the island of Hawai'i under one rule (Cordy 1994). According to Kamakau (1992) 'Umi was a skilled fisherman, and fishing for *aku*, his favorite fish, often brought him to the beaches of South Kohala from Kalahuipua'a to Makaula, where he also fished for *'ahi* and *kala* with many other famed fishermen and all the chiefs of the kingdom. 'Umi's reign lasted until around ca. A.D. 1620, and was followed by the rule of his son, Keawenui a 'Umi, and then his grandson, Lonoikamakahiki (Cordy 1994).

Lonoikamakahiki's reign was marked by political intensification and regularly occurring wars between intra-island and inter-island polities, which included battles that transpired in the general vicinity of the current project area. One such battle was fought between Lonoikamakahiki (Lono) and his older brother, Kanaloakua'ana, who rebelled against him. According to Fornander, Kanaloakua'ana and his rebel forces were situated at:

> . . . the land called Anaehoomalu, near the boundaries of Kohala and Kona. The rebel chiefs were encamped seaward of this along the shore. The next day Lono marched down and met the rebels at the place called Wailea, not far from Wainanalii, where in those days a watercourse appears to have been flowing. Lono won the battle, and the rebel chiefs fled northward with their forces. At Kaunooa [Kauna'oa], between Puako and Kawaihae, they made another stand, but were again routed by Lono, and retreated to Nakikiaianihau, where they fell in with reinforcements from Kohala and Hamakua. Two other engagements were fought at Puupa [on the plain north of Waikōloa] and Puukohala, near the Heiau of that name, in both of which Lono was victorious. . . (Fornander 1996:120-121)

Later, Lonoikamakahiki battled the forces of Maui led by Kamālālawalu (Kama) on the plain of Waikōloa below Pu'u 'Ōā'oaka (Maly and Maly 2002). According to Kamakau:

> After Kama-Iala-walu's warriors reached the grassy plain, they looked seaward on the left and beheld the men of Kona advancing toward them. The lava bed of Kaniku and all the land up to Hu'ehu'e was covered with the men of Kona. Those of Ka'u and Puna were coming down from Mauna Kea, and those of Waimea and Kohala were on the level plain of Waimea [Waikōloa]. The men covered the whole of the grassy plain of Waimea like locusts. Kamalalawalu with his warriors dared to fight. The battlefield of Pu'oa'oaka was outside of the grassy plain of Waimea, but the men of Hawaii were afraid of being taken captive by Kama, so they led [Kamalalawalu's forces] to the waterless plain lest Maui's warriors find water and hard, waterworn pebbles. The men of Hawaii feared that the Maui warriors would find water to drink and become stronger for the slinging of stones that would fall like raindrops from the sky. The stones would fall about with a force like lightning, breaking the bones into pieces and causing sudden death as if by bullets . . .
>
> . . . The Maui men who were used to slinging shiny, water-worn stones grabbed up the stones of Pu'oa'oaka. A cloud of dust rose to the sky and twisted about like smoke, but the lava rocks were light, and few of the Hawaii men were killed by them. This was one of the things that helped to destroy the warriors of Kama-lala-walu: They went away out on the plain where the strong fighters were unable to find water . . . The warriors of Maui were put to flight, and the retreat to Kawaihae was long. [Yet] there were many who did reach Kawaihae, but because of the lack of canoes, only a few escaped with their lives ... Kamalalawalu, ruler of Maui, was killed on the grassy plain of Puako, and some of his chiefs were also destroyed. (Kamakau 1991:58-60)

While the project area is located proximate to the lands in these stories, it receives no specific mention suggesting that it was peripheral to the areas and events described.

Marking the end of the Precontact Period, Hawaiians' first significant encounter with Europeans occurred in 1778 when Captain James Cook and his crew on board the ships *H.M.S. Resolution* and *Discovery* arrived in Kaua'i. With the arrival of foreigners, Hawai'i's culture and economy were drastically altered. Demographic trends during this period indicate population reduction in some areas, due to war and disease, yet increases in others, with relatively little modification of material culture. There was a continued trend toward craft and status specialization, intensification of

agriculture, *ali'i* controlled aquaculture, upland residential sites, and the enhancement of traditional oral history. The Kū cult, *luakini heiau*, and the *kapu* system were at their peaks, although Western influence was already altering the cultural fabric of the Islands (Kirch 1985; Kent 1983). Foreigners very quickly introduced the concept of trade for profit, and by the time Kamehameha I had conquered O'ahu, Maui and Moloka'i, in 1795, Hawai'i saw the beginnings of a market system economy (Kent 1983). This marked the end of an era of uniquely Hawaiian culture. Some of the work of the commoners shifted from subsistence agriculture to the production of foods and goods that they could trade with early visitors. Introduced foods often grown for trade with Westerners included yams, coffee, melons, potatoes, corn, beans, figs, oranges, guava, and grapes (Wilkes 1845).

In 1792, Captain George Vancouver, who had sailed with Cook during his 1778-1779 voyages, arrived in Kealakekua Bay with a small fleet of British ships, where he met with Kamehameha. Vancouver stayed only a few days during this first visit, but returned again in 1793 and 1794 to resupply his fleet. Vancouver introduced cattle and sheep to the Island of Hawai'i during his 1793 and 1794 visits, giving them as gifts to Kamehameha I, who immediately made them *kapu*, thus preventing them from being killed (Kamakau 1992). Five cows, two ewes, and a ram brought by Vancouver in 1793 were set free to roam in the saddle area of Waimea between Mauna Kea, Mauna Loa, and Hualālai (Escott 2008).

During one of his visits Vancouver anchored at Kawaihae and a member of his crew, Archibald Menzies, a surgeon and naturalist, trekked inland towards Waimea. Menzies' journal records the journey and describes the land in the vicinity of the project area as follows:

> I travelled a few miles back…through the most barren, scorching country I have ever walked over, composed of scorious dregs and black porous rock, interspersed with dreary caverns and deep ravines…The herbs and grasses which the soil produced in the rainy seasons were now mostly in the shriveled state, thinly scattered and by no means sufficient to cover the surface from the sun's powerful heat, so that I met with few plants in flower in this excursion. (Menzies 1920:55)

In the early 1800s, Kamehameha gave control of present day Waikōloa then Waikōloa Nui Ahupua'a (excluding the coastal *'ili* of 'Anaeho'omalu and Kalāhuipua'a) to Isaac Davis (Rosendahl 2000). Although the land of Waikōloa Nui gifted to Davis encompassed a large area, it lacked extensive resources, and was primarily a place for catching birds and gathering *pili* grass. When Davis died in 1810 without naming an heir, John Young took control of the land and protected it for Davis' children, who were at that time too young to take on the responsibility (Rosendahl 2000).

Waikōloa Nui would eventually become a favored pasture for the cattle given by Vancouver to Kamehameha. By the early nineteenth century the *kapu* cattle quickly multiplied in the region to the extent that they became a scourge for the native planters of the Waimea area. In order to protect the upland agricultural fields from the overwhelming number of grazing cattle, sometime between 1813 and 1819, Kamehameha ordered the construction of a wall extending from the northern boundary of Waikōloa Nui to near Pu'u Huluhulu (Barrère 1983). The wall was designed to keep wild cattle in Waikōloa Nui and out of the more agriculturally productive areas on the Waimea side. The wall was called *Pā* of Kauliokamoa after the *konohiki* who oversaw its construction (Wolforth 2000).

The year 1819 was a pivotal one in Hawaiian history. In May of that year Kamehameha died in Kona and his young son Liholiho assumed rule over the kingdom. In concert with Kamehameha's widows Ka'ahumanu and Keōpūolani, Liholiho abolished the ancient religion and quelled a rebellion to reinstate the traditional *kapu* system in December of 1819. In October of 1819, seventeen Protestant missionaries set sail from Boston to Hawai'i and arrived in Kailua-Kona on March 30, 1820, to a county in religious turmoil and ripe for conversion. Many of the *ali'i*, who were already exposed to western material culture had adopted their dress and welcomed the opportunity to become educated in a western style. Soon they were rewarding their teachers with land and positions in the Hawaiian government. During this period, the sandalwood trade wreaked further havoc on the lives of the commoners, as they weakened from the heavy production, exposure, and famine just to fill the coffers of the *ali'i*, who were no longer under any traditional constraints (Oliver 1961; Kuykendall and Day 1976). The lack of control of the sandalwood trade was to soon lead to the first Hawaiian national debt as promissory notes and levies were initiated by American traders and enforced by American warships (Oliver 1961). The Hawaiian culture was well on its way towards Western assimilation as industry in Hawai'i went from the sandalwood trade, to a short-lived whaling industry, and gave way to the more lucrative, but environmentally destructive sugar industry.

The population of South Kohala continued to reside either near the shore or in the uplands of Waimea throughout the first half of the nineteenth century, but as previously discussed, the arrival of foreigners, their introduction of a western economy, and the rise of the sugar and cattle industries had a profound impact on daily life in Kohala. Even the landscape of Waimea was substantially altered; initially through deforestation associated with the sandalwood trade, followed by the effects of countless grazing cattle (Rechtman and Prasad 2006). A network of stone walls began

to appear as a way for people to keep feral cattle out of their gardens and house lots. Commercial ventures soon replaced traditional agricultural practices and introduced crops (Irish potatoes, watermelons, cabbage, onions, tomatoes, mulberries, figs, and beans) were grown to replenish the cargo ships at Kawaihae Harbor; and in the late 1840s many of the potatoes grown in the Waimea area were shipped to California to help feed the gold rush (Haun et al. 2003). In addition, a sugar mill operated in the Waimea area from the 1820s until the 1840s.

As reported in the *Sandwich Island Gazette* in September 10, 1836, the lower elevation of Waikōloa (inclusive of the current project area) was considered to be inhospitable:

> The western part of the district remains to be noticed. This consists of a gradual descent of about 10 miles to the seaside. It is entirely composed of an uneven rock waste, covered with long grass. This barren tract is untenanted and uncultivated, Rain seldom falls here and, besides the grass, nothing is seen to vary the monotony until you approach the coast, when the eye is only relieved by the tallow blossoms of the Nohu [Tribulus].

By the mid-nineteenth century, the agriculturally marginal areas of leeward Kohala were abandoned in favor of more productive and wetter lands in windward Kohala. According to Tomonari-Tuggle (1988), the remnant leeward population was concentrated into a few small coastal communities (such as Puakō, located roughly 5 miles northwest of the project area) and dispersed upland settlements. These settlements were no longer based on traditional subsistence patterns, largely because of the loss of access to the full range of necessary resources. As a result, the windward slopes of North Kohala and the Waimea plain eventually became the population centers for the district. Tomonari-Tuggle clarifies some of the reasons for this migration:

> Outmigration and a demographic shift from rural areas to growing urban centers reflected the lure of a larger world and world view on a previously isolated community. Foreigners, especially whalers and merchants, settled around good harbors and roadsteads. Ali'i and their followers gravitated towards these areas, which were the sources of Western material goods, novel status items which would otherwise be unavailable. Associated with the emergence of the market, cash-based economy, commoners followed in search of paying employment. (1988:33)

The population of the district of Kohala declined rapidly as native populations were decimated by disease and a depressed birth rate. Epidemics in 1848 and 1849 killed more than 10,000 people in twelve months throughout the Hawaiian Islands (Tomonari-Tuggle 1988). In 1848 in North Kohala, Rev. Bond reported that 100 people had died within a three week period, and in October of that year he reported that a measles epidemic had nearly every resident of the district in the hospital (Damon 1927). Following these epidemics, the population of the district had been reduced to nearly half of the more than 6,000 people reported in the 1835 census (Schmitt 1977). The number of coastal residents soon dwindled and most of the coastal villages were inhabited by only a few solitary residents. An 1848 description of the town of Waimea cited by McEldowney stated that "it can scarcely be said that there is any native population at all."(1983:432). This statement seems to sum up the devastating demographic changes that were taking place as the native population had been reduced by disease, displacement, and ongoing revisions in land tenure.

At the time of the Great *Māhele* in 1848, the disposition and distribution of the lands of Waimea was rather complicated and was under dispute between the Boundary Commissioners, *kama'āina* informants, and land petitioners. Waimea was a discrete land unit (Figure 4) considered to be a *kalana* (county) or *'okana* (subdistrict) as opposed to an *ahupua'a* (Pukui and Elbert 1986). To further confound the issue, some of the land units within Waimea were considered *ahupua'a* while others were considered *'ili kūpono*, defined by Puhui and Elbert as "A nearly independent *'ili* land division within an *ahupua'a* paying tribute to the ruling chief and not the chief of the *ahupua'a*. Transfer of the *ahupua'a* from one chief to another did not include the *'ili kūpono* located within its boundaries" (1986:98). As a result of the *Māhele* and Boundary Commission testimonies, many smaller *ahupua'a* names were dropped and the *'ili kūpono* were given *ahupua'a* status; the majority of the Waimea area was retained as Crown Lands, with the exception of a portion of Waikōloa Ahupua'a that was awarded as *Konohiki* Lands. Over 140 claims for Land Commission Awards (LCAw.) were made by native tenants within the Waimea area. Nearly all of these claims were for house lots or cultivated sections (Haun et al. 2003). Of the land commission awards reviewed by Kelly and Nakamura (1981:30), over twenty percent were issued to persons with non-Hawaiian surnames.

During the *Māhele*, Waikōloa (Nui) Ahupua'a, including the project area, was awarded to George Davis Hū'eu (LCA 8521-B; Figure 5), son of Isaac Davis, one of Kamehameha I's trusted advisors. According to Wolforth et al. (2005), Kamehameha I had given Davis the land as a reward for his service, but after Davis died prematurely under suspicious circumstances in 1810, his friend John Young (another advisor to Kamehameha I) took it upon himself to make sure that Isaac Davis' children would receive their father's lands when they came of age. A portion of Young's Last Will and Testament read as follows (Cahill 1999:167):

> ... I give and bequeath to be equally divided between my surviving children and the surviving children of my departed friend, the late Isaac Davis, of Milford in England, in such manner as it may please His Majesty the King and his Chiefs; Provided always that each and all of the said children receive a just and equal portion. (reproduced in Wolforth et al. 2005:12)

As a result, John Young's lands were designated *'ina ho'oilina* or inherited lands, during the *Māhele*, a designation applied only to these lands that does not appear elsewhere in the *Māhele* records (Wolforth et al 2005).

Royal Patent number 5671 was issued to Isaac Davis that consisted of a large area of dry, non-arable terrain on grassy slopes known as *pili* lands (after the *pili* grass that grew in abundance there), which extended to the *'a'ā* on the Kona District boundary; and did not include any portion of the fertile uplands or shoreline access (Wolforth et al. 2005). In 1865, George Hū'eu, Davis's only surviving heir, received Waikōloa as an unsurveyed Land Commission Award.

> We consider it clear that in making the grant the King intended to give, and did give to Isaac Davis, a tract of land of very great extent, although not of proportionate value, There were no cattle or sheep in this country when the grant was made, and the land given to Isaac Davis only yielded what revenue could be derived from wild birds and pili grass (Boundary Commission 1867 in Wolforth et al 2005:13)

In 1868, George Hū'eu leased his remaining lands in Waikōloa to the Waimea Grazing and Agricultural Company, which made them the largest ranching operation on the island (Escott 2008). Under the terms of the lease, the Hū'eu family was allowed to continue grazing their 1,000 head of cattle, 1,000 head of sheep, and 100 horses there (Escott 2008). By the late-1870s, largely due to persistent drought conditions within its grazing lands, the Waimea Grazing and Agricultural Company went out of business; Parker Ranch purchased their herd and acquired their lease for roughly 95,000 acres of Waikōloa. A sketch map prepared by J. S. Emerson in 1882 during the Hawaiian Government Survey of South Kohala (Figure 6), shows the Parker Ranch grazing lands and the network of trails that ran through them; none of these trail are located in the vicinity of the current project area, which is simply labeled as *'a'ā* on the map.

The coastal areas of Waikōloa, 'Anaeho'omalu and Kalāhuipua'a had been passed from Kamehameha I to Kamehameha II and then to Kamehameha III who retained them as Crown Lands until he passed them on to his wife Queen Kalama (LCA 4452; Wolforth et al. 2005). Only nine small residential *kuleana* were awarded in the uplands of Waikōloa near the town of Waimea and none were awarded within or in close proximity to the current project area (Maly 1999). Coastal residents in South Kohala, relied primarily on the ocean for sustenance, and they augmented their diet with produce procured through trade with the upland areas. In addition, according to testimony from 1865 Boundary Commission hearings, Waikōloa Ahupua'a was known as a place for bird catching; Ehu testified, "Waikōloa was the land that had the birds" (Maly 1999:88).

In the decades following the *Māhele* of 1848, the population along the Kohala coast continued to decline and the remnant inland agricultural fields were abandoned as they succumbed to the ravages of free-range cattle or were bought up by ranching and sugar interests. The remaining tenants built *kuleana* walls to enclose their homes, gardens, and domesticated animals in an effort to keep free-ranging animals out of their property and also to mark property boundaries as part of the new land tenure system (Tomonari-Tuggle 1988). The economy also transitioned, becoming cash based and taxes were collected. Foreigners controlled much of the land and most of the businesses, and the native population was largely dependent on these foreigners for food and money (Haun et al. 2003).

Between the years of 1895 and 1913, the Puakō Sugar Plantation and Mill operated on 1800 acres along the bay in Puakō (Puakō Hisotrical Society). This short-lived operation was run by the Hinds who also founded the Hāwī Mill and Plantation in North Kohala and included leased portions of the Parker Ranch. T Puakō Sugar Plantation was forced to close as a result of damaging floods, the lack of freshwater and the high winds that plagued the area (John Hind n.d.). While operational, the Puakō Sugar Plantation led to an influx of population in the area and helped spur the development of roadways connecting Puakō with Kawaihae and Waimea. Upon cessation of plantation activities, the leased lands reverted back to Parker Ranch. The landholdings of Parker Ranch continued to grow as then manager Alfred W. Carter acquired thousands of acres in Waikōloa and neighboring *ahupua'a* that included the Pu'uloa Sheep and Stock Company, which encompassed over 3,700 acres and the Ke'amuku Sheep Station in Waikōloa. Over the next decade these lands were converted to cattle ranching. By 1932, Parker Ranch had grown to include over 325,000 acres of fee lands (Bergin 2004). With the expansion of ranching operations, population also expanded in Waimea.

In December of 1943, nearly 123,000 acres of land in the Waimea-Waikōloa area were leased by the U. S. War Department for use as a troop training area (Escott 2008). The U.S. Military's 91,000-acre Waikōloa Maneuver Area was the site of an artillery firing range on which live ammunition and other explosives were employed, with the

remaining acreage utilized for troop maneuvers. The Waikōloa Manuever Area extended from the coast to present-day Pohakuloa Training Area, and from the Waimea-Kawaihae Road to south of Waikoloa Road, where the current project area is located. According to Escott:

> The military utilized portions of this property for troop maneuvers and weapons practice, while other areas served as artillery, aerial bombing and naval gun fire ranges. Troop exercises were conducted using 30 caliber rifles, 50 caliber machine guns, hand grenades, bazookas, flame throwers, and mortars. Larger ordnance and explosive (OE) or unexploded ordnance (UXO) items used included 37 millimeter (mm), 75 mm, 105 mm, and 155 mm high explosive (HE) shells, 4.2 inch mortar rounds, and barrage rockets. From 1943 through 1945 nearly the entire Waikoloa Maneuver Area was in constant use, as the Marine infantry reviewed every phase of training from individual fighting to combat team exercises. (Escott 2008)

In September of 1946, the Waikōloa Maneuver Area, with the exception of the 9,141 acre Lālāmilo Firing Range, was returned to Parker Ranch (Haun et al. 2010). When the use permit was cancelled in December of that year, the lands once again reverted to leased cattle pasture administered by the Territory of Hawai'i. Following World War II, the lands in the vicinity of the project area were once again used for cattle ranching and bird hunting; however, clean-up of unexploded ordnance within the Waikōloa Maneuver Area is still ongoing.

Since the 1950s modern development, concentrated along the coast and around the Villages of Waimea and Waikōloa, north of the project area, has intensified. In 1949-50 the coastal lands of Puakō were divided into the Puakō Beach Lots and a road was built to Kawaihae, which brought many new residents to the area (Maly 1999). During the 1970s the current alignment of Queen Ka'ahumanu Highway (Highway 19), extending from Kailua to Kawaihae, was constructed across the coastal sections of Waikōloa *ahupua'a*; Waikōloa Road was built to connect the new lower highway with the upper highway (Highway 190); and Waikōloa Village was established about 3.5 miles northeast of the project area. With the construction of the new highways and the shifting residential patterns, the older coastal roads and *mauka/makai* travel routes largely fell into disuse.

In 1991, the current project area was included in an archaeological inventory survey (Jensen and Burgett 1991) of a roughly 300-acre property conducted by Paul H. Rosendahl, Ph.D., Inc. (PHRI) for the then proposed quarry location. PHRI identified nineteen sites and established an archaeological preserve with a fifty foot buffer zone, which led to the boundary definition of the current quarry parcel. The archaeological preserve is located on TMK: (3) 6-8-001:067 immediately to the north of the current study area (Figure 7). The nineteen sites were recorded along the top and around the margins of two *'a'ā* ridges located within the northern third of their study area. These sites appeared to be interconnected by a poorly defined trail system, which was likely only minimally used at the time the features were constructed and for limited access thereafter. No midden, artifacts, or other portable cultural material were detected on the surface of any of the features or in the subsurface testing of a rock shelter feature (SIHP Site 15051B). Although never excavated, the features at this site were mostly interpreted to be burials and as a result of the PHRI investigation, all nineteen sites were preserved "as is". The Waikoloa Development Company chose not to proceed with any additional data recovery or further evaluation at that time. As previously discussed, a buffer zone of fifty feet was created around the area where the archaeological features were found, and an archaeological preserve was created on the parcel (TMK: (3) 6-8-001:067) to the north of the current study area.

In May of 1999, PHRI conducted archaeological monitoring for further development of the quarry site and associated access road. In a letter report, PHRI (Rechtman 1999) confirmed that the established buffer zone was maintained: the access road was well *makai* of the buffer boundary and the northern boundary of the quarry (the current project area) was placed an additional 50 meters south of the buffer zone

During the archaeological study (Gotay and Rechtman 2015) conducted in support of the present permit application no archaeological sites were observed with the current project area and almost no natural landscape was present as prior and ongoing mechanical quarrying activity and the associated network of ungraded and graded access roads cover roughly ninety-five percent of the approximately 220 acre project area; this is clearly seen in a recent aerial photograph (Figure 8).

There have been several studies conducted over the past fifteen or so years (Haun et al. 2010; Maly 1999; Maly and Maly 2002; Wolforth et al. 2005; Wong-Smith 2007, 2009) that contain cultural and oral-historical information relevant to Waikōloa Ahupua'a and the general area covered under the current permit application. A review of the information contained in these studies is relevant for the present analysis.

Maly (1999), in his study of the coastal trails of South Kohala, reported the results of oral-historical interview with ten individuals knowledgeable of the South Kohala inclusive of the current permit area. His interviewees included: Robert Keākealani, Sr. (from earlier 1980-86 taped interviews); Robert Keākealani, Jr.; Leina'ala

Keākealani-Lightner; Jiro Yamaguchi; William Akau; A. Kahikilani Akau; F. Coco Vredenburg-hind; Kenneth Francis Brown; E. Tita Ruddle-Spielman; and J.K. Spielman. In addition to discussions of the locations and use of trails, one of Maly's interviewees described a traditional dryland planting area known as Makahonu located within a kīpuka in the Kanikū flow in Waikōloa Ahupua'a in the vicinity of the current intersection of Waikōloa Road and Queen Ka'ahumanu Highway, *makai* of the current project area. Agricultural activities (the cultivation of sweet potato, pumpkin, and sugarcane) continued at this location into the early twentieth century.

The Maly and Maly (2002) study focused on an area of Waikōloa that is *mauka* of the current permit area, in the vicinity of Waiki'i and Ke'āmoku. They conducted comprehensive archival-historical research as well as a series of oral-historical interviews with elder native Hawaiians and *kama'āina* residents of the greater region. Among other conclusions, they related that the pu'u (hills) on the landscape are significant and the names of many are still in common use, "pu'u such as Ahumoa, Po'opo'o, 'Iwa'iwa, Holoholokū, Pā, and Hīnai, are integral to the storied landscape of Waikōloa . . ." (Maly and Maly 2002:212).

An area to the north and slightly *makai* of the current project area has been the subject of three previously completed cultural impact assessments related to the Villages of 'Āina Le'a project. Helen Wong-Smith's (2007) conclusion in that study relates similarly to the current permit area:

> The cultural impacts to any locale in Hawai'i are not always readily evident. What is assessed by Western eyes as "barren land" may be a rich resource to Hawaiians for harvesting material i.e. *pili* grass; spiritual aspects, i.e. the wind; or for the trails on which to travel. References to these cultural features have been found for the general Waikōloa, but not specific to the project area, Most cultural sites in this section of South Kohala occur between 40 and 280 ft. elevation, with the highest density near gullies and gulches, dropping off at 160 ft. (Wong-Smith 2007:21)

In a follow-up study, Wong-Smith (2009) conducted focused research on a potential *mauka/makai* trail with the assistance of Sonny Keākealani (the son of Robert Keākealani Sr.). Together they identified a trail used by cattle ranchers that extended from Pu'uwa'awa'a Ranch to Puako across the Villages of 'Āina Le'a project area in Waikōloa Ahupua'a. This historic trail is well to the north of the current West Hawaii Concrete permit area. A third Cultural Impact Assessment for the 'Āina Le'a development area was conducted by Haun et al. (2010) for a utility corridor at a similar elevation but quite different environment than the current permit area. Their study area was conducted of an area on an older lava flow with well-developed soil and dry stream beds. Based on archival research and a field inspection, their "study did not identify any culturally significant resources or any evidence that the project areas are currently being used for any traditional cultural practices." (Haun et al. 2010:19).

One final study is worth mentioning here, a Section 106 study (Wolforth et al. 2005) conducted for the Saddle Road Extension Project, the corridor of which extends down from Highway 190 through Waikōloa Ahupua'a except in the vicinity of the West Hawai'i Concrete Quarry where it bends to the south into Pu'uanahulu Ahupua'a to avoid the quarry and then back into Waikōloa then down to Queen Ka'ahumanu Highway. As part of the consultation for that project eighteen individuals were contacted. While substantial cultural information was shared about the general area, no cultural places or practices were identified to exist or have taken place in the portion of their study corridor that is in the vicinity of the quarry parcel (current permit area).

Upon collective review of these prior cultural studies, a pattern that emerges is that two types of significant cultural resources are regularly referenced in the historical and oral-historical literature. One of these types of resources are landscape features referred to as *pu'u* (prominent hills) and the other are trails; both are highly traditionally valued and culturally significant. Pu'u not only mark the traditional landscape, but these natural features are almost always named and storied places with ancestral associations; while the network of trails on the traditional landscape provides a connection of both place and people. Numerous *pu'u* and trails are identified within Waikōloa, but none are within or in the proximity of the subject permit area.

Given the culture-historical background presented above, along with the summarized results of prior archaeological and oral-historical studies in the general Waikōloa area, and combined with the twenty year history of intensive land use within the permit area, it is the finding of the current analysis that there are no specific valued natural and cultural resources within the current project area; and there has been no evidence identified of traditional and customary cultural practices having been exercised, nor have any such practices been documented as taking place in the past within this project area.

References Cited

Barrera, W., Jr.
1971 Archaeological Excavations and Survey at Keauhou, North Kona, Hawaii. *Departmental Report Series* 71-10. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Barrère, D.
1983 Report 2: Notes on the Lands of Waimea and Kawaihae. IN Clark and Kirch (editors) Archaeological Investigation of the Mudlane-Waimea-Kawaihae Road Corridor, Island of Hawaii, pp. 25-38. Prepared for State of Hawaii, Department of Transportation.

Beckwith, M.
1976 *Hawaiian Mythology*. Honolulu: University of Hawaii Press.

Bergin, B.
2004 *Loyal to the Land: The Legendary Parker Ranch, 750-1950*. University of Hawai'i Press, Honolulu.

Brundage, L.
1971 *Alfred W. Carter Hawai'i's Dean of Cattlemen and Notes on Hawaiian Livestock*. Privately printed, Kamuela, Hawai'i.

Cartwright, B.
1933 Some Aliis of the Migratory Period. *Bishop Museum Occasional Papers*, 10(7). Honolulu.

Cordy, R.
1994 A Regional Synthesis of Hamakua District, Hawai'i Island. Historic Preservation Division, DLNR, State of Hawai'i.

Damon, E.
1927 Father Bond of Kohala. *The Friend*, Honolulu.

Doyle, E.
1953 *Makua Laiana: The Story of Lorenzo Lyons*. Compiled from the manuscript journals, 1832-1886. Honolulu, Honolulu Star Bulletin.

Ellis, W.
1969 *Polynesian Researches, Hawaii*. Rutland, Vermont: Charles E. Tuttle Company, Inc., 1831. Reprint.
2004 *Journal of William Ellis, A Narrative of an 1823 Tour Through Hawai'i*. Mutual Publishing.

Escott, G.
2008 Archaeological Monitoring Plan (AMP) for Munitions and Explosives of Concern (MEC) and Supporting Functions for Former Waikoloa Maneuver Area, Hawai'i on Portions (1,320.063 acres) of the Former Waikoloa Maneuver Area, Lālāmilo and 'Ōuli Ahupua'a, South Kohala District, Hawai'i [TMK: (3)-6-2-001:050, 051, 065; AND (3)-6-6-02:031, 032, 034, 035, 39-43]. SCS Project Number 970-1. Prepared for U.S. Army Engineer District: Honolulu.

Fornander, A.
1996 *Ancient History of the Hawaiian People*. Mutual Publishing, Australia.

Gotay, T., and R. Rechtman
2015

Haun, A., D. Henry, and K. McGuire
2003 Archaeological Inventory Survey DHHL Residential Development at Lālāmilo (TMK: 3-6-6-01:10, 54 & 77 and 3-6-6-04:12-17). South Kohala District, Island of Hawai'i. Haun & Associates, Report 116-071203, Keaau, Hawaii. Prepared for PBR Hawaii, Hilo, Hawai'i.

Haun, A., S. Kailihiwa, and D. Henry
2010 Archaeological Assessment Portions of TMK: (3) 6-8-01:37 and (3) 6-8-02:19 Land of Waikoloa, South Kohala District, Island of Hawai'i. Haun and Associates Report 714-012610. Prepared for D W 'Aina Le'a Development, Waikoloa, Hawai'i.

Haun, A., S. Kailihiwa, and D. Henry
2010 Second Addendum to Cultural Impact Assessment DW 'Aina Le'a Development, Land of Waikoloa, South Kohala District, Island of Hawai'i. Haun and Associates Report 712-0126910. Prepared for D W 'Aina Le'a Development, Waikoloa, Hawai'i.

Hawkins, R.
2011 *A Pacific Industry: The History of Pineapple Canning in Hawaii.* London: I.B. Tarus & Co.

Judd, B.
1932 "Early Days of Waimea, Hawaii" Fortieth Annual Report of the Hawaiian Historical Society for the year 1831 with papers read at the annual meeting February 29, 1932.

Kamakau, S.
1964 *Ka Po'e Kahiko*: The People of Old. *B.P. Bishop Museum Special Publication* 51. Bishop Museum Press, Honolulu.

1976 The Works of the People of Old, *Na hana a ka Po'e Kahiko. B.P. Bishop Museum Special Publication* 61. Bishop Museum Press, Honolulu.

1991 *Tales and Traditions of the People of Old, Nā Mo'olelo a ka Po'e Kahiko.* Bishop Museum Press, Honolulu.

1992 *Ruling Chiefs of Hawaii.* The Kamehameha Schools Press, Honolulu (Revised Edition).

Kelly, M., and B. Nakamura
1981 A Progress Report on Background History of the Mudlane-Waimea-Kawaihae Road Corridor. IN *The Mudlane-Waimea- Kawaihae Archaeological Project: Interim Report,* P. Kirch and B. Clause, eds., pp. 26-56. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Kuykendall, R., and A. Day
1976 *Hawaii: A History; From Polynesian Kingdom to American Statehood.* Englewood Cliffs: Prentice-Hall, Inc.

Maly, K.
1999 *Nā Ala Hele Ma Kai O Kohala Hema.* Kumu Pono Associates Report HiAla-17K (043099). Prepared for *Nā Ala Hele* Program State Division of Forestry and Wildlife, Hilo.

Maly, K, and Maly, O.
2002 *He Wahi Mo'olelo No Ka 'Āina A Me Nā 'Ohana O Waiki'i Ma Waikōloa (Kalana O Waimea, Kohala), A Me Ka 'Āina Mauna:* A Collection of Traditions and Historical Accounts of the Lands and Families of Waiki'i at Waikōloa (Waimea Region, South Kohala), and the Mountain Lands, Island of Hawai'i (TMK Overview Sheet 6-7-01). *Kumu Pono* Associates Report HiWaikii61-111202. Prepared for Waiki'i Ranch Homeowner's Association, Kamuela, Hawai'i.

McEldowney, H.
1983 A Description of Major Vegetation Patterns in the Waimea-Kawaihae Region During the Early Historic Period. IN Clark, J., and P. Kirch (1983).

Menzies, A.
1920 *Hawaii Nei, 128 Years Ago.* Edited by William F. Wilson. Honolulu: The New Freedom Press.

Oliver, D.
1961 *The Pacific Islands*. Honolulu: University of Hawaii Press.

Pukui M. and S. Elbert
1986 *Hawaiian Dictionary*. University of Hawaii Press, Honolulu.

Rechtman, R., and U. Prasad
2006 An Archaeological and Cultural Assessment Survey of Pu'u Ne'ene'e Ranch (TMKs: 3-6-4-01:051,053, 156, 157, 158, 159), Pu'ukapu Ahupua'a, South Kohala District, Island of Hawai'i. Rechtman Consulting Report RC-0399. Prepared for Ken Russell, Kukulu Pono Construction LLC. Kamuela, Hawai'i.

Rosendahl, P.
2000 Archaeological Inventory Survey of TMK 6-8-01:22, Land of Waikoloa, South Kohala District, Island of Hawai'i. Paul H. Rosendahl, Ph.D., Inc. Report 2017-072000. Prepared for White Sand Beach LP, Tinguely Development, Kailua-Kona, Hawai'i.

Schilt, R., and A. Sinoto
1980 Limited Phase I Archaeological Survey of Mahukona Properties, North Kohala, Island of Hawai'i. B.P. Bishop Museum, Honolulu. Prepared for Belt, Collins and Associates.

Schmitt, R.
1977 *Historical Statistics of Hawaii*. Honolulu: University of Hawaii Press.

Tomonari-Tuggle, M.
1988 North Kohala: Perception of a Changing Community. A Cultural Resource Management Study. Prepared for Division of State Parks, Outdoor Recreation, and Historic Sites, Department of Land and Natural Resources, State of Hawaii.

Wilkes, C.
1845 *Narrative of the United States Exploring Expedition During the Years 1838–1842, Under the Command of C. Wilkes, U.S.N.,* Volume 4. Philadelphia: Loa and Blanchard.

Wolforth, T.
2000 An Archaeological Inventory Survey of Approximately 15 Acres for a Proposed Quarry and Related Activity at Parker Ranch Within Waikōloa Ahupua'a, South Kohala District, Island of Hawai'i (TMK: 6-8-01:001). Scientific Consultant Services, Inc., Report 216-1, Honolulu, Hawai'i. Prepared for William L. Moore Planning, Hilo and Parker Ranch, Waimea.

Wolforth, T., G. Escott, and L. McGerty
2005 Inventory Survey for the Saddle Road Extension: Investigations into Resource Extraction in the Middle Elevations of Waikoloa Ahupua'a in Kohala and Pu'uanahulu Ahupua'a in Kona [TMK 6-7-01:3; 6-8-01:5 and 27; 6-8-02:13, 14, and 15, and 7-1-03:1]. SCS Report 173.2 prepared for DMT Consultant Engineers.

Wong Smith, H.
2007 Cultural Impact Assessment for Villages of 'Āina Le'a. Prepared for Bridge 'Āina Le'a, LLC.

2009 Addendum to Cultural Impact Assessment DW 'Āina Le'a Development, LLC, Waikōloa, Hawai'i Island, TMK Nos. 6-8-01:25, 36, 37, 38, 39, and 40. Prepared for D W 'Aina Le'a LLC.

Figure 1. Google Earth™ satellite image showing location of the project area outlined in red.

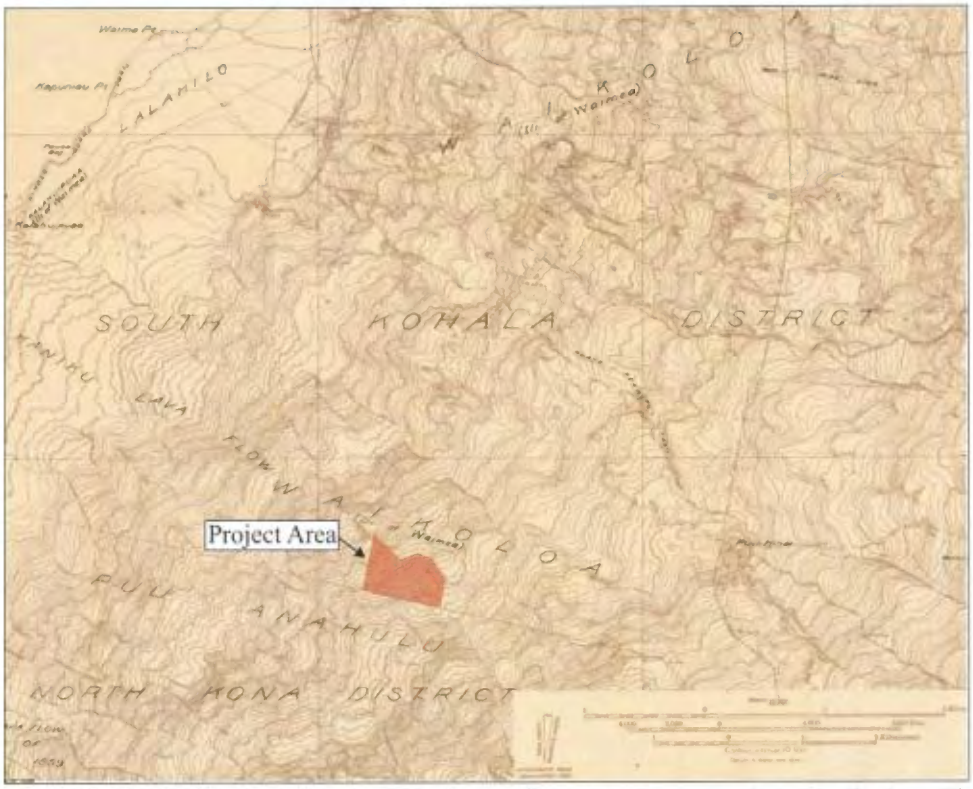


Figure 2. Portion of 1923 USGS. Pu'u Hinai quadrangle showing the project area within Kanikū Lava Flow.

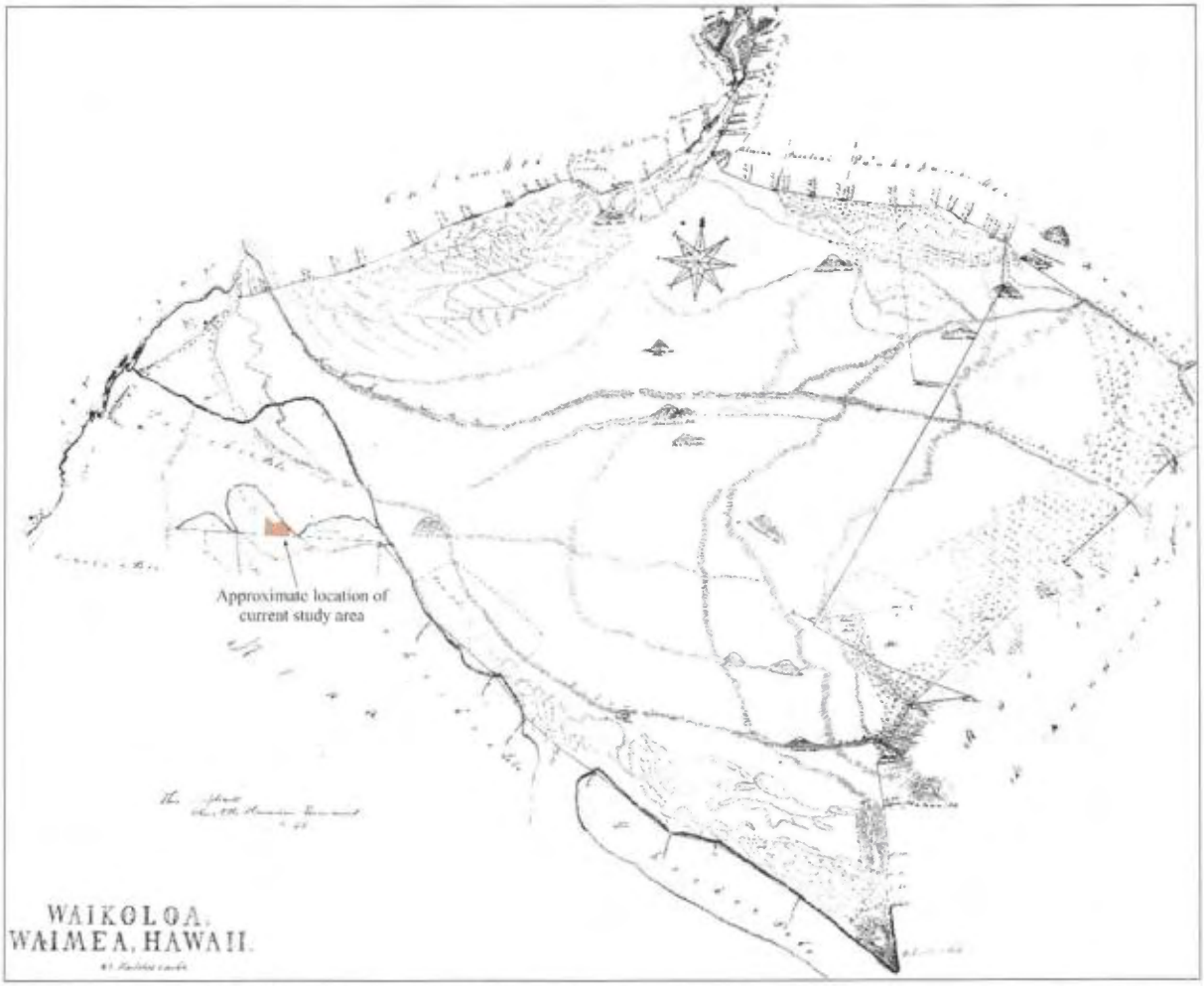


Figure 3. Registered Map No. 574 showing Waikōloa, the *kalana* of Waimea and the approximate location of the current study area (prepared by Kaelemakule, n.d.).

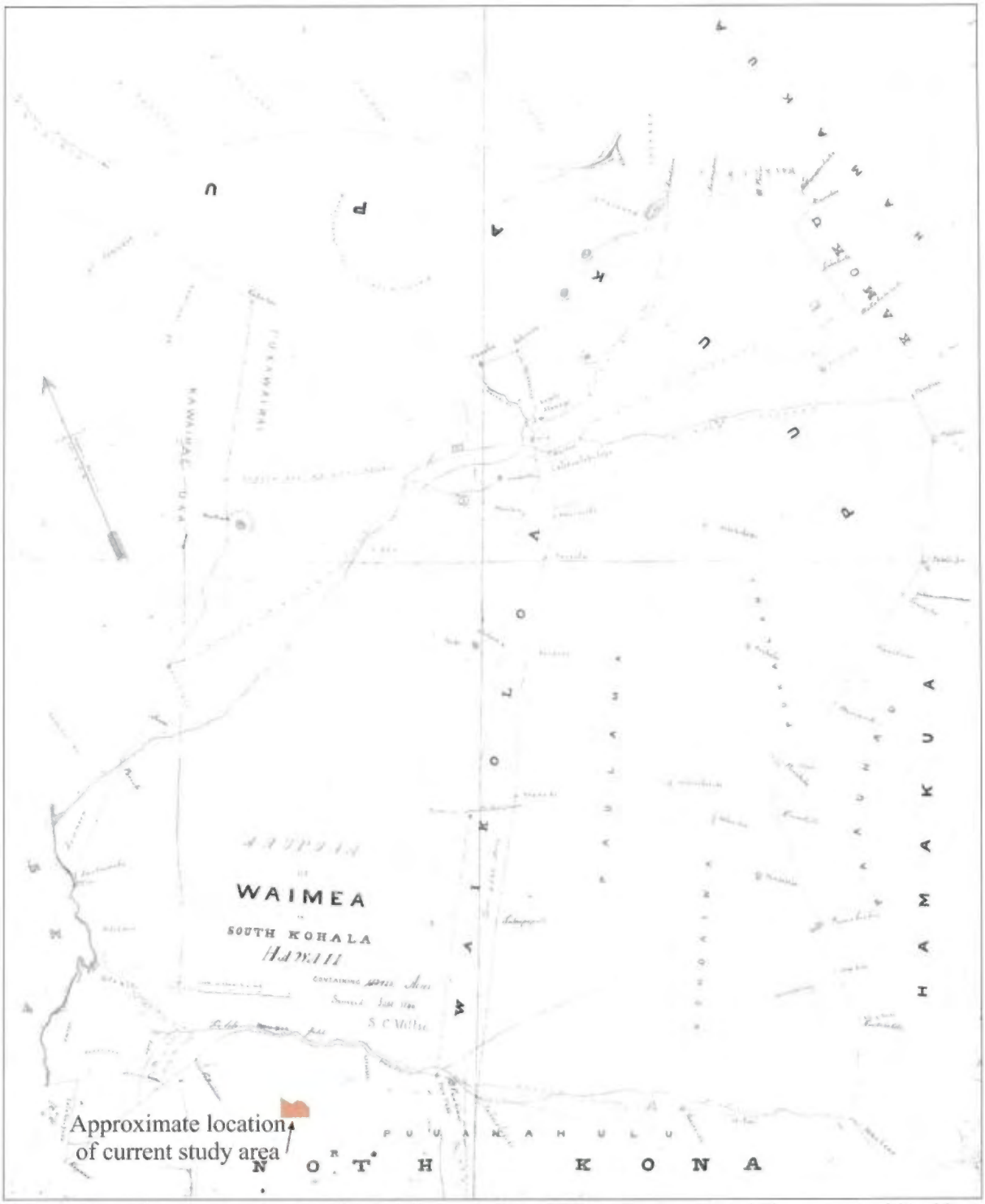


Figure 4. Hawai'i Registered Map No. 712 showing the *kalana* of Waimea and associated *ahupua'a* ca. 1866 with approximate location of the current study area.

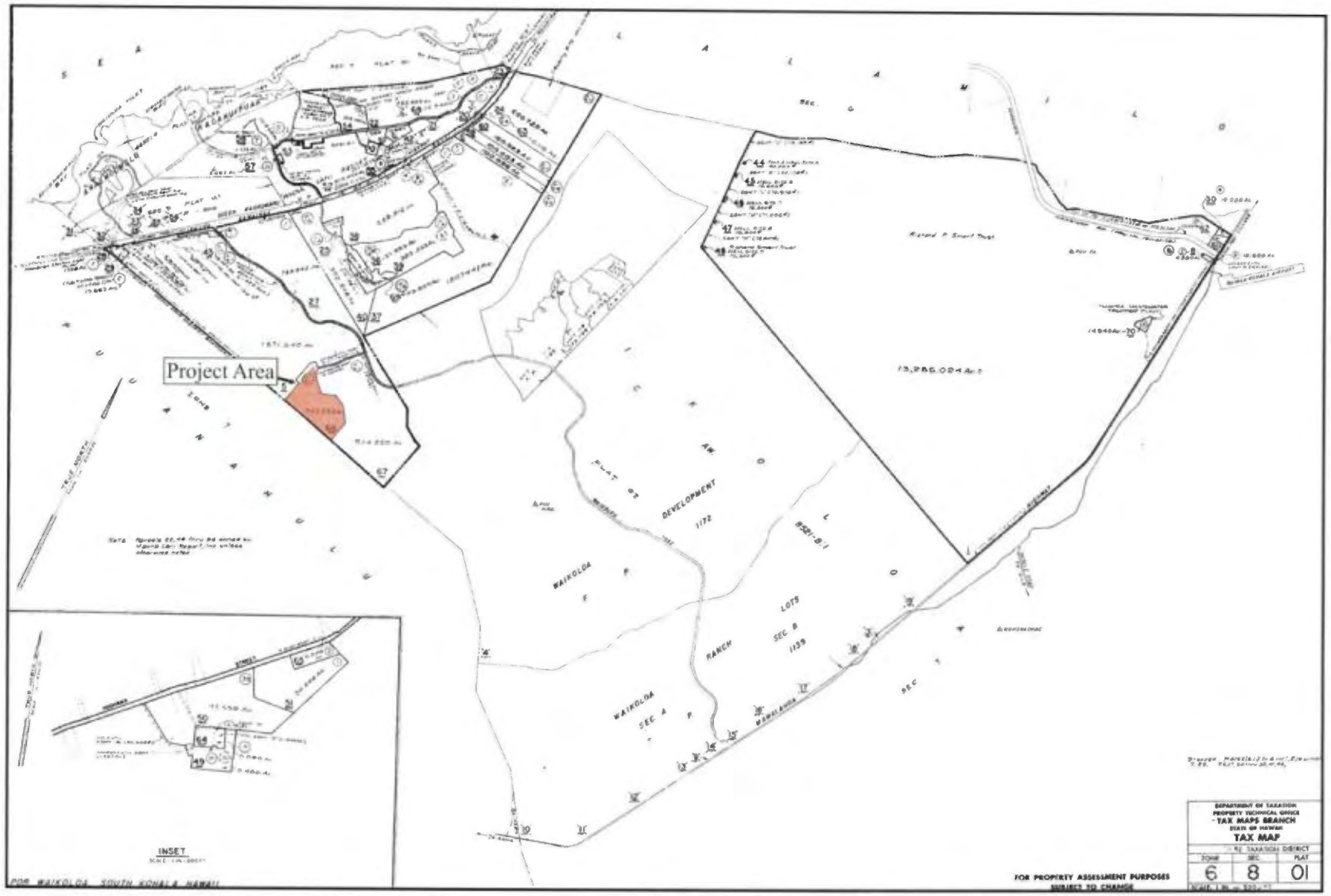


Figure 5. Tax Map Key (TMK) showing LCAw 8521-B and the location of the current project area (Parcel 066 por.) shaded red.

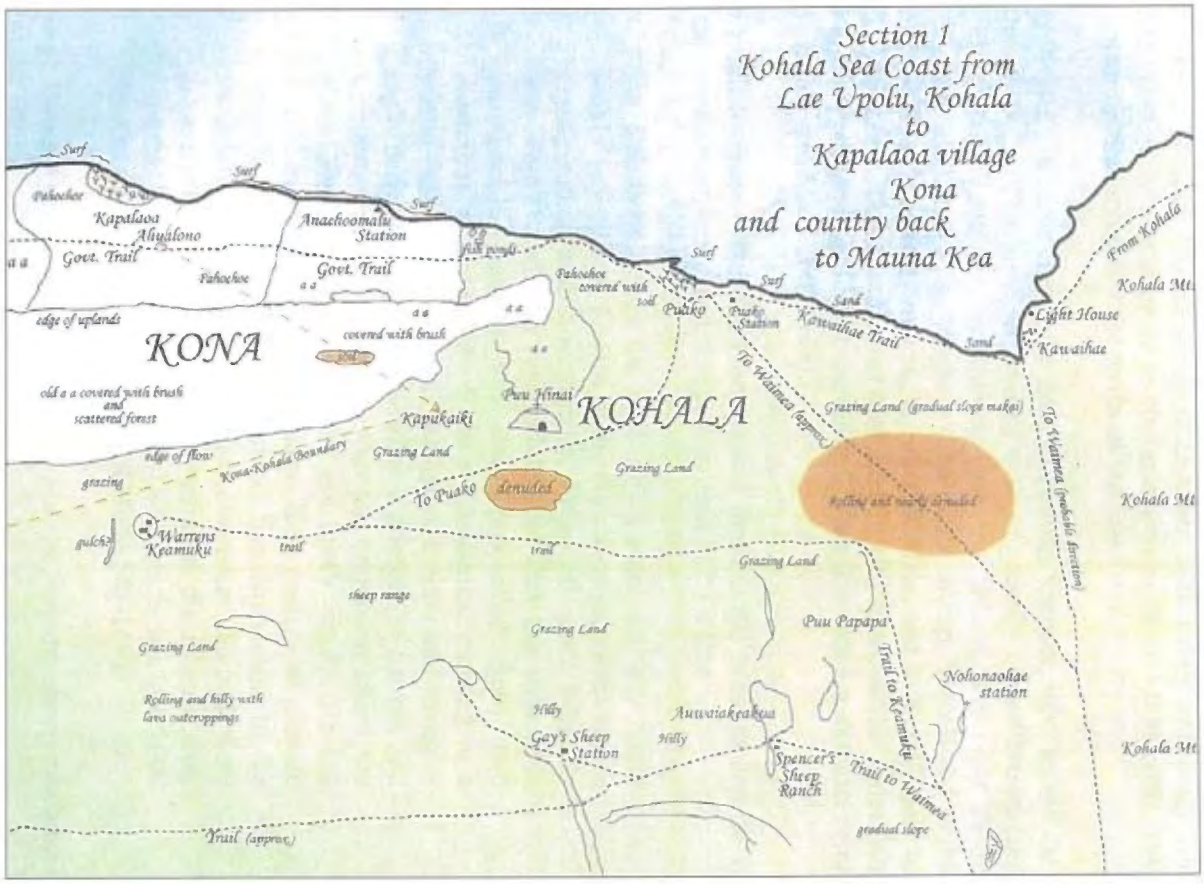


Figure 6. Emerson sketch map of South Kohala coast ca/ 1882 (from Escott 2008:43).

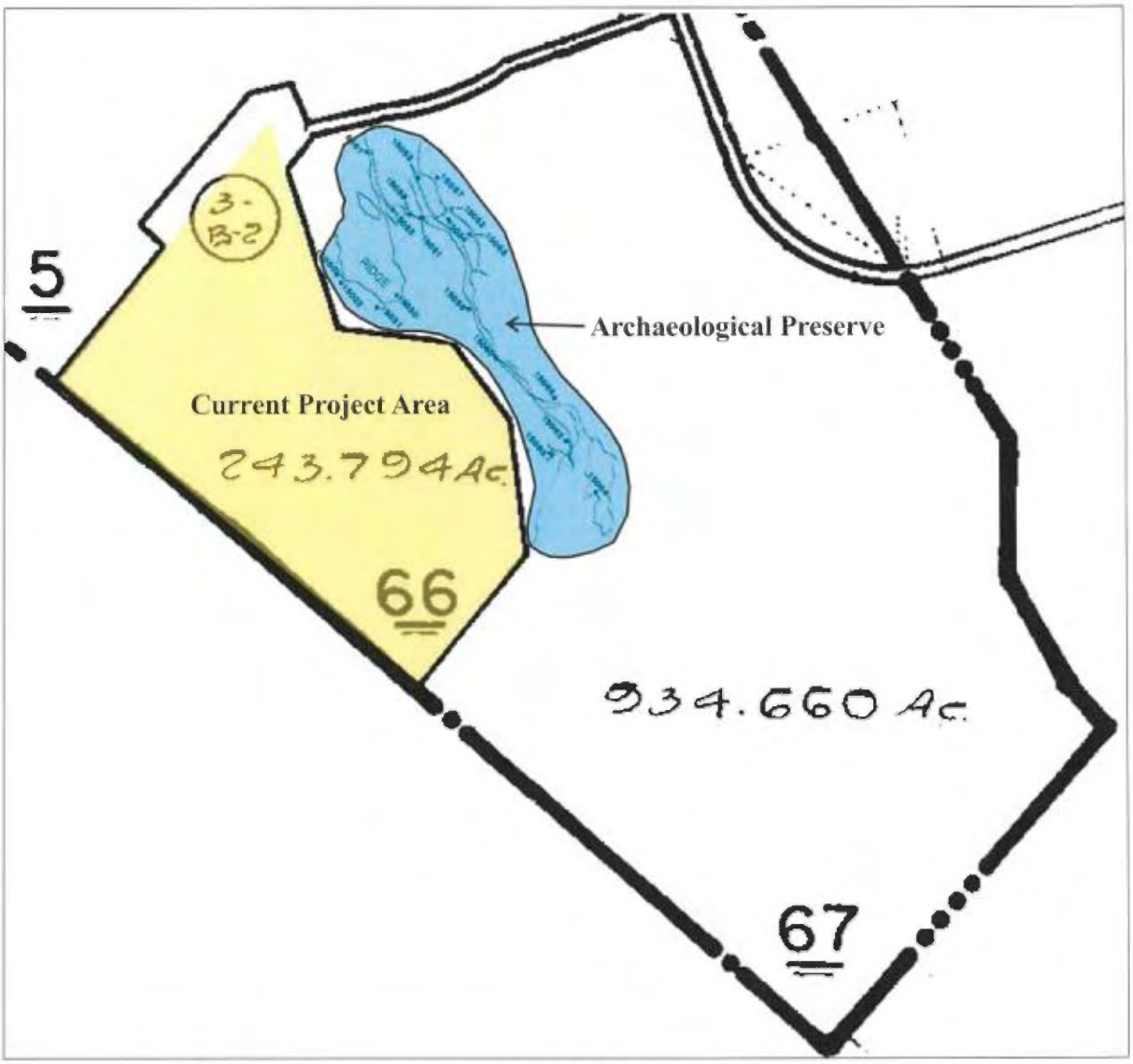


Figure 7. Portion of Tax Map (3) 6-8-001 showing archaeological preserve adjacent to current project area.

Figure 8. Google Earth image of study area showing network of access roads and quarried areas.