HONUA'ULA

FINAL ENVIRONMENTAL IMPACT STATEMENT

VOLUME 3 OF 4
(APPENDICES A-L)

Prepared for:

Accepting Authority

Maui Planning Department / Maui Planning Commission

Applicant:

Honuaʻula Partners, LLC

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June 2012

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Design Guidelines

HONUA'ULA

Design Guidelines

March 2010

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March 2010

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preface

These Design Guidelines are intended to provide guidance for all community development and construction—new buildings, building additions, site work and landscaping — as well as any subsequent changes or alterations to previously approved plans of existing homes. The Design Guidelines will be administered and enforced by the Honua'ula Design Review Committee (DRC) in accordance with procedures set forth in the Honua'ula Declaration of Covenants, Conditions and Restrictions (CC&R's) recorded with the State of Hawaii, and as may be amended thereafter. In the event of any conflict between Design Guidelines and CC & R's, the CC & R's shall govern and control.

These Design Guidelines are also intended to provide a framework which owners and their design team may use to create buildings and homes that promote the goals of Honua'ula. Accordingly, the DRC reserves the right to review, approve or disapprove design proposals based upon the proposal's support of these community goals, regardless of the proposal's adherence to specific sections of these guidelines.

The Design Guidelines may also be amended from time to time by the DRC. It is the Homeowners' responsibility to be sure that they have current Design Guidelines and have carefully reviewed all applicable sections of the CC & R's.

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HONUA'ULA COMMUNITY DESCRIPTION/PURPOSE AND INTENT

Honua'ula is designated "Project District 9" in the County of Maui Kīhei-Mākena Community Plan. Under Chapter 19.90A, Maui County Code (MCC), the purpose and intent of Project District 9 is to establish permissible land uses and appropriate standards of development for a residential community consisting of single-family and multifamily dwellings complemented with village mixed uses, all integrated with a golf course and other recreational amenities.

Consistent with the Kīhei-Mākena Community Plan and the County Code, Honua'ula is a master-planned community embracing "smart growth" principles such as diverse residential opportunities, commercial mixed uses, on-site recreational amenities, and integrated bicycle and pedestrian path/trail networks. Honua'ula also fosters preservation of natural and cultural resources while contributing to Maui's social fabric and economic diversity.

Honua'ula reflects community values and features distinctive architecture to create an interesting, unique community in context with the Kīhei-Mākena region. This cohesive approach integrates natural and human-made boundaries and landmarks to craft a sense of place within a defined community. Incorporation of unique elements and natural and cultural resources will provide Honua'ula residents with a distinctive home for generations. In addition, the topography is a key defining feature of Honua'ula, and one of the principle design and planning goals is to preserve and utilize this topography as much as possible.

Honua'ula's integration of mixed land uses is a critical component of creating a true community. By locating commercial and retail establishments within a quarter-mile of the higher density residential areas, alternatives to driving, such as walking or biking, once again become viable.

Honua'ula's open space, parks, conservation areas, bicycle and pedestrian network, and golf course provide for significant recreational benefits, protection of important habitat and natural features, and an overall setting of enhanced environmental quality and community health.

1.1 SINGLE AND MULTI-FAMILY RESIDENTIAL SUB-DISTRICTS

The Single- and Multi- Family Residential sub-districts contain Honua'ula's residential neighborhoods. The total number of residences that may be constructed on-site in Honua'ula will not exceed 1,150. Homes are priced for a range of consumer groups, including workforce affordable homes. Because of the Property's elevations and topography, many homes will have golf course and/or ocean views.

1.2 VILLAGE MIXED USE SUB-DISTRICT

The Village Mixed Use sub-district allows for a mix of residential, commercial, and recreational and community facilities serving the needs of Honua'ula residents and guests.

The intent of the Village Mixed Use sub-district is to create community identity and character with landmark buildings and grouping of services within a central core that includes a mix of uses. Permitted uses in the village mixed use district include: retail food and beverage establishments; grocery stores; retail shops; offices; business services; minor medical offices; religious institutions; and public facilities.

1.3 RECREATION AND OPEN SPACE/UTILITY SUB-DISTRICT

The Recreation and Open Space/Utility sub-district may include: the golf course and golf driving range; community and recreation centers; parks and playgrounds; native plant conservation areas; landscaped common or open space areas; trails and bike-pedestrian ways; drainage, utility, and erosion control systems; wells and reservoirs; and greenhouses and nurseries for the propagation of plants.

Open space in the Recreation and Open Space/Utility sub-district includes landscaped buffers, drainage ways, and steep topographic features. A major buffer zone is located between Maui Meadows and Honua'ula. This buffer area is at least 100 feet wide consisting of a 50-foot wide landscape buffer and a landscaped roadway. Other major buffer areas include areas bordering Pi'ilani Highway.

1.4 GOLF COURSE AND CLUBHOUSE

The homeowner's golf course and clubhouse includes: an 18-hole championship golf course; golf practice range; clubhouse facility with a restaurant; pro-shop; spa; and indoor and outdoor recreational amenities. The golf course and driving range are part of the Recreation and Open Space/Utility sub-district; the clubhouse and related facilities are within the Village Mixed Use sub-district. Major portions of the golf course have been designed as an integral part of the community's drainage system.

1.5 CIRCULATION AND ROADWAYS

Pi'ilani Highway provides primary access to Honua'ula from the intersection of Pi'ilani Highway/Wailea Ike Drive. At or before the completion of 50 percent of Honua'ula, Pi'ilani Highway will be extended south with two lanes from Wailea Ike Drive to provide a connection with an extension of Kaukahi Street in Wailea Resort.

A system of pedestrian and bike paths is integrated along the community's roadways and open spaces. This secondary circulation system of linked pedestrian/bike trails provides another option for traveling within the community. The community trail system connects residential areas to the village mixed use areas, neighborhood parks, golf course clubhouse, and other areas.

2

COMMUNITY DESIGN STANDARDS

These design standards establish a consistent framework of common community elements that reflect the context of surrounding areas. The following are guiding community principles that have been incorporated in the planning and design of Honua'ula:

- Create a distinct Honua'ula design character and identity;
- Establish a hierarchy of roadways and project features;
- Establish significant landmark features in appropriate locations;
- Promote a sense of place;
- Provide recreational opportunities and activities;
- Preserve and enhance botanical and cultural resources; and
- Preserve and use Honua'ula's unique topography as much as possible.

3

DEVELOPMENT STANDARDS

Honua'ula is subject to all federal, state, and county statutes, ordinances, rules, and regulations, and shall be further subject to the following standards included within the Project District zoning ordinance (Chapter 19.90A, MCC) and the Change in Zoning ordinance (Ordinance 3554 (2008)):

A. Environment.

1. Existing natural drainageways shall remain as open spaces and their hardening is discouraged, provided that landscaping, walkways, bikeways, roadways, fences, drainage, and minor recreational and other structures, that do not detract from the natural environment or adversely affect drainageways and improvements, may be permitted.

2. The drainage master plan shall incorporate the golf course and open spaces as areas for stormwater detention and desilting basins.

3. When grading is necessary, retaining existing rolling topography and natural drainageways is strongly encouraged.

B. Energy Efficiency.

1. The requirements of Chapter 16.16 MCC shall apply to all uses within Honua'ula. Chapter 16.16, MCC, sets forth design requirements for the efficient use of energy in new buildings and new construction in existing buildings.

2. All residential energy systems shall be designed and constructed to meet all applicable ENERGY STAR requirements established by the Climate Protection Division of the United States Environmental Protection Agency in effect at the time of construction. Energy systems include all hot water systems, roof and attic areas, outside walls, windows, air cooling systems, and heating systems.

3. All residential units shall be equipped with a primary hot water system at least as energy efficient as a conventional solar panel hot water system, sized to meet at least 80 percent of the hot water demand for the respective units.

4. All air cooling systems and all heating systems for laundry facilities, swimming pools, and spa areas shall make maximum use of energy-efficient construction and technology.

C. Infrastructure and Public Services.

1. Honua'ula shall not burden government agencies by requiring the provision of major infrastructure improvements or public services.

2. Honua'ula, will develop, maintain, and operate, a private water source, storage facilities, and transmission lines in accordance with Department of Water Supply standards and all applicable community plans.

3. Honua'ula roadways may meet standards for private, nondedicable, resort-residential roadway and pedestrian access in accordance with health and safety requirements.

4. Roadways will incorporate landscaped bike/pedestrian ways as part of a comprehensive system of landscape roads and bike/pedestrian ways.

5. Nonpotable water shall be used for all irrigation purposes.

D. Architectural Design.

1. Each building or structure shall be designed by a licensed architect in conformance with the intent of Honua'ula and these design guidelines.

2. The architect of Honua'ula should act as a bridge between the natural and man-made environment. Accordingly, building design should blur the distinction between indoor and outdoor space, equal emphasis should be placed on the spaces between buildings, and structures should recede into the landscape as opposed to dominating it.

3. Create buildings that are unique to their locations and requirements, while remaining consistent with the overall Architectural Design objectives of the community.

4. The height of any structure within Honua'ula shall be measured in accordance with Section 19.04.040, MCC.

E. Landscape Planting.

1. Comprehensive landscaping shall be provided for all community common areas, including along streets and drainageways, and in improved open spaces.

2. Landscaping shall be considered an integral element of Honua'ula and shall be used for visual screening, shade, definition, and environmental control.

3. Existing native Hawaiian species shall be retained or relocated, to the extent practicable.

4. Use of native Hawaiian species is strongly encouraged.

5. Within the southern portion of Honua'ula a Native Plant Preservation Area is established for the protection of native Hawaiian plants and significant cultural sites worthy of preservation, restoration, and interpretation for public education and enrichment. No development is allowed within the Native Plant Preservation Area other than fences, trails, and structures necessary for the maintenance of the area.

6. A fire buffer area is established between Maui Meadows and Honua'ula. The fire buffer shall be a minimum of 100 feet wide, with a minimum fifty-foot wide landscaped buffer area within it. No structures, except rear and side boundary walls or fences and garden walls no higher than six (6) feet, are permitted in the buffer.

7. A minimum 20 foot wide landscape buffer area is established between any single-family and multifamily development adjoining Piilani Highway extension corridor.

F. Signs

A comprehensive sign program, consistent with Chapter 16.12A, MCC, is established for all signs within Honua'ula. The comprehensive sign program shall include details regarding, type, number allowable, area, format, conceptual design, color scheme, building materials, lighting, and installation.

4

SITE DEVELOPMENT DESIGN GUIDELINES

The following examples suggest a range of acceptable residential and mixed use development. These Design Guidelines strive to provide a framework for a quality community, while allowing flexibility for market demands over time. The following are the guiding principles incorporated in this document:

- Adhere to the adopted Project District (Chapter 19.90A, MCC) and zoning requirements (Ordinance 3554 (2008) and related development standards;
- Promote a diversity of products to meet a range of market demands;
- Satisfy the mix of market and affordable housing requirements;
- Integrate parcels for attached and detached housing products;
- Provide for human scale commercial development;
- Encourage sensitivity to the natural environment; and
- Provide an integration of site planning with the architectural solutions of buildings.

4.1 INDIVIDUAL HOMESITE DIAGRAMS / BUILDING ENVELOPES

Homesite diagrams will be prepared for each individual homesite to define site-specific design parameters such as building envelope areas, building setbacks, pad elevations, and maximum roof elevations. As applicable, utility easements are indicated on, and consistent with, the site improvement plans. In addition, special landscaping restrictions to enhance views may be defined. Refer to Figure 4.1 – Sample Homesite Diagram and each Individual Homesite Diagram for the subject lot. Building envelope locations are determined by the specific characteristics of each lot, zoning setback criteria, and the planning and design objectives for Honua'ula.

An Individual Homesite Diagram for each lot shall be included in the initial and any subsequent Sales Contract. No modifications to the homesite diagrams/building envelopes shall be made by Individual Homesite owners or successors, unless modifications are in compliance with these Design Guidelines and approved by the DRC.

Structures within the building envelope shall conform to the maximum building height requirements, as specified, to enhance views from neighboring Homesites. No buildings, including roofs, accessory buildings, or trellises, shall extend beyond the Individual Homesite's building envelope limits, with the exception that cantilevered roofs, soffits, roof eaves, and trellises may project up to four feet into the side and front yard setbacks.

Depending on characteristics of the Individual Homesite, special setbacks and height restrictions have been established. These restrictions enhance view planes of other homesites and provide landscape transition areas that are consistent with the natural areas or fringe areas of the adjacent golf course.

4.2 CONSOLIDATION OF LOTS

When two or more Individual Homesites are combined and consolidated into one homesite, the DRC will designate a new homesite diagram/building envelope, based on the new Individual Homesite boundaries and consistent with these Design Guidelines.

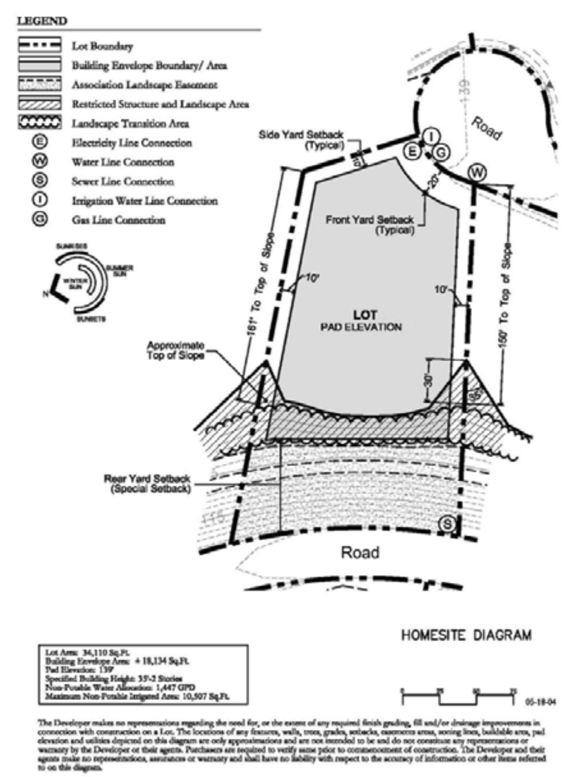

Figure 4.1 - Sample Homesite Diagram

4.3 SETBACKS

Setbacks for the Individual Homesites have been established to provide a uniform standard for the building setbacks. Refer to Section 5 for details. Additionally, special setbacks, such as the expanded rear yard setbacks defined by the Association Landscape Easement (ALE)(see Section 6), have been established on certain Individual Homesites to further define the building envelope. No buildings, structures, or walls shall be placed within the Association Landscape Easement. However, trails or paths may be permitted within the Association Landscape Easement (Section 1.5 and 6.7) if approved by the DRC.

The Restricted Structure and Landscape Area (RSLA) (see Section 6) is designated to restrict the height and amount of improvements so as to provide a transition to the ALE, golf course, and natural areas. The Landscape Transition Area (LTA) (see Section 6) is a designated area which is intended to provide more specific landscape and construction transition from the ALE to the Building Envelope Area (BEA) (see Section 4.1).

Refer to the Individual Homesite Diagram for specific building setbacks and special setbacks that define the BEA and other restrictions.

4.4 GRADING

In conformance with Section 19.04.040, MCC regarding building heights, any site grading shall be done with knowledge that the allowable building heights may be impacted by the site grading. Specifically, building "height" means the vertical distance measured from a point on the top of a structure to a corresponding point directly below on the natural or finish grade, whichever is lower. If the lot has been graded, please refer to the Lot Diagram to verify what the natural grade of the lot was to determine the resultant allowable building heights.

The grading of building pads by individual owners shall be confined to the minimum amount necessary to provide for the architectural concepts. To encourage architectural concepts that step the building form with the sloping terrain, step pads or building pads may be constructed within the building envelope to step down from the established building pad elevation and conform to the topography of the individual site. Refer to Figure 4.2 – Grading with Step Pads. The step pads shall not exceed a total of 10 feet vertical. All finish grades over one foot vertical to three feet horizontal (i.e. 1:3 slope) within the building envelope shall be reviewed for stability against erosion.

No fill conditions shall raise any portion of the property more than three feet above the specified Site Plan Pad Elevation, except for landscape berms as may be approved by the DRC. For the purpose of these Design Guidelines, the specified Pad Elevation shall be same as the finish floor elevation of the proposed Structures.

Grading shall be subject to review for compliance with this section and conformance to the natural topography of the site. All grading shall be compliant with the Maui County Code regarding grading (Chapter 20.08, MCC). Upon completion of project construction, any disturbed areas of the Association Landscape Easement shall be restored naturally to blend with the adjacent landscaping.

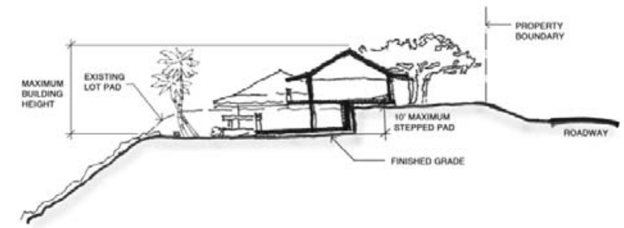

Figure 4.2 - Grading with Step Pads

4.5 FILL MATERIAL

Any fill material imported for use on an Individual Homesite shall be free of organic matter or plant material. The edges of any exposed fill material shall be treated to be indistinguishable from adjacent Common Areas and Association Landscape Easements.

4.6 DRAINAGE

Individual homesite development shall protect the existing natural drainage system and provide for proper drainage using natural channels whenever possible. Based on the Site Development improvements and related drainage easements designed and constructed in accordance with the Onsite Drainage Report, Individual Homesites, to the extent possible and in compliance with County of Maui regulations, shall provide drainage improvements without increasing any drainage flows from the lot area.

To determine specific lot drainage requirements, the design consultant shall review any specified drainage easements, the referenced Drainage Report, Site Development Improvements, and applicable County of Maui regulations. Where drainage easements are provided on Individual Homesites, no grading, improvements, or landscaping shall be permitted that would impede the drainage flows. Along the roadway frontage of ndividual Homesites, existing grades (as specified on the Individual Homesite Diagrams) shall be maintained during and after construction to maintain the drainage design of the roadway and related common areas. Any drainage structures associated with construction on an Individual Homesite shall be confined within the Individual Homesite. Drainage transitions shall be provided to prevent erosion of Common Areas or neighboring properties, and to blend with adjacent common features.

4.7 RETAINING WALLS

Retaining walls shall not exceed six feet in height from the top of the wall to finish grade. If multiple retaining walls are used in any given location, the aggregate wall height shall not exceed 10 vertical feet per this measurement and shall be terraced to include a minimum three foot-wide horizontal landscaped area between walls. A fence may be incorporated into the retaining wall if it is a different material, visually transparent, and approved by the DRC. Wall materials and finishes shall be as discussed in Section 6.6. Refer to Figure 4.3 – Typical Retaining Wall Requirements.

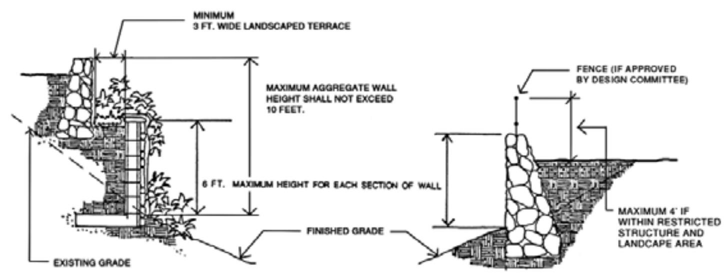

Figure 4.3 - Typical Retaining Wall Requirements

4.8 PARKING

Single-Family Residential Sub-district – Depending on the lot size and location within the community, on-site parking requirements may be specified that exceed the minimum County code requirements (Chapter 19.36, MCC). Example: In the Single Family Residential District, for single family dwellings, there shall be a minimum of four parking spaces for automobiles, with at least two spaces covered. All covered parking shall be in a completely enclosed garage, which is architecturally integrated with the total development. Uncovered parking shall be designed to limit the visibility of parked automobiles from roadways, the golf course, and other parcels and homesites. Carports are not permitted. Uncovered parking spaces are not allowed in setbacks or yards.

Multifamily Residential Sub-district –The minimum parking number parking spaces in the Multifamily Residential Subdvision is two parking spaces for each unit.

Village Mixed Use Sub-district – For parking requirements within the Village Mixed Use Sub-district refer to Chapter 19.36, MCC.

4.9 DRIVEWAYS AND CONNECTION TO COMMON FACILITIES

Driveway material shall be asphaltic concrete or substitute material, textured, and colored to blend with the surroundings. Pavers are encouraged to increase permeability and reduce runoff. Connection points for vehicular access are limited to one per Individual Homesite, unless approved by the DRC. The location of the connection point(s) is subject to review and approval by the DRC.

4.10 UNDERGROUND UTILITIES

All utility lines and associated conduits shall be installed underground.

4.11 SEWER CONNECTION

Provisions for sewage disposal shall be made by connection to the lateral sewer system provided to each Lot. At the time of connection to the sewer system, an account application shall be provided to the Honua'ula Wastewater Corporation or assignee, the operator of the system.

4.12 SIGNS AND ENTRY FEATURES

All signs, including residence names and addresses, and related entry features shall be designed as an integrated part of the residence and/or garden walls. Signs and entry features shall be reviewed and approved by the DRC.

No sales, leasing, or announcement signs shall be permitted on Lots or Common Areas of the community.

4.13 MAILBOXES

No individual home delivery will be provided by the U.S. Postal Service.

Cluster mailboxes will be used for mail delivery and pick-up. A cluster box typically consists of eight or more individually locked compartments with an outgoing mail deposit compartment. Installation, location, and collection of cluster boxes shall be reviewed and approved by the Kīhei Postmaster.

If the cluster mailboxes are to be housed in a structure, refer to Section 5.4 Auxiliary Structures.

4.14 SPORT COURTS

Tennis, basketball, and other sport courts are not allowed on Individual Homesites, except when approved by the DRC. No court lighting will be allowed.

4.15 ANIMAL FACILITIES

All animal facilities for permissible common household pets, including dog runs or enclosed pens, shall be set back at a minimum of 40 feet from any adjoining Lot or neighboring property. Animal facilities shall be screened from view with appropriate landscaping.

5

ARCHITECTURE DESIGN GUIDELINES

5.1 DESIGN PRINCIPLES

These Design Guidelines create an overall architectural theme for Honua'ula. In addition, the guidelines provide a framework so that a consistent architectural character is achieved. The Honua'ula site possesses characteristics unique and apart from similar developments in the Hawaiian Islands. With the property's dramatic ocean views in almost all directions, ancient lava flow topography, and unique landscape character, the architecture of Honua'ula should act as the bridge between the natural and man-made environment. Accordingly, building designs should blur the distinction between indoor and outdoor space. Equal emphasis should be placed on the spaces between buildings and structures should recede into the landscape as opposed to dominating it. At Honua'ula, each Owner and their Architect are encouraged to create buildings that are unique to their locations and requirements, while remaining consistent with the overall Architectural Design objectives and the community design standards. The following are the guiding principles and design objectives for architectural design:

- Adhere to the adopted Project District (Chapter 19.90A, MCC) and zoning requirements (Ordinance 3554 (2008) and related development standards.
- Require high quality standards to establish lasting value for the Kihei-Makena region.
- Encourage building forms that respect and maintain both the unique topographic and landscape character of each individual building site.
- Encourage building designs that de-emphasize the scale and size of the structures where possible, expressed as a grouping of individual "pavilions" linked together by interior or exterior passages.
- Create buildings that are appropriate to the climate, solar orientation, prevailing winds, and casual Island lifestyle.
- Encourage buildings that respect the view corridors of the buildings above them, where possible, longer ridge lines should run parallel to the directions of major views.
- Create buildings composed of materials, textures, and finishes that exist naturally in the environment, opposed to being "manufactured."
- Encourage building designs that are simple, timeless, and permanent in their execution.
- Encourage buildings that respect local traditions, history, and culture but avoid literal translations of Hawaiian "styles."
- Where practical, design sites and buildings that are sustainable and utilize "green" building strategies.

Figure 5.1 - Architectural Character Concept - Clubhouse

5.2 RESIDENTIAL DESIGN

For all residential and related structures, the following design guidelines apply.

5.2.1 Building Materials and Construction Techniques

Honua'ula literally translated means "red earth". In an effort to create a strong relationship between the lands of Honua'ula and the built environment, building materials, textures and finishes should be selected from those that exist in their natural states as opposed to manufactured, industrial, or man-made materials. For example, exterior walls could be integral colored cement plaster in softly textured earth tones, or stained woods in a natural finishes while glossy painted or metallic finishes would be discouraged. Roofs of natural cedar shingle, shakes, or metals of a dull and natural patina are appropriate, while composition asphalt shingles of unnatural patterns are discouraged. Stained or sealed wood should have a UV protective coating applied to it. Of course, all materials should be high quality, durable and, when possible, become more attractive with time due to natural aging and exposure to the environment. Furthermore, to reinforce a more intimate scale with buildings that recede in the landscape, long unbroken walls and roofs, large unsmooth surfaces, and severe straight lines are to be minimized.

Figure 5.2 - Natural Rock Wall

Figure 5.3 - Cedar Board and Batten

5.2.2 Building Forms and Massing

Reduce the apparent scale and mass by encouraging buildings and roof forms that are perceived as a series of smaller structures or volumes linked by interior or exterior connectors, as opposed to more monolithic structures. Preserve views and view corridors from adjacent parcels and properties that overlook parcels below. Encourage building masses that step with the existing topography.

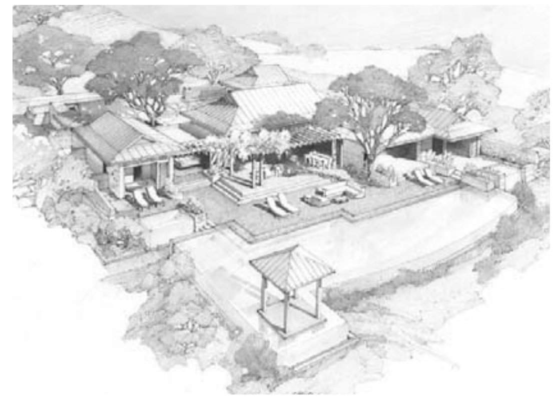

Figure 5.4 - Architectural Character Concept - Single-Family Residential

On sloping sites, buildings shall be composed of smaller more manageable volumes that respond to and preserve both the topography and the natural vegetation and attributes of each unique site. On constructed pad sites, building mass shall be varied and for the most part, a composition of horizontal instead of vertical volumes. Building elements should be articulated and softened by deep-set entries and windows, various levels, offsets and penetrations. Projections such as operable storm shutters, trellises, pergolas, deep roof overhangs and covered loggias or porches that link the outside to inside areas are encouraged. Buildings are encouraged to follow the following guidelines:

- Where possible, encourage building components broken into individual "pavilions" that allow light and air into more than one side of interior spaces. These pavilions should be connected to the main mass with lower roof forms. Refer to Figure 5.5.
- Similarly, roof forms and volumes should be broken into smaller components and varied in height and volume. Refer to Figure 5.6.
- Large, iconic, monolithic building masses shall be avoided.
- Continuous vertical walls over 2 stories in height shall be avoided.
  - *Where they occur, single-story elements like a roof form, arbor or a shade structure should be utilized to break up the mass.*

- Where possible, the building mass should step down or transition with grade, and multiple floor levels are acceptable.
- Building mass should be articulated through the use of multiple levels, shade structures, covered lanais, and projecting balconies; where possible larger masses should be located near the center of a lot and transition to smaller masses at the periphery.
- Consideration shall be given to lots adjacent to and above each site in order to preserve their view corridors.
- Significant building entrances should be articulated by roof forms, overhangs, porches or courtyards. Dominant or out-of-scale entries are strongly discouraged.
- Projecting decks and balconies should be proportional with the façade, and long unbroken raised decks are discouraged except on steeper sites where the result will be preservation of the natural site features.


Figure 5.5 - Pavillion


Figure 5.6 - Broken-Up Roof Forms


Figure 5.7 - Larger Element in Center of Building Mass

5.2.3 Building Height

Building Height is measured from the highest point of the structure to a corresponding point directly below on natural or finish, whichever is lower (see section 19.04.040 in the Maui County Codes). Maximum building height for a single family detached residence is 2 stories and 30 feet. Maximum building height for a multi-family residential structure is 4 stories and 50 feet.


Figure 5.8 - Single-Family Detached Height Restriction


Figure 5.9 - Multi-Family Height Restriction

5.2.4 Roofs

At Honua'ula, roofs will be a dominant feature in the view plane from most sites. As such, colors, texture, materials and form need to be carefully designed to integrate the buildings with the site and preserve the views from adjacent or higher properties. In general, major and higher roof ridge lines should run parallel to the direction of the major views and roofs should be further broken in to smaller components where possible. A combination of sloped and flat roofs is acceptable and encouraged if it further reduces apparent mass; however, the major building masses should have sloped roofs. Traditional Hawaiian and simple hipped roofs, double pitched hipped roofs (such as Dickey roofs), and Dutch gables are encouraged; however, simple gables are discouraged. Roof slopes should generally not exceed a 10 in 12 slope, and the lower slope of a double-hip should not exceed 4 in 12.

To achieve the desired architectural solutions, the following roof design guidelines shall be adhered to:

- Where sloped roofs are employed, large overhangs should be used to shade the building and occupants. Overhangs should exceed 30" in depth as a minimum.
- Roof overhangs should be proportional to the building mass and fascias should be minimized in depth.
- A single monolithic roof mass should be avoided and smaller roof forms should be utilized to break up the roof mass.
- Gutters and downspouts should be incorporated into the design or concealed or decorative where possible. Copper or natural lead/tin coated finishes are encouraged; however, long horizontal and vertical runs shall be avoided.
- Not more than 25% of the roof area shall be flat (slopes of less than 3:12)
- Vents, mechanical equipment and solar panels shall be concealed whenever possible, and locating these items on the sloped portion of a roof shall be avoided. Where possible, they shall be located in wells or flat roofs. The parapets of these flat roofs shall be high enough to screen the mechanical equipment/solar panel/vents.
- The roof material, form, and color must be approved by the Design Review Committee.
- Sloped roof material and color should be natural in texture and color, essentially neutral in the landscape and should not be reflective with a maximum LRV of 26.
- Sloped roofs can be composed of natural wood shingles or shakes, smaller sized concrete tiles or naturally weathered or natural patina metal finish. If painted metal roofs are used, the reflectivity and sheen should be kept to a minimum and harmonize with the natural surroundings.
- Flat roofs can be of any acceptable material in a natural color and with an LRV of less than 26. Green roofs are encouraged.

Figure 5.10 - Dickey Roof

Figure 5.11 - Wood Roof

Figure 5.12 - Concrete Tile Roof

5.2.5 Walls

Similar to the roof form, the walls will be a major visual factor at Honua'ula. The mass, form, and material choice for walls must be carefully considered. The scale of the walls shall be proportional to its surroundings. Accordingly, large unbroken walls in the vertical and horizontal planes shall be avoided where possible. Predominant walls should be of natural materials like stone, integral color or modeled plaster, or wood with warmth and texture. Finishes should exude an artisanal texture, hand hewn, or toweled, and colors should be chosen from a palette that occurs naturally and is appropriate to its surroundings. Where possible, darker colors and hues that recede into the landscape and heavier versus lighter textures are strongly encouraged.

Figure 5.13 - Concept Wall with Exposed Aggregate

To achieve the desired architectural solutions, the following guidelines shall be adhered to:

- Unbroken vertical walls on a building mass over 2 stories in height shall be avoided.
- Walls over 16 feet in height should be stepped or battered.
- Landscape walls, whether retaining or decorative, shall not be more than 6 feet in height in a single run.
- Material changes in walls must occur only in an inside corner and should be avoided on an outside corner condition.
- The color of the exterior walls should not be obtrusive and should blend in with the built and natural environment.
- Acceptable materials include, but are not limited to, natural stone, integral color cement plaster with a slight texture and subtle color variations, stained concrete, and wood siding.
- Where heavy materials like stone and concrete are used, the wall thickness should be more than 10 inches; in these cases windows and doors should be recessed at least 6 inches from the exterior plane.
- Where stone walls are used, all openings shall have a lintel incorporated above it.
- The wall construction, material choice, and color scheme must be approved by the DRC.

Figure 5.14 - Stepped Retaining Wall

Figure 5.15 - Textured Stucco Wall

Figure 5.16 - Painted Board and Batten

5.2.6 Doors and Windows

At Honua'ula, the natural beauty of the site and the spectacular vistas (both distant and near) are predominant features. Therefore designs are encouraged to incorporate nature and views into the built environment. The separation between what is outside and what is inside should be minimized through the use of large doors and windows that open onto the natural environment and/or to the spectacular views. Where possible, fully open and operable window systems to the floor level are encouraged in the living area. Since the expansive views are so dramatic in this location, divided lights within the window and door systems are not encouraged below eye level. In addition, fenestrations on more than one side into courtyards or gardens, clerestories or other devices to increase sources of natural light and cross ventilation into the interior space are strongly encouraged.

To achieve the desired architectural solutions, the following guidelines shall be adhered to:

- Doors and windows shall be proportional to the building mass.
- Reflective glass shall be avoided in the door and window systems.
- Where multi-pane systems are used, true divided lights should be used.
- Windows and doors within a stone or concrete wall should be recessed at least 6 inches from the exterior face. The trim and molding in these applications should be kept to a minimum.
- The use of privacy and protective systems like storm shutters are encouraged.
- The window and door systems should emphasize the importance of the space.
- Acceptable materials include, but are not limited to, stained or painted wood, aluminum clad systems (painted or anodized). The door and window color should complement both the primary building color and the natural surrounding environment.


Figure 5.17 - Stained Wood Windows and Doors


Figure 5.18 - Floor to Ceiling Door System


Figure 5.19 - Stained Concrete Wall with Window System Recessed from Exterior Face

5.2.7 Accessory Structures and Building Projections

Accessory structures that are not connected to the main building mass and building projections attached to the building mass are strongly encouraged. The use of these forms will reinforce the overall development design objectives of de-emphasizing the scale and size of the structures. These elements should be consistent with the overall architectural composition, the buildings they are associated with, and comply with the following guidelines:

- On grade pad mounted mechanical equipment must be concealed from the street and adjacent lots.
- Exterior finishes for the accessory structure should be consistent with the finishes of the main building.
- Spacing of these accessory structures shall comply with Chapter 16.08.060 of the Maui Housing Code.

5.2.8 Color

Honua'ula, coincidentally, literally translates to "Red Earth". As such, the color selection for this development should be inspired by the earth and, more importantly, the site. The micro-climate at the site is not your typical "tropical" environment with lush vegetation. Rather it is a much drier area of Maui which receives vast amounts of direct sunlight. As a result, bright stark colors in this environment tend to overpower and compete with the site. Therefore, muted earth tone colors are encouraged while stark full bodied colors should be avoided whenever possible. The dominant building color should complement the site and not compete with it. In general, color schemes achieved by the natural material choices are strongly encouraged (use of wood roofs, stone base, stained wood windows and doors, etc.). Texture, hue, and shadow patterns are effective devices to break up large expansive surfaces.


Figure 5.20 - Roof Material and Color Blending in with the Site

To achieve the desired architectural solutions, the following guidelines shall be adhered to:

- Exterior materials and paint colors shall not exceed a value or chroma of 6 as indicated on the Munsell color system.
- The color of the roof generally should be darker than the body color of the building.
- Accent colors should not compete with the primary dominant color.
- Changes in exterior wall colors should be made at interior intersections of walls.
- The color application and scheme should be consistent throughout the property.
- Exterior hardscape colors should be complementary to the primary building color.
- The DRC shall review and approve all color schemes.


Figure 5.21 - Wall Color and Material Blending in with the Site

5.3 VILLAGE MIXED USE/COMMERCIAL DESIGN

Within the Village Mixed Use Sub-District, including commercial uses, building structures shall adhere to the following design guidelines.

5.3.1 Building Materials

In addition to the residential design standards, the following commercial buildings guidelines shall be applicable:

- Use of natural materials are encouraged. Wood and stone are highly encouraged. In areas with pedestrian activity, non-natural materials like PVC should be avoided.
  - Stained and sealed wood shall have a UV protective coating applied to it.
  - If a painted wood appearance is desired, a Hardie product is acceptable.
- Reflective or tinted glass should be avoided.
- Sloped roofs can be composed of natural wood shingles or shakes, smaller sized concrete tiles or naturally weathered or natural patina metal finish. If painted metal roofs are used, the reflectivity and sheen should be kept to a minimum and harmonize with the natural surroundings.
- Flat roofs can be of any acceptable material in a natural color and with an LRV of less than 26.

5.3.2 Building Forms and Massing

Similar to the residential architectural design guidelines, commercial buildings shall adhere to the following guidelines:

- Avoid large monolithic building forms where possible. The building massing should be broken up into smaller elements that will be proportional to the user.
- Similarly, roof forms and volumes should be broken into smaller components and varied in height and volume.
- Continuous vertical walls over 2 stories in height shall be avoided.
  - Where they occur, single-story elements like a roof form, arbor or a shade structure should be utilized to break up the mass.
- Significant building entrances should be articulated by roof forms, overhangs, porches or courtyards. Dominant or out-of-scale entries are strongly discouraged.
- Walkways directly in front of storefronts should be covered with large overhangs to protect the pedestrian and the building from sun exposure and the elements.
  - Tenants are encouraged to "personalize" the covered walkways in front of their establishment. These may include but are not limited to adding seating groups, signage, or planters in front of their establishment. This action will require DRC.
- Outdoor covered dining areas are highly encouraged.

Figure 5.22 - Architectural Character Concept - Village Mixed Use

Figure 5.22 - Architectural Character Concept - Village Mixed Use

Figure 5.23 - Building Massing Broken Up into Smaller Components

Figure 5.24 - Outdoor Dining Area

Figure 5.25 - "Personalized" Outdoor Walkway/Lanai

5.3.3 Building Height

Building Height is measured from the highest point of the structure to a corresponding point directly below on natural or finish, whichever is lower (see section 19.04.040 in the Maui County Codes). Maximum building height is 4 stories 50 feet.

Figure 5.26 - Height Restriction

5.3.4 Roofs

The following design guidelines for roofs shall apply to commercial buldings:

- Where sloped roofs are employed, overhangs should exceed 30" in depth as a minimum.
- A single monolithic roof mass should be avoided and smaller roof forms should be utilized to break up the roof mass.
- Gutters and downspouts should be incorporated into the design or concealed or decorative where possible. Copper or natural lead/tin coated finished are encouraged; however, long horizontal and vertical runs shall be avoided.
- Vents, mechanical equipment and solar panels shall be concealed where possible and shall not be located on the sloped portion of a roof. These elements shall be located in a roof well.
- Parapets should be tall enough to screen the roof top mechanical equipment from view.
- Commercial kitchen exhaust fans must be located in roof wells and not side mounted on an exterior wall.
- Acceptable materials include but are not limited to wood shingles or shakes, concrete tile roofs, metal roofs with at naturally weathered finish.
- The roof material, form, and color must be approved by the DRC.

Figure 5.27 - Smaller Roof Forms - Metal Roof

5.3.5 Walls

For commercial buildings, the following wall design guidelines shall apply:

Figure 5.28 - Stucco with Slight Texture

- Unbroken vertical walls over 2 stories in height shall be avoided.
- Walls over 16 feet in height should be stepped or battered.
- Change in wall materials are encouraged to add character to the building. Changes in materials must occur on an inside corner of a building, and never on an outside corner of a building.
- The color of the exterior walls should be tasteful and should blend in with the built and natural environment.
- Acceptable materials include, but are not limited to, natural stone, integral color cement plaster with a slight texture, stained concrete, and wood siding.
- Where heavy materials like stone and concrete are used, the wall thickness should be more than 10 inches, in these cases windows and doors should be recessed at least 6 inches from the exterior plane.
- Where stone walls are used, all openings shall have a lintel incorporated above it.

5.3.6 Doors and Windows

Similar to the residential architectural guidelines, commercial buildings shall adhere to the following:

- Reflective glass should be avoided in the door and window systems.
- Where multi-pane systems are used, true divided lights should be used.
- Windows and doors within a stone or concrete wall should be recessed at least 6 inches from the exterior face. The trim and molding in these applications should be kept to a minimum.
- The window and door system should emphasize the importance of the space.
- Acceptable materials include, but are not limited to, stained or painted wood, aluminum clad systems (painted or anodized). The door and window color should compliment both the primary building color and the natural surrounding environment.

5.3.7 Color

Similar to the color guidelines for residential structures, mixed use and commercial building colors shall meet the following guidelines:

- Exterior materials and paint colors shall not exceed a value or chroma of 6 as indicated on the Munsell color system.

- The color of the roof generally should be darker than the body color of the building.
- Accent colors are encouraged but should not compete with the primary dominant color.
  - *Changes in exterior wall colors should be made at interior intersections of walls.*
- The color application and scheme should be consistent throughout the property.
- Exterior hardscape colors should be complimentary to the primary building color.
- The DRC will review and approve all color schemes.

5.3.8 Lighting

In addition to the Exterior Lighting standards (Section 5.7), retail areas should be well lit in the evening to make the spaces appear active. Lighting should emphasize the entrances to establishments, outdoor spaces and passageways. The following guidelines and codes shall apply:

- Reduce/ eliminate light pollution:
  - *Avoid up lighting walls.*
  - *Minimize light glare. The light fixtures should be angled to spotlight the tenant's merchandise and should not be angled in a way to cause glare and distracting reflections.*
- All outdoor lighting must be in compliance with Chapter 20.35, Maui County Code.

5.3.9 Services/Utilities

The following guidelines are applicable to the design of service entrances, loading docks, and related utilities that are necessary to support commercial uses:

- Service entrances and loading docks should be located in an areas not see by the public and should be visually screened.
  - *Where loading docks are adjacent to residential areas, measures must be taken to mitigate the noise levels.*
- Where possible, service paths should be separate from public paths.
- On-street loading areas should be avoided. Goods and services should be loaded into the business from the rear of the building, separate from the public entrance.
- Refuse collection areas shall be next to the loading areas and shall be screened from public view.
- "Food and beverage" establishments will require a refrigerated trash compactor at the loading/service area.
- Window mounted air conditioners are prohibited.
- Mechanical systems should be located in roof wells. Where mechanical systems are on grade, they should be pad mounted on isolators away from public view.

5.4 AUXILIARY STRUCTURES

Auxiliary structures include park pavilions, restrooms, maintenance buildings, gate houses, and related community utility structures.

All auxiliary structures shall be reviewed and approved by the DRC.

Depending on the location of the structure, the design guidelines and development standards of the location must be designed to blend into the surrounding landscape setting and, if appropriate, be visually screened from surrounding residences and community facilities.

Refer to Section 5.0 Architectural Design Guidelines, and Section 5.5 Zoning Sub-District Development Standards.

5.5 ZONING SUB-DISTRICT DEVELOPMENT STANDARDS

5.5.1 Single-Family Residential Sub-district

Minimum Lot Area: 7,500 square feet

Minimum Lot Width: 65 feet

Building Height Limit: 30 feet and two stories, except that vent pipes, fans, chimneys, antennae, and rooftop solar collectors may exceed such height limitation by not more than eight feet.

Limitation on Second Floor Area: On Individual Homesite dwellings with second stories, the total area of the second story shall not exceed 75 percent of the first story, including enclosed areas and covered lanais (as defined by the vertical support line), but excluding the garage, porte cochere, and similar vehicle structures. For the purpose of this calculation, the second floor area shall include all floor area and spatial voids (such as clear-story grand rooms, stairwells, etc.) at the second floor level.

Third floors shall not be allowed. Basements or non-habitable uses (such as wine cellars enclosed within foundation walls or underhouse structure shall be permitted as long as they are not visible, exposed, or accessible from outside of the structure.

Side Yard Building Setback and Wall Articulation: A minimum side yard building setback of six feet for one-story buildings and 10 feet for two-story buildings from the property line to the building wall will be required to provide sufficient space between adjoining residences for light, ventilation, landscaping, and privacy. Cantilevered roofs, soffits, roof eaves, and trellises may project up to four feet into the side yard building setback. In addition, building walls along the side yards will require articulation to avoid long uninterrupted walls. The minimum depth of such roof and wall articulations shall be four feet.

Fences, garden walls, or retaining walls within the side yard setback shall also be designed and land-scaped to avoid long, continuous, and uninterrupted wall segments, as they may be seen from sur-rounding properties.

Front and Rear Yard Building Setbacks: The minimum front yard building setbacks shall be 15 feet, and the minimum rear yard building setback shall be 10 feet. Buildings and walls facing the street and rear yard shall be articulated to provide a pleasant and properly scaled façade, avoiding large, uninterrupted, and out-of-scale facades. Garage openings shall not be allowed to face toward the street, unless ap-proved by the DRC due to special conditions (i.e. shallow lot depths). No buildings or structures, except fences and garden walls, may project into the front yard setback, and no buildings, structures, or walls may project into the rear yard setback. However, as permitted, cantilevered roofs, soffits, roof eaves, and trellises may project up to four feet into the front yard building setback.

5.5.2 Multifamily Residential Subdivision

Minimum Lot Area: 10,000 square feet

Minimum Lot Width: 70 feet

Maximum lot coverage ratio: 35 percent

Maximum floor area-lot area ratio: 90 percent

Building Height Limits: 50 feet and four stories, except that elevator shafts, air conditioning equipment, vent pipes, fans, antennae, and solar collectors may exceed such height limitation by not more than 10 feet;

Setbacks: The following setbacks shall apply to the uses and structures in the multifamily residential sub-district:

a. Front yard: one-story and two-story buildings shall have a minimum front yard of 15 feet, and three-story and four-story buildings shall have a minimum front yard of 20 feet.

b. Side yard: one-story and two-story buildings shall have a minimum side yard of 10 feet, and three-story and four-story buildings shall have a minimum side yard of 15 feet.

c. Rear yard: one-story and two-story buildings shall have a minimum rear yard of 15 feet, and three-story and four-story buildings shall have a minimum rear yard of 20 feet.

5.5.3 Village Mixed Use Sub-District

The Village Mixed Use Sub-District envisions a community center comprised of a mix or residential, commercial, and recreational and community facilities serving the needs of residents and guests. The intent of the Village Mixed Use Sub-District is to create community identity and character with land-mark buildings and a grouping of services within a central core that includes a mix of uses.

Minimum lot area: 6,000 square feet

Minimum lot width: 60 feet

Minimum yards: No yard setbacks shall be required, except:

a. That required for off-street parking.

b. If the lot abuts a lot in the single-family residential sub-district or the multifamily residential sub-district, the side or rear yard setbacks of the abutting district shall apply.

Maximum height: 50 feet or four stories, except that:

a. Elevator shafts, air conditioning equipment, vent pipes, fans, antennae, and solar collectors may exceed such height limitation by not more than ten feet.

b. The golf clubhouse structure may have a height not to exceed fifty-five feet, subject to design approval by the planning director.

Maximum lot coverage ratio: 35 percent

Maximum floor area-lot area ratio: 90 percent

5.5.4 Recreation and Open Space Sub-district

Uses and structures shall be permitted in the Recreation and Open Space Sub-District: athletic courts and fields, community recreation centers, golf course and driving ranges, greenhouses and nurseries, historic buildings and sites, open land recreation, parks, playgrounds, common open space areas, swimming pools, trails and bike pedestrian ways, wells and reservoirs.

Minimum front, side and back yards: 20 feet

Maximum height: 35 feet

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5.6 SPECIFIC ARCHITECTURAL DESIGN CONTROLS

5.6.1 Skylights

Skylights must be integrally designed into the roof structure and must not be obtrusive. Skylight glazing shall not be back-lit or manufactured of reflective material. Skylight framing and glazing shall be colored, tinted, or coated to match or blend with adjacent roof materials and configured to minimize reflectivity. Refer to Figure 5.29 – Skylights.

Figure 5.29 - Skylights

5.6.2 Solar Equipment

Solar power generating equipment is encouraged and should integrate with the architectural design of the roof structure. All solar designs must be reviewed and approved by the DRC. Refer to Figure 5.30 – Solar Equipment.

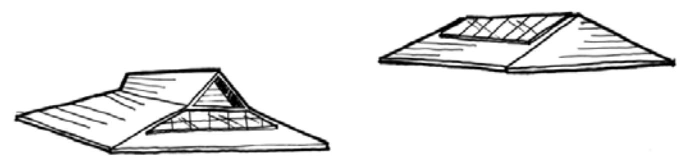

Figure 5.30 Solar Equipment

5.6.3 Foundation Walls and Underhouse Construction

To provide for a blending of the developed homesites with the natural landscape, all retaining walls, garden walls, exposed foundations, or other underhouse walls are encouraged to be of lava rock. Stained and sealed concrete is also acceptable. Other materials will be considered, provided the architectural concepts are subject to DRC review and approval.

To minimize a large extent of structure visible from below, the underhouse construction, including foundation and related retaining walls shall not exceed 10 feet in aggregate height from the top of the wall or finished floor elevation to the point of lowest contact with the finished grade. Posts and cross framing shall not be visible, and open lathwork shall not be used. The underhouse construction shall be treated as an integral part of the architectural expression.

5.6.4 Basements

Basements, with access and ventilation provided from within the Structure, shall be allowed. Basements that are partially exposed and visible on any elevation of the Structure shall be considered as part of the Single-Family Residence or Accessory building. .

5.6.5 Service Yards and Storage Tanks

Enclosed service yards shall provide space for garbage and trash receptacles and other maintenance utility (i.e. electrical transformer, air conditioning equipment, etc.) or service facilities to limit their visibility from neighboring properties or Common Areas and roadways. Tanks and mechanical equipment must be enclosed within the buildings or service yards. No service yards or equipment enclosures shall extend into a front or rear yard setback or special setback area. If a service yard is located within a side yard, the enclosure shall provide for sound attenuation through walls and underground vaults to minimize any noise audible from neighboring parcels. Solid noise-absorbing equipment covers may be required after installation if the equipment is audible from adjacent properties.

5.6.6 Impervious Surface Coverage

The total amount of impervious surface coverage, including buildings, paved lanais/patios, pools, walkways, and driveways, shall be limited to no more than 50 percent of the Individual Homesite lot area to provide a significant amount of landscaped area. Individual Homesites shall be well-landscaped with significant areas of landscaping to provide shade, texture, color, and natural transitions to the golf course and natural open spaces. Refer to Section 6 for landscaping guidelines.

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5.7 EXTERIOR LIGHTING

The light source of any exterior lighting shall not be directly visible from the common roadways, neighboring properties, or the golf course. An exterior lighting plan shall be submitted for review with the Plan Approval Drawings.

Exterior building lighting, either attached to or as part of the building, should be the minimum needed to provide general illumination and security of entries, patios, and outdoor spaces. Exterior site lighting must be directed onto vegetation or prominent site features, such as boulders or art pieces, and not upon the building. Lighting of plant materials shall be achieved by hidden light sources such as lamps recessed into the ground or hidden by plant materials. Refer to Figure 5.31 – Lighting Concepts. To preserve the dark sky, no uplighting is allowed. Only low voltage, incandescent lamps with a maximum of 25 watts may be used for all exterior lighting applications. With the exception of driveway lights, all lighting must occur within the building envelope. Subtle lighting of the driveway entry or address number is allowed. All exterior lighting is must be in compliance with Chapter 20.35, MCC.

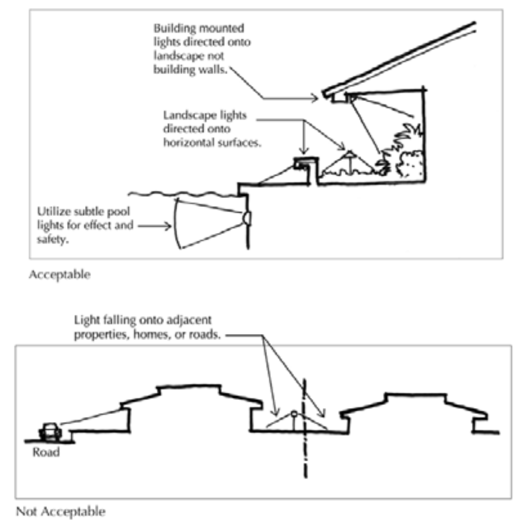


Figure 5.31 - Lighting Concepts

5.8 ENERGY AND RESOURCE CONSERVATION MEASURES

Site and building design along with construction techniques that utilize the latest advances in energy and resource conservation are encouraged. New building technologies, innovative building materials, thoughtful site planning, and creative construction systems can be used to create more energy-efficient, durable, and higher quality homes.

Ventilation and Solar Measures: Living areas such as living rooms, dining rooms, kitchens, and bedrooms should be planned for maximum ventilation. The use of solar panels is encouraged to reduce energy consumption requirements.

Resource Efficiency Measures: Building construction and design should emphasize efficient building practices and the reuse and reduction of materials. Recycling of materials should be maximized. Building designs should include adequate space for recycling bins in kitchens, utility areas, and trash enclosures. As required by County of Maui building codes, all buildings shall utilize high-efficiency (low flow) showerheads, toilets, faucets, and similar appliances.

Building Design Measures: Consideration should be given to increasing the required insulation in walls, ceilings, and foundations to reduce energy consumption and lower utility bills.

6

LANDSCAPE GUIDELINES

6.1 EXISTING LANDSCAPE

The existing landscape within Honua'ula shall be preserved and enhanced by using native plants whenever possible to make a seamless transition between the natural and introduced landscape. Areas adjacent to the golf course and natural drainageways, is intended to be preserved during all site development, homesite grading, and improvement construction, while providing the ability of Individual Homesite owners to maintain views.

As designated on the Homesite Diagrams and established as an easement in favor of the Association, the Association Landscape Easement area (see below) will be maintained by the Association in a relatively natural state. As described below, a Landscape Transition Area of a Lot shall be maintained in a manner consistent with the landscape of the Association Landscape Easement, unless this area is disturbed during site improvements. Individual Homesites fronting the golf course shall provide informal plantings of native vegetation within the Landscape Transition Area to create a natural landscape transition area to the golf course, while also preserving views.

6.2 PLANTING

The purpose of planting is to utilize appropriate plant species and densities to create an informal, naturalistic communitywide landscape that will allow buildings and other improvements to rest graciously upon the land. New plantings should frame views, lessen the impact of new structures, and screen use areas. Planting should also limit the amount of landscaping requiring intensive irrigation.

The use of larger specimen trees is preferred in areas close to the house, in the rear and front yard, to help blend buildings and roof massing with the site, accentuate entry areas, provide for climate amelioration, and help define outdoor spaces.

Planting of trees must take into consideration views from adjoining homesites. Where designated on the Homesite Diagram as a Restricted Structure and Landscape Area, structures and landscaping shall be restricted as described below. The use and/or quantity of tall palms or large canopy trees may be restricted where views from other homesites may be impacted.

Association Landscape Easement

Association Landscape Easement (ALE) designated on Individual Homesites establishes the Special Setback and will be landscaped and maintained by the Association in a relatively natural condition. This portion of the Lot shall not be disturbed, except for the establishment of paths or trails that may be approved by the DRC. No structures are permitted within this area. Any proposed modifications to the landscape within this easement shall be reviewed and approved by the DRC.

Restricted Structure and Landscape Area

As designated on the Individual Homesite Diagram, the height of structures (i.e. walls, fences, and accessory structures) and landscaping within Restricted Structure and Landscape Area (RSLA) of the building envelope and side-yard setback shall be limited to a maximum of four feet above the Approved Pad Elevation. The purpose of restricting the height of structures and landscaping within this area is to enhance views toward the ocean and golf course from adjoining properties and provide a visual transition from the residence to the surrounding open space and adjoining golf course.

The intent of the Restrictive Structure and Landscape Area (RSLA) is to use the area as an exterior extension of the home (i.e., infinity edge pools and related enclosed pool equipment, decks, walls and fences, and expanded at-grade landscaped areas). With the restriction on heights and improvements, and the desire to have this edge to be softened with the required landscape transition plantings, the DRC shall use the following guidelines to assess the appropriate nature of the proposed improvements within the RSLA: 1) no more than 50 percent of this RSLA shall be improved with retaining walls and related filled/elevated landscaped areas, pools, and decks; 2) the length of walls within this area shall not exceed approximately 50 percent of the lot width, as measured from the lowest edge of the building envelope as determined by the DRC, and 3) the walls and related landscaping shall be articulated and designed to provide a transition to the surrounding open space or golf course. All walls within the RSLA shall be field stone or similar volcanic stones from the region.

<u>Landscape Transition Area</u>
When abutting a natural or golf course transition area, landscaping shall incorporate native vegetation sparsely planted in informal clusters that will blend into the natural landscape. As delineated on the Individual Homesite Diagram, a Landscape Transition Area (LTA) should provide a natural landscaped transition from the arid golf course rough area and Association Landscape Easement area to the more intensively landscaped area of the Homesite.

<u>Side Yard Landscaping</u>
Landscaping within the side yard areas should be designed to maintain an open visual corridor between homes when viewed from the adjoining street. To the extent possible, privacy fences or garden walls should be designed in a manner to avoid multiple walls. Party wall agreements and a coordinated landscape planting plan are encouraged to provide side yard privacy between homes.

<u>Plant Materials</u>
Plant materials should envelope buildings and help complete structures and outdoor rooms. Shrubs may be used as informal low walls, vines may be used to fill in walls between structural components, and trees may be used to provide scale for building masses. In addition, all planting shall be in conformance with the Maui County Planting Plan.

Prohibited plants represent species with weed-like, or other, characteristics that are potentially destructive to indigenous plants.

6.3 PLANT HEIGHTS AND LOCATIONS

Shrubs or trees that grow to or cannot be easily maintained to heights of 25 feet are discouraged. Palms, including coconuts, that will mature to heights greater than 25 feet shall be used to frame views while not obstructing views from other homesites. All principal plant materials shall be subject to review and approval by the DRC. The landscape plan shall indicate the expected height of trees and palms when mature and shall be subject to design review and approval. As provided for in the Declaration, the Association may perform maintenance to sustain plant heights consistent with the approved plans and specified design heights of the plants. The Association may require an owner to enter into a maintenance agreement for any approved landscaping that may grow above the approved design height.

Plant materials shall be located so that the mature spread of the plant will not overhang the adjacent property.

Individual Homesite landscaping shall be reviewed and approved by the DRC for consistency with the community design philosophy to break up building massing and provide views from offsite and from buildings within.

6.4 IRRIGATION SYSTEMS

The landscape design and irrigation system design (non-potable systems) for each Individual Homesite shall minimize water usage by selection of appropriate plant material and water application methods (e.g., drip irrigation). The non-potable water usage limitations should be considered at the design stage. The landscape architect should design the Homesite landscaping consistent with the amount of non-potable water allocated for the Individual Homesite. To confirm that the landscape plan can be sustained with the allocated irrigation water (non-potable), the landscape architect shall submit the projected water usage calculation including total irrigated area and water surface area of pools, ponds or water features.

All irrigation systems shall be designed to use non-potable water and minimize water consumption.

Landscape irrigation systems shall utilize the non-potable brackish water provided to each Lot and shall require separate meters of a type approved by the Board. Depending on the overall operational requirements of the non-potable irrigation system, the Board may impose restrictions on when the non-potable system for the Individual Homesite may be operated. The Association may record the use of water indicated by the submeter for each Lot. Each Owner shall permit a representative of the Association to enter onto their property for the purpose of collecting data for records of water use.

The Board may impose other reasonable requirements and take other actions intended to restrict water usage in connection with any approval of plans and specifications for any improvements to be constructed and for any landscaping to be installed on any Lot including:

1. Restrictions of the kind of vegetation that may be included in any landscaping;
2. Restrictions on the total area of irrigated landscaping;
3. Require submission of anticipated water use calculations from a landscape architect as a condition to approval of any landscaping plan;
4. Restrictions on when the non-potable irrigation system may be operated.
5. Imposition of fines on Owner who violates the water use restrictions set forth in the Declaration;
6. Seeking legal and/or equitable remedies against any such Owners.

6.5 POOLS AND WATER FEATURES

Pools and water features should be designed as integral parts of the outdoor spaces and visually blend with the landscape. Landscaping should be selected and arranged to complement water features. Swimming pools and other water features shall be within the building envelope and screened with low landscape walls and/or plantings to minimize their visibility.

Pool enclosures, as required by County or other ordinances, are required, and design solutions that eliminate the need for pool fences are encouraged. Lava rock and darker colors must be used on exposed walls or surfaces of infinity pools visible from off-site. All pools and water features with infinity edges visible from Common Areas or other homesites are required to comply with the general design guidelines depicted in Figure 6.1 – Infinity Edge Design Guidelines.

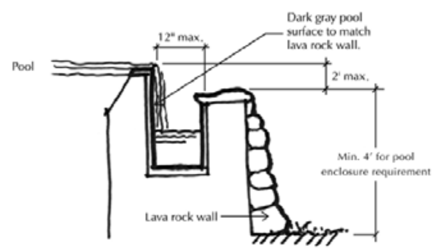


Figure 6.1 - Infinity Edge Design Guidelines

Equipment for pools and water features should be located behind walls or in underground vaults to contain noise. Solid noise absorbing covers for equipment may be required after installation if it is discovered that the equipment is audible from adjacent properties.

To minimize the reflection of sunlight from swimming pools, large water areas, ponds, etc., water features shall be designed to limit their visibility from homesites and the golf course through the use of architectural or natural materials. Water features (other than a swimming pool of reasonable size) may be disallowed if the DRC determines the resulting water usage to be excessive.

6.6 FENCES AND GARDEN WALLS

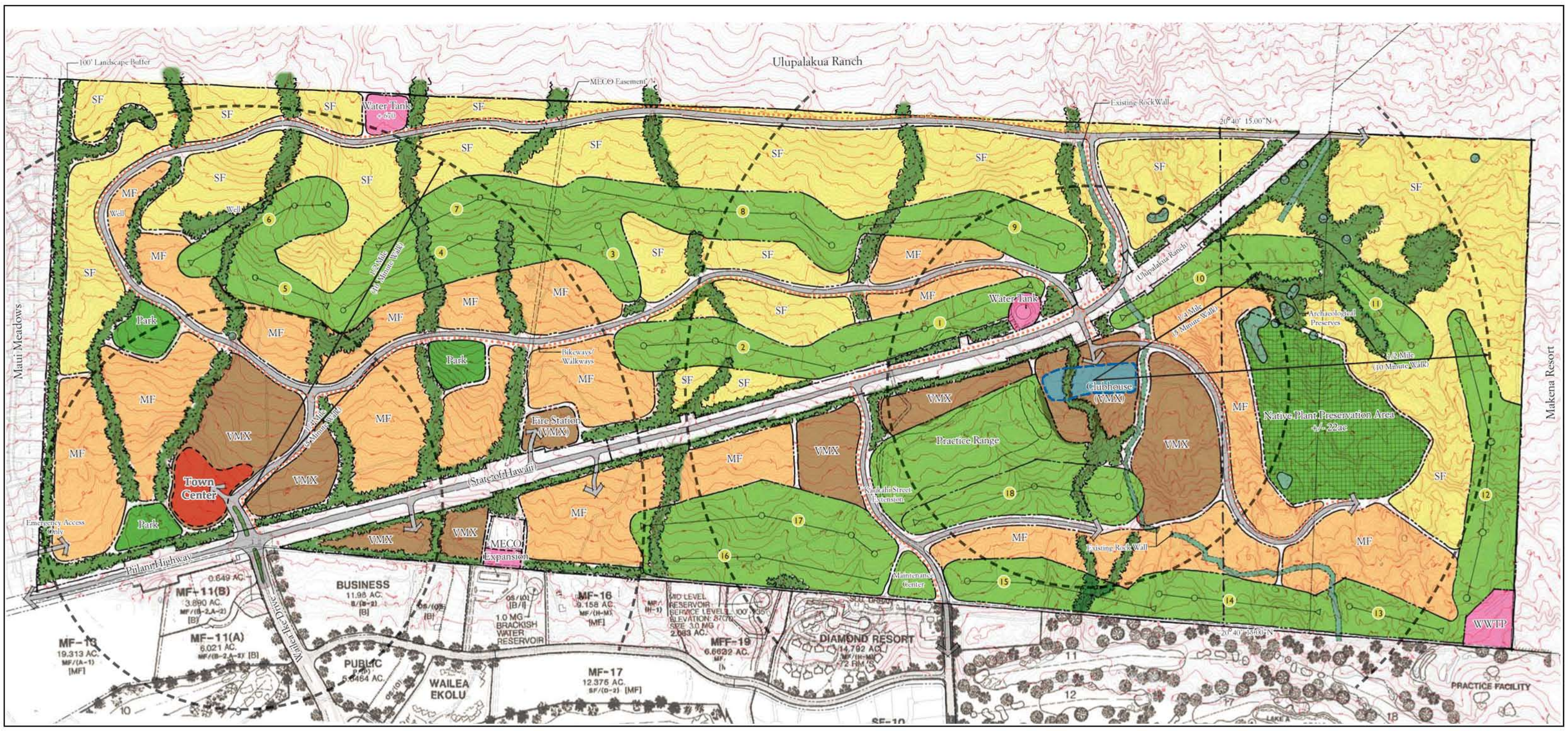
All fences or garden walls shall be designed as an integral part of the architecture and shall be subject to approval of building materials, color, and height, as described in Section 5 Architecture Design Guidelines. The maximum height of fences and garden walls shall be six feet, except for enclosures utilized for exterior courtyards or bathing areas within the building envelope area. A maximum height limit of eight feet shall be imposed on building envelope areas.

Fences or garden walls located within the front yard building setback shall be set a minimum of four feet from the property line and shall be articulated to avoid long continuous sections. The integration of landscaping with garden walls or fences in the front yard over four feet in height is required to soften and visually interrupt the monolithic appearance of the wall or fence.

Within side yards, privacy or security fences or walls should be coordinated with the adjacent Lot to avoid multiple walls or fences. Where possible, the use of a single wall or fence (with a party wall agreement) is encouraged.

6.7 PATH OR TRAILS

Any paths or trails proposed to be constructed within the Association Landscape Easement shall be a maximum of three feet wide, be located to minimize disturbance to the landscaping, and be used only as a footpath. The location and details of the path or trail shall be submitted to the DRC for review and approval.



LEGEND

Honua'ula

Residential Subdistricts

- SF Single-Family Residential
- MF Multi-Family Residential

VMX Subdistrict

- VMX VMX-Village-Mixed Use
- Town Center
- Clubhouse

Recreation, Open Space / Utility Subdistrict

- Golf Course, Parks, and Open Space
- Native Plant Preservation Area
- WWTP Utilities

Conceptual Master Plan - VMX Detail

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

NORTH

LINEAR SCALE (FEET) 0 300 600 1,200

Plan By: VITA PLANNING & LANDSCAPE ARCHITECTURE

PBR HAWAII & ASSOCIATES, INC.

Disclaimer: This graphic has been prepared for general planning purposes only.

Typical Hale Unit
Perspective View

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

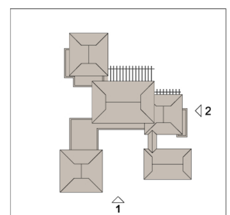
HKS
HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

Layout: Building H - Hale Unit - Perspective View AH00 (01-06-2010)
Disclaimer: This graphic has been prepared for general planning purposes only.

1 FRONT ELEVATION

2 SIDE ELEVATION



KEY PLAN

0 4' 8'
SCALE: 1/8"=1'-0"

Typical Hale Unit
Elevations

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

HKS
HILL GLAZIER STUDIO

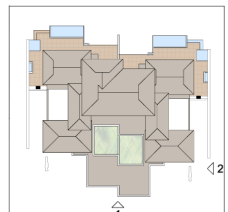
PBR HAWAII & ASSOCIATES, INC.

Layout: Building J - Hale Unit Type B - Elevations AJ501C (12-14-2009)
Disclaimer: This graphic has been prepared for general planning purposes only.

1 FRONT ELEVATION

2 SIDE ELEVATION

SCALE: 1/8"=1'-0"



KEY PLAN

Typical Duplex Units
Elevations

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

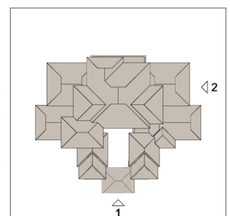
HKS HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

Layout: Building L - Duplex Units - Elevations AL501C (12-14-2009)
Disclaimer: This graphic has been prepared for general planning purposes only.

1 FRONT ELEVATION

2 SIDE ELEVATION



KEY PLAN

SCALE: 1/8"=1'-0"

Multi-Family Units 1
Elevations

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

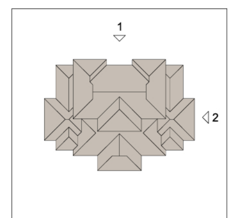
HKS
HILL GLAZIER STUDIO

PBR HAWAII
& ASSOCIATES, INC.

Layout: Building M - Elevations AM501C (12-23-2009)
Disclaimer: This graphic has been prepared for general planning purposes only.

1 BACK ELEVATION

2 SIDE ELEVATION



KEY PLAN

0 4' 8'
SCALE: 1/8"=1'-0"

Multi-Family Units 2
Elevations

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

HKS
HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

Layout: Building N - Elevations AN501C (12-14-2009)
Disclaimer: This graphic has been prepared for general planning purposes only.

VMX / Town Center
Perspective View

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

HKS
HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

Layout: Building B - VMX / Town Center - Perspective View AB00 (01-06-2010)
Disclaimer: This graphic has been prepared for general planning purposes only.

Conceptual Town Center Site Plan

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

NORTH

LINEAR SCALE (FEET)

0 15 30 60 90

VITA PLANNING & LANDSCAPE ARCHITECTURE

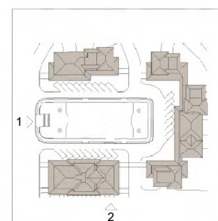
HKS HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

Layout: Building B - Town Center - Floor Plan AB201 (1-12-2010)
Disclaimer: This graphic has been prepared for general planning purposes only.

1 FRONT ELEVATION

2 SIDE ELEVATION



KEY PLAN

VMX / Town Center
Elevations (1 of 2)

Honua'ula

Honua'ula Partners, LLC
ISLAND OF MAUI

HKS
HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

Layout: Building B - VMX / Town Center - Elevations AB501 (12-23-2009)
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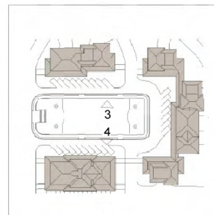
3 INTERIOR SQUARE ELEVATION

4 INTERIOR SQUARE ELEVATION



KEY PLAN

0 8' 16'
SCALE: 1/16"=1'-0"

VMX / Town Center
Elevations (2 of 2)

Honua'ula

Honua'ula Partners, LLC — ISLAND OF MAUI

HKS
HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

Layout: Building B - VMX / Town Center - Elevations AB502C (12-23-2009)
Disclaimer: This graphic has been prepared for general planning purposes only.

Clubhouse and Amenity Buildings
Perspective View

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

HKS
HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

Layout: Golf and Amenities Building - Perspective View AA00 (01-06-2010)
Disclaimer: This graphic has been prepared for general planning purposes only.

Conceptual Clubhouse and Amenity Buildings Site Plan

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

NORTH

LINEAR SCALE (FEET)

0 15 30 60 90

HKS
HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

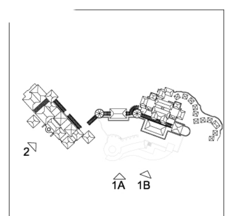
Layout: Golf Clubhouse Site Plan AA202 (1-12-2010)

Disclaimer: This graphic has been prepared for general planning purposes only.

1A ENTRY - MAKAI ELEVATION

1B FITNESS - MAKAI ELEVATION

2 GOLF CLUB ELEVATION



KEY PLAN

Clubhouse and Amenity Buildings
Elevations (1 of 2)

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

HKS
HILL GLAZIER STUDIO

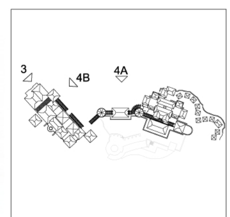
PBR HAWAII & ASSOCIATES, INC.

Layout: Golf and Amenities Building - Elevations AA501C (12-23-2009)
Disclaimer: This graphic has been prepared for general planning purposes only.

3 GOLF CLUB - SIDE ELEVATION

4A AMENITIES BUILDING - ENTRY ELEVATION

4B GOLF CLUB - ENTRY ELEVATION



KEY PLAN

Clubhouse and Amenity Buildings
Elevations (2 of 2)

Honua'ula

Honua'ula Partners, LLC

ISLAND OF MAUI

HKS
HILL GLAZIER STUDIO

PBR HAWAII & ASSOCIATES, INC.

Layout: Golf and Amenities Buildings - Elevations AA502C (12-23-2009)
Disclaimer: This graphic has been prepared for general planning purposes only.

Appendix B

Groundwater Resources Assessments

Groundwater Resources Assessment

Assessment of the Potential Impact on Water Resources of the Honua'ula Project in Wailea, Maui

Prepared for:

Honua'ula Partners, LLC
P. O. Box 220
Kihei, Maui, Hawaii 96753

Prepared by:

Tom Nance Water Resource Engineering
680 Ala Moana Boulevard - Suite 406
Honolulu, Hawaii 96813

February 2010

Table of Contents

List of Figures

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Introduction

This report presents an assessment of the potential impact on water resources of the Honua'ula project which will be located on approximately 670 acres on TMK 2-1-08:56 and 71 in Wailea, Maui (its location is shown on Figure 1). Figure 2 illustrates the development plan and Exhibit 1 provides a detailed land use summary by its three phases of development. The land uses include 1150 residential units, a golf course, commercial and community facilities, parks, and preservation-conservation areas. The projected is bisected by a right-of-way (ROW) for the proposed extension of Piilani Highway.

Aspects of the Project That Will Impact Water Resources

Four aspects of the project have the potential to impact water resources. These are: use of groundwater for potable consumption and landscape irrigation; generation, treatment, and reuse of domestic wastewater; increase of surface water runoff; and percolation to groundwater of excess landscape irrigation. Each of these is described and quantified in the sections below.

Use of Groundwater. The project's potable and irrigation supply will be provided by brackish wells. Four of these wells have already been developed, two onsite and two others offsite on the north side of Maui Meadows (Figure 1 shows their locations). The offsite wells are referred to herein as the Kamaole wells. Table 1 provides a compilation of the expected use of brackish groundwater by development phase. This compilation incorporates the following assumptions:

- Reverse Osmosis (RO) treatment of the brackish supply will provide the project's potable water. Sixty-five (65) percent of the feedwater supply would be converted to potable water and the remaining 35 percent would be a concentrate that would be reused for golf course irrigation.
- Domestic wastewater will be treated to R-1 quality and it will be reused for golf course irrigation.
- Landscape irrigation in areas outside of the golf course will be supplied by brackish well water.
- An allowance of 10 percent for unmetered use and losses is included in the calculations of potable and brackish irrigation requirements.

Based on these assumptions, year-round average pumpage of brackish groundwater is estimated to be 1.1, 1.4, and 1.7 million gallons per day (MGD) at the completion of Phases 1, 2, and 3, respectively. To provide for summertime maximum use periods and to have standby capacity, another offsite well will be needed for Phase 1 and one more will be needed for Phase 2. The total number of the project's wells would then be six. Depending on the actual water use rates that materialize, a fifth Kamaole well may or may not be needed to complete Phase 3.

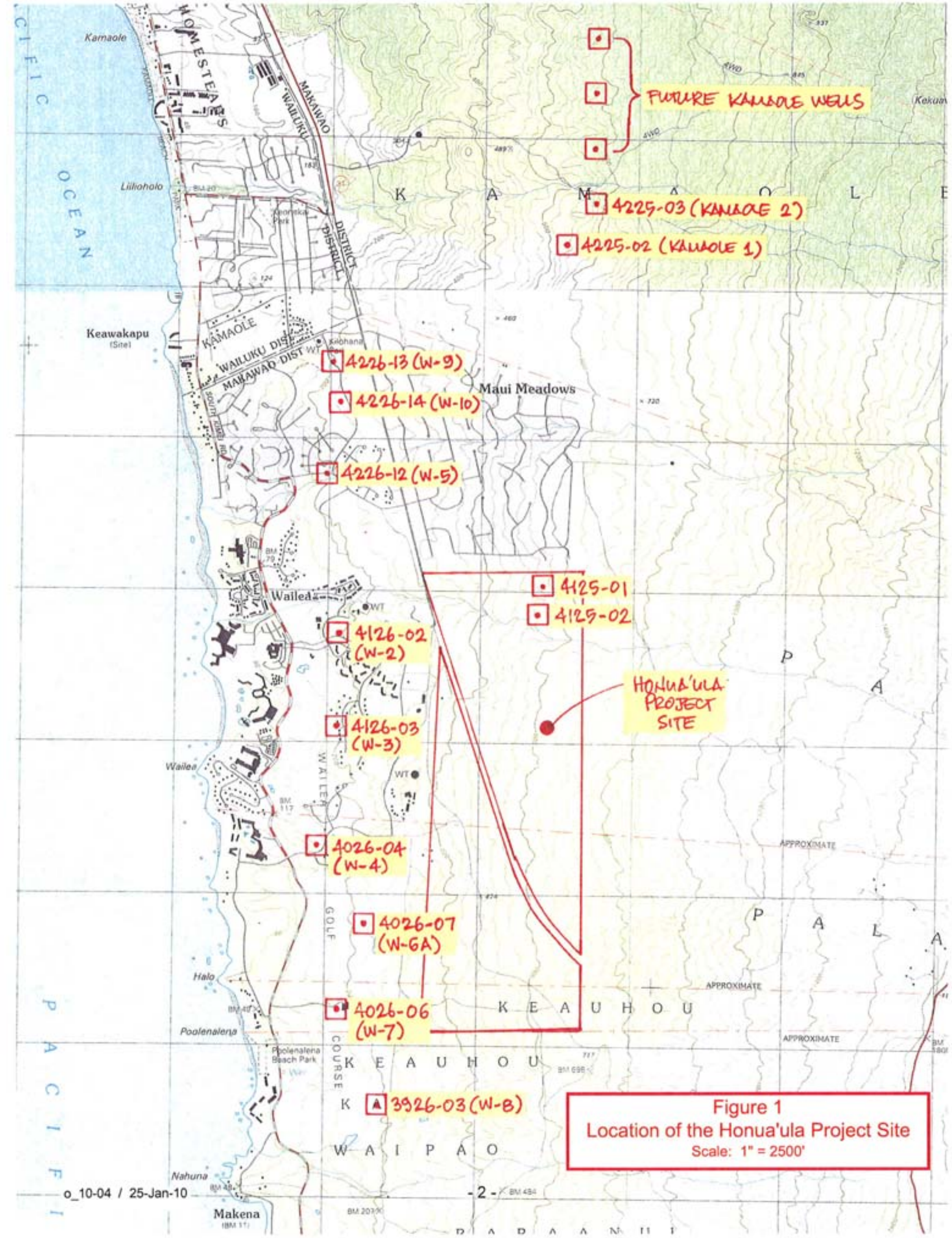


Figure 1
Location of the Honua'ula Project Site
Scale: 1" = 2500'

Exhibit 1
Page 1 of 2

Honua`ula Preliminary Land Use Summary

DRAFT November 20, 2009

(Information taken from the VITA Concept and Phasing Plans dated 12/1/2009)

Phase 1 -

Zone 640

Land Use Types	Approx. Unit Count	Approx. Roadway / Landscape Buffer Lineal Footage (L.F.)	Approx. Land Area (Acre)
SF Type A - Custom	21	--	12.2
SF Type B - Hale	53	--	29.2
SF Type C - Cottage	62	--	32.5
MF Duplex	40	--	16.9
MF Affordable Housing	75	--	10.5
Parkway (100' ROW)	--	250	0.6
Major Collector Road (60' ROW)*	--	7,150	10
Minor Collector (56' ROW)	--	--	0
Minor Street (44' ROW)	--	2,200	2.2
25' Landscape Buffer Along Piilani Highway	--	850	0.5
Mixed-use Village	--	--	7
Golf Course Envelope	--	--	105.3
Puplic parks	--	--	0
Piilani Highway Extension (150' ROW)	--	--	0
Fire Station	--	--	0
MECO Expansion	--	--	0
Golf Clubhouse	--	--	10
Golf Maintenance Yard	--	--	1.8
Native Plant Preservation Area	--	--	22
Water Tank Site	--	--	0
Waste Water Treatment Plant	--	--	2
Natural Open Area (Drainage Detention, Arch. Preserve, etc.)	--	--	3.1
		Land Area Subtotal :	265.8

Zone 810

Land Use Types	Approx. Unit Count	Approx. Roadway / Landscape Buffer Lineal Footage (L.F.)	Approx. Land Area (Acre)
SF Type A - Custom	22	--	12.8
SF Type B - Hale	60	--	32.9
SF Type C - Cottage	46	--	19.1
MF Duplex	16	--	5.6
MF Affordable Housing	0	--	0
Parkway (100' ROW)	--	0	0
Major Collector Road (60' ROW)*	--	4,850	6.7
Minor Collector (56' ROW)	--	--	0
Minor Street (44' ROW)	--	0	0
25' Landscape Buffer Along Piilani Highway	--	0	0
Mixed-use Village	--	--	0
Golf Course Envelope	--	--	65
Puplic parks	--	--	0
Piilani Highway Extension (150' ROW)	--	--	0
Fire Station	--	--	0
MECO Expansion	--	--	0
Golf Clubhouse	--	--	0
Golf Maintenance Yard	--	--	0
Native Plant Preservation Area	--	--	0
Water Tank Site	--	--	1.8
Waste Water Treatment Plant	--	--	0
Natural Open Area (Drainage Detention, Arch. Preserve, etc.)	--	--	8.5
		Land Area Subtotal :	152.4

Phase 2 -

Zone 640

Land Use Types	Approx. Unit Count	Approx. Roadway / Landscape Buffer Lineal Footage (L.F.)	Approx. Land Area (Acre)
SF Type A - Custom	11	--	6.4
SF Type B - Hale	0	--	0
SF Type C - Cottage	80	--	41.6
MF Duplex	114	--	28.6
MF Affordable Housing	200	--	18.7
Parkway (100' ROW)	--	--	0
Major Collector Road (60' ROW)*	--	5,000	6.8
Minor Collector (56' ROW)	--	--	0

Zone 810

Land Use Types	Approx. Unit Count	Approx. Roadway / Landscape Buffer Lineal Footage (L.F.)	Approx. Land Area (Acre)
SF Type A - Custom	--	--	0
SF Type B - Hale	--	--	0
SF Type C - Cottage	--	--	0
MF Duplex	6	--	1.7
MF Affordable Housing	--	--	0
Parkway (100' ROW)	--	--	0
Major Collector Road (60' ROW)*	--	--	0
Minor Collector (56' ROW)	--	--	0

Minor Street (44' ROW)	--	--	0
25' Landscape Buffer Along Piilani Highway	--	6,000	3.4
Mixed-use Village	--	--	0
Golf Course Envelope	--	--	0
Piilani Highway Extension (150' ROW)	--	4,000	15
Puplic parks	--	--	6
Fire Station	--	--	2
MECO Expansion	--	--	1
Golf Clubhouse	--	--	0
Golf Maintenance Yard	--	--	0
Native Plant Preservation Area	--	--	0
Water Tank Site	--	--	0
Waste Water Treatment Plant	--	--	0
Natural Open Area (Drainage Detention, Arch. Preserve, etc.)	--	--	5.5
	Land Area Subtotal :		**135**

Minor Street (44' ROW)	--	--	0
25' Landscape Buffer Along Piilani Highway	--	--	0
Mixed-use Village	--	--	0
Golf Course Envelope	--	--	0
Piilani Highway Extension (150' ROW)	--	--	0
Puplic parks	--	--	0
Fire Station	--	--	0
MECO Expansion	--	--	0
Golf Clubhouse	--	--	0
Golf Maintenance Yard	--	--	0
Native Plant Preservation Area	--	--	0
Water Tank Site	--	--	0
Waste Water Treatment Plant	--	--	0
Natural Open Area (Drainage Detention, Arch. Preserve, etc.)	--	--	0
	Land Area Subtotal :		**1.7**

Phase 3 -

Zone 640

Land Use Types	Approx. Unit Count	Approx. Roadway / Landscape Buffer Lineal Footage (L.F.)	Approx. Land Area (Acre)
SF Type A - Custom	2	--	1.2
SF Type B - Hale	0	--	0
SF Type C - Cottage	13	--	8.2
MF Duplex	15	--	5.2
MF Affordable Housing	175	--	12.5
Parkway (100' ROW)	--	0	0
Major Collector Road (60' ROW)*	--	0	0
Minor Collector (56' ROW)	--	0	0
Minor Street (44' ROW)	--	--	0
25' Landscape Buffer Along Piilani Highway	--	--	3
Mixed-use Village	--	--	0
Golf Course Envelope	--	--	0
Piilani Highway Extension (150' ROW)	--	--	0
Puplic parks	--	--	0
Fire Station	--	--	0
MECO Expansion	--	--	0
Golf Clubhouse	--	--	0
Golf Maintenance Yard	--	--	0
Native Plant Preservation Area	--	--	0
Water Tank Site	--	--	2
Waste Water Treatment Plant	--	--	0
Natural Open Area (Drainage Detention, Arch. Preserve, etc.)	--	--	3
	Land Area Subtotal :		**35.1**

Zone 810

Land Use Types	Approx. Unit Count	Approx. Roadway / Landscape Buffer Lineal Footage (L.F.)	Approx. Land Area (Acre)
SF Type A - Custom	25	--	14.6
SF Type B - Hale	68	--	39.6
SF Type C - Cottage	41	--	23.8
MF Duplex	5	--	1.7
MF Affordable Housing	0	--	0
Parkway (100' ROW)	--	--	0
Major Collector Road (60' ROW)*	--	6,100	8.3
Minor Collector (56' ROW)	--	0	0
Minor Street (44' ROW)	--	--	0
25' Landscape Buffer Along Piilani Highway	--	--	3.5
Mixed-use Village	--	--	0
Golf Course Envelope	--	--	0
Piilani Highway Extension (150' ROW)	--	--	0
Puplic parks	--	--	0
Fire Station	--	--	0
MECO Expansion	--	--	0
Golf Clubhouse	--	--	0
Golf Maintenance Yard	--	--	0
Native Plant Preservation Area	--	--	0
Water Tank Site	--	--	0
Waste Water Treatment Plant	--	--	0
Natural Open Area (Drainage Detention, Arch. Preserve, etc.)	--	--	3.5
	Land Area Subtotal :		**95**
	TOTAL LAND AREA :		**685**

* Approximately 1.5 acres major collector road ROW are in Ulupalakua Ranch property and they are irrigated by the project.
** The ROW of Highway Extension (approximately 15 acres) is within the land of State of Hawaii and Ulupalakua Ranch. They are irrigated by the project.

o_10-04 / 25 Jan-10

Table 1

Average Brackish Water Use by Development Phase

Component of Supply	Phase 1 (MGD)	Phase 2 (MGD)	Phase 3 (MGD)
Potable System			
Average + 10%	0.1474	0.2735	0.3766
Required Raw Water Supply (65% RO Recovery)	0.2268	0.4208	0.5794
Concentrate From RO for Golf Course Irrigation Reuse	0.0794	0.1473	0.2028
WWTP R-1 Effluent (80% of Average Potable Use)	0.1072	0.1989	0.2739
Golf Course Irrigation			
Average Use	0.7167	0.7167	0.7167
Supply From RO Concentrate	0.0794	0.1473	0.2028
Supply From WWTP R-1 Effluent (80% of Potable Use)	0.1072	0.1989	0.2739
Required Supplement From Non-Potable System	0.5301	0.3705	0.2400
Supply From Brackish Wells			
Feedwater to RO System	0.2268	0.4208	0.5794
Supplement for Golf Course Irrigation	0.5301	0.3705	0.2400
Supply for Non-Potable System (Average + 10%)	0.3623	0.6390	0.8908
Total Average Withdrawal From Brackish Wells	1.1192	1.4303	1.7102

o_10-04 / 25-Jan-10

Wastewater Generation, Treatment, and Reuse. Two alternatives are being considered for the treatment of the project's domestic wastewater: (1) use of the nearby Makena Resort's wastewater treatment plant (WWTP); or (2) constructing a new, onsite WWTP. In either case, treatment would be to R-1 quality and the treated effluent would be used for golf course irrigation. For 110 turf acres of golf course and driving range, irrigation is expected to be 0.72 MGD as a year-round average (refer to Table 2). As shown on Table 1, the portion provided by the WWTP effluent would be about 15 percent at the end of Phase 1 and increase to about 38 percent at full build-out.

Collection and Detention of the Project's Increase in Rainfall-Runoff. As identified in the February 2010 Preliminary Engineering Report by Wilson Okamoto Corporation (WOC, 2010), the tributary watershed above the project consists of almost 4000 acres. Runoff from this area, from the 670-acre project site, and from the 15-acre Piilani extension ROW drains through the Wailea Resort and its golf courses prior to discharging along the shoreline. In conformance with County drainage regulations, the project will utilize detention basins so that there will be no increase in the peak rate of stormwater runoff leaving the site as a result of the project's development.

To quantify the required stormwater retention volume, WOC, 2010 divided the project site into 27 drainage areas and did pre- and post-development rainfall-runoff analyses. All analyses were based on the 100-year, 24-hour storm event. For this hypothetical storm event, WOC, 2010 calculated the required detention volumes so for each basin that there would be no increase in the peak runoff rate. The combined detention storage volume was computed to be 76.56 acre-feet. WOC, 2010 proposes to meet this requirement with the installation of 26 stormwater detention basins with a combined storage volume of 81.6 acre-feet.

Each of the 26 proposed detention basins would have a drain outlet consisting, in part, of a vertical perforated pipe within a gravel mound which would act as a filter. In addition to reducing the peak runoff rate by detention storage, this configuration will also capture floatables and suspended solids in the basin, thereby reducing the sediment load in water released from the detention basins. Based on this proposal, the assessment herein assumes the pre- and post-development volumes of runoff leaving the project site are the same. As a consequence, it is also assumed that the volume of rainfall which percolates to groundwater is essentially unchanged. Seepage from the detention basins will actually increase the amount of percolation, but no credit for that is included in the analyses which follow.

Percolation to Groundwater of Excess Landscape Irrigation. Percolation of excess applied irrigation water will occur from the golf course and driving range, from irrigated landscaping in roadway and buffer areas, from parks and other landscaped public areas, and from the residential parcels. The quantities of applied irrigation as year-round averages by development phase are compiled below. As a first order approximation, it is assumed that 10 percent of the applied irrigation on the golf course (with close management of application rates) percolates to groundwater and that elsewhere, the excess application rate is 15 percent. The percolation quantities are included in the summary below.

Table 2

Estimated Golf Course Irrigation Requirement

Month	Rainfall (Inches)	Pan Evaporation (Inches)	Crop Requirement (Inches)	Supply Requirement	
				(GPD / Acre)	GPD for 110 Acres
January	3.13	5.06	3.182	3,484	383,221
February	1.75	5.30	4.250	4,653	511,845
March	1.63	6.50	5.522	6,046	665,037
April	0.89	6.74	6.206	6,795	747,414
May	0.57	7.74	7.398	8,100	890,971
June	0.41	7.72	7.474	8,183	900,124
July	0.31	7.98	7.794	8,533	938,663
August	0.37	8.05	7.828	8,571	942,758
September	0.51	7.60	7.294	7,986	878,446
October	0.47	6.36	6.078	6,655	731,998
November	1.18	5.68	4.972	5,444	598,798
December	2.24	4.76	3.416	3,740	411,403
Annual	13.46	79.49	71.414	6,516	716,723

Notes:
1. Rainfall is the average of Gages 260 and 260.2.
2. Pan evaporation is the average of Gages 361, 363.1, and 372.3.
3. In computing the crop requirement, plant evapotranspiration (ET) is assumed to be equal to pan evaporation and the rainfall is assumed to be 60% effective.
4. The required supply assumes 80% application efficiency. This accounts for leakage, overspray, and periodic salt flushing.
5. The total required supply assumes 110 turf acres of golf course and driving range will be irrigated.

Summary of Estimated Percolation to Groundwater of Excess Applied Irrigation

Component of Irrigation Supply	Phase 1 (MGD)	Phase 2 (MGD)	Phase 3 (MGD)
Non-Potable System (Brackish Well Water)	0.362	0.639	0.891
▪ Amount Percolating to Groundwater (15%)	0.054	0.096	0.134
Golf Course System			
▪ RO Concentrate	0.079	0.147	0.203
▪ WWTP R-1 Quality Effluent	0.107	0.199	0.274
▪ Brackish Well Water From N-P System	0.531	0.371	0.240
▪ Total Irrigation Application	0.717	0.717	0.717
▪ Amount Percolating to Groundwater	0.072	0.072	0.072
Total Percolation to Groundwater	0.126	0.168	0.206

Description of Water Resources in the Honua'ula Project Area

Overview. Owing to the relatively dry conditions in and above the project site, there are no perennial streams in the area. Runoff occurs in the mauka-to-makai gulches which cross the site only during and for a short time following intense rainfall events. This being the case, the assessment of impacts on water resources focuses primarily on groundwater.

The project site and its offsite wells are within the Kamaole Aquifer System, an 89-square mile area delineated and regulated by the State Commission on Water Resource Management (CWRM). The Kamaole Aquifer is triangular-shaped, with its apex at the top of Haleakala and its base along the 11-mile length of shoreline from Waiakoa Gulch on the north to Cape Kinau on the south. The Waiakoa Gulch boundary of the aquifer is coincident with the Wailuku-Makawao district boundary, but it is otherwise of no known hydrologic significance. The southern boundary of the aquifer is the southeast rift zone of Haleakala which is likely to be a barrier to groundwater flow.

As far as has been demonstrated by drilled wells and by geophysical soundings, groundwater in the Kamaole Aquifer exists as a basal lens from the shoreline as far inland as the 1700-foot contour. Groundwater pumpage from the aquifer is estimated to be a little more than four MGD (a number of active wells do not have reported use). Most of this pumpage is by the nine Wailea Resort and 11 Makena Resort brackish wells which irrigate a total of five 18-hole golf courses.

In 1990, the CWRM set the sustainable yield of the Kamaole Aquifer at 11 MGD. This was based on a computed groundwater recharge of 25 MGD and the assumption that 44 percent of the recharge could be withdrawn by wells without adversely impacting the integrity of the aquifer. Several far more

detailed and sophisticated studies on the aquifer's recharge have been completed since then. These suggest that the recharge amount on which the CWRM's sustainable yield is based is substantially underestimated (refer to the tally below). As such, these studies also indicate that the actual sustainable yield for the aquifer may be as much as 50 percent greater. The most recent of these studies is considered to be the most reliable. Using the results of the latest USGS study (Engott and Vana, 2007), the groundwater flowrate may be on the order of 3.4 MGD per mile. This rate is used in the section on impacts to groundwater following later in this report.

Studies With Computations of the Kamaole Aquifer's Recharge Since 1990

Study	Year	Computed Recharge	
		MGD	% of Precipitation
USGS Water Resources Investigations Report 98-04159 by Pat Shade	1999	24	21
Water Resource Review of the Kamaole Aquifer by Waimea Water Services, Inc.	2004	29	22
USGS Scientific Investigations Report 2007-5103 by John Engott and Thomas Vana	2007	37.4	37

The project's impacts to groundwater will occur in two geographically distinct areas: (1) beneath and downgradient of the project site itself; and (2) downgradient of the project's offsite Kamaole wells on the north side of Maui Meadows. The project site spans a 1.9-mile length of the coastline. Assuming lateral dispersion on the order of 10 degrees, the project's impacts may occur across a 2.3-mile section of the shoreline. Using 3.4 MGD per coastal mile, the pre-development groundwater flowrate discharging into the marine environment is assumed to have been on the order of 7.8 MGD. Five of Wailea Resort's nine golf course irrigation wells are within this potentially impacted zone. (Of Wailea's other four wells, three are to the north and downgradient of Maui Meadows and the fourth is to the south.) Table 3 identifies these five Wailea wells and provides a compilation of their average water quality based on annual sampling by Marine Research Consultants (Dr. Steven Dollar) since 1991. According to CWRM records, the draft of these five wells is about 1.4 MGD as a year-round average. Wailea's other four wells average about 1.0 MGD.

Two of the project's offsite Kamaole wells have been drilled and pump tested (Nos. 4225-02 and 4225-03). At least two and possibly a third well will need to be developed. These will be located north of the two existing wells. These four or five wells will span a 0.8-mile long length at about 580-foot elevation and may impact the groundwater flow along a 1.4-mile long shoreline segment. Again using 3.4 MGD per coastal mile, the pre-development flowrate may have been on the order of 4.8 MGD. Based on CWRM records, there are 20 wells in this potentially impacted downgradient area (refer to Table 4). Most of

Table 3

Averaged Water Quality Data of the
Five Wailea Resort Golf Course Irrigation Wells
Downgradient of the Honua'ula Project Site

Well		Averaged Data, 1991 to 2009								
Wailea Number	State Number	NO_3 (µM)	NH_4 (µM)	DON (µM)	TN (µM)	PO_4 (µM)	DOP (µM)	TP (µM)	Silica (µM)	Salinity (PPT)
2	4126-02	238	1.32	7.89	248	1.66	0.66	2.32	450	1.43
3	4126-03	236	1.71	16.63	254	2.16	0.62	2.77	569	1.22
4	4026-04	196	1.31	10.42	208	2.08	0.32	2.40	580	1.64
6 A	4026-07	174	2.00	25.16	201	2.13	0.54	2.67	538	1.40
7	4026-06	332	1.42	11.60	345	2.27	0.51	2.79	550	1.81
Average of the Five Wells		235	1.55	14.34	251	2.06	0.53	2.59	538	1.50

Notes:
1. Data from Marine Research Consultants based on annual sampling from 1991 to 2009.
2. The units of µM can be converted to milligrams per liter by multiplying by the atomic weight and dividing by 1000.
3. DON and TN are dissolved organic nitrogen and total nitrogen, respectively.
4. Similarly, DOP and TP are total dissolved phosphorus and total phosphorus, respectively.

Table 4

Wells in the Downgradient Area Potentially
Impacted by the Honua'ula Project's Offsite Kamaole Wells
(Information From the Files of the State CWRM)

State Well No.	Year Drilled	Casing Diameter (Inches)	Ground Elevation (Feet MSL)	Well Depth (Feet)	Current Use
4226-06	1949	6	?	59	None
4226-10	1951	8	?	63	None
4226-11	1956	10	?	157	?
4226-15	1999	6	77	105	Landscape Irrigation
4226-17	2002	6	52	59	Landscape Irrigation
4326-02	1946	8	?	23	None
4326-03	1947	8	?	34	None
4326-04	1948	7	?	103	None
4326-05	1955	8	?	47	None
4326-06	1949	8	75	110	None (Lost)
4326-07	1990	6	64	84	?
4326-09	2001	6	64	95	Landscape Irrigation
4326-11	2004	6	80	95	Landscape Irrigation
4326-12	2004	6	83	100	Landscape Irrigation
4327-01	1947	8	?	38	None
4327-02	1947	10	?	37	None
4327-04	1949	8	?	22	None
4327-05	1949	8	?	38	?
4327-06	1967	?	?	45	None
4327-07	2000	6	56	80	Landscape Irrigation

these wells are more than 50 years old and are no longer in use. However, at least six are relatively recent (installed since the 1990s) and were developed to provide landscape irrigation for condominium parcels. The total draft of these wells is likely to be in the range of 0.12 to 0.30 MGD as a year-round average.

Potential Impacts to Groundwater Downgradient of the Honua'ula Project Site

Table 5 is a compilation of the potential year-round average changes to groundwater flowrate, salinity, and nitrogen and phosphorus loading downgradient of the project after full build-out. In addition to the data and calculations presented previously, the following assumptions are incorporated into the results compiled in Table 5:

- Of the 1.7 MGD average draft from the project's wells at full development, about 25 percent or 0.43 MGD would be supplied by the two existing onsite wells (Nos. 4125-01 and -02).
- Of the site's 18 inches of average annual rainfall, the pre- and post-development portion percolating to groundwater will be essentially the same. For this analysis, it is assumed that this amounts to one-third of the rainfall amount (the remaining two-thirds will evaporate to atmosphere or become runoff). In comparison to pre-development conditions, the post-development portion percolating to groundwater will have increases of nitrogen and phosphorus of 20 and 2.0 μM, respectively.
- For all of the sources of supply used to irrigate the golf course and other landscaped areas, the portion percolating through the root zone will have a salinity increase of 10 percent and a 50 percent reduction of their nitrogen and phosphorus concentrations as a result of plant uptake and processes in the soil.
- The R-1 WWTP effluent reused for golf course irrigation will have 775 μM (10.85 mg/l) nitrogen and 165 μM (2.00 mg/l) phosphorus.
- On a long term basis, it is assumed that the salinity of the combined brackish well water supply is 0.95 PPT. With a 65 percent product recovery rate, the salinity of the remaining 35 percent, the concentrate for irrigation reuse on the golf course, will be 2.41 PPT.
- Essentially all of the nitrogen and phosphorus in the brackish water that is run through the RO treatment process will be contained in the 35 percent of the feedwater that becomes RO concentrate and is reused for golf course irrigation.

Table 5

Compilation of Potential Changes to Groundwater in the
Area Downgradient of the Honua'ula Project Site After Full Build-Out

Component of Flow	Flowrate (MGD)	Salinity (PPT)	Nitrogen (lbs / day)	Phosphorus (lbs / day)
Pre-Development Groundwater	7.8	1.00	228.3	5.217
Withdrawal by Onsite Well Nos. 4125-01 and -02	0.43	0.95	12.59	0.288
Percolation From the Project Site to Groundwater				
- Percolating Rainfall	No Change	No Change	0.14	0.0077
- Percolation From the Golf Course				
- RO Concentrate	0.0203	2.651	0.170	0.0010
- WWTP Effluent	0.0274	0.440	0.248	0.0114
- Brackish Water	0.0240	1.045	0.070	0.0004
- Applied Fertilizer Dissolved in Percolate	--	--	0.788	0.0066
- Percolation From Other Landscaped Areas				
- Brackish Water	0.1336	1.045	0.391	0.0022
- Applied Fertilizer Dissolved in Percolate	--	--	0.981	0.0082
Post-Development Groundwater				
- Amounts	7.5753	1.0062	218.498	4.9665
- Change Compared to Pre-Development Flowrate	- 2.9%	+ 0.62%	- 4.3%	- 4.8%

- Fertilizer applications in landscaped areas will be at three pounds per 1000 square feet per year for nitrogen and at 0.5 pounds per 1000 square feet per year for phosphorus. Of these applications, 10 percent of the applied nitrogen and 2 percent of the applied phosphorus will be carried in percolate below the root zone.

- In the hundreds of feet of travel by the percolate through the vadose zone (the unsaturated lavas between the ground surface and groundwater) and the thousands of feet of travel with groundwater to discharge at the shoreline, natural processes will remove 80 percent of dissolved nitrogen and 95 percent of dissolved phosphorus. These removal rates are based on the natural removal rates of the Kealakehe WWTP effluent which is disposed of in a shallow pit upgradient of Honokohau Harbor in Kona on the Big Island. At that location, vertical travel through the vadose zone is only about 50 feet and the movement in groundwater to discharge into the upper end of the harbor is about 3500 feet.

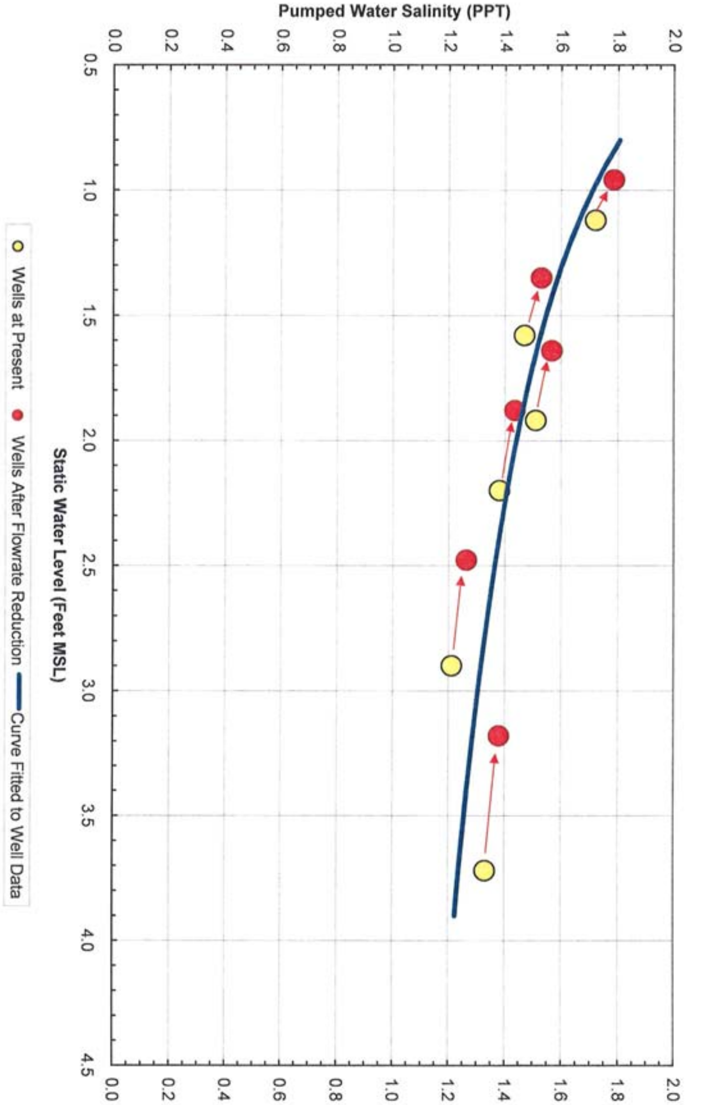
As shown on Table 5, the computed changes to groundwater are as follows: a 2.9 percent reduction in flowrate; a 0.6 percent increase in salinity; a reduction in nitrogen loading of 4.3 percent; and a reduction in phosphorus of 4.8 percent. The largest factor contributing to these results is that most of the groundwater supply (about 75 percent) will come from the offsite Kamaole wells. These calculations indicate that, with the possible exception of a salinity increase in Wailea Resort's Well 2 (No. 4126-02) which is downgradient of Honua'ula's two onsite wells, development of the project will not impair Wailea Resort's golf course irrigation.

Potential Impacts to Groundwater Downgradient of the Offsite Kamaole Wells

About 75 percent or 1.28 MGD of the project's brackish supply will be provided by the project's four (or five) offsite Kamaole wells. As indicated previously, the downgradient area that may be impacted by this pumping is a 1.4-mile long coastal segment with a pre-development groundwater flowrate that may have been on the order of 4.8 MGD. Pumpage of the project's Kamaole wells would reduce this flowrate by about 27 percent. Some salinity increase in the downgradient wells as a result of this flowrate reduction is almost certain to occur, particularly in those wells which are closest to the shoreline.

Figure 3 was created to provide an approximation of salinity increases in the six active wells. Static water levels and salinity data for these wells, as on file with the CWRM, are plotted on the graph and a curve fitted to these data was created. The groundwater level reduction can be expected to vary with the square root of the flowrate, meaning that a 27 percent reduction in flow is likely to create a 15 percent drop in static water levels. If the static level-to-salinity relationship remains as defined by the fitted curve on Figure 3, projected salinity increases may be on the order of five percent. If the actual impact impairs the utility of the downgradient landscape irrigation wells, additional Kamaole wells to distribute the draft over a greater area would alleviate this.

Figure 3. Relationship of Static Water Level to Pumped Water Salinity in Active Wells Downgradient of the Honua'ula Project's Kamaole Wells



Groundwater – Supplement Report July 16, 2010

TNWRE
Tom Nance Water
Resource Engineering

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Original ☑ will ☐ will not be mailed to you.

July 16, 2010
10-152 | 10-04

MEMORANDUM

To: Tom Schnell - PBR
Charlie Jencks - Honua'ula Partners

From: Tom Nance

Subject: Responses to the Planning Commission's Informational Request on Existing Wells in and Other Aspects of the Kamaole Aquifer (Comments 9, 10, and 11)

This memo and its attachments address requests made by the Planning Commission regarding existing wells and other aspects of the Kamaole Aquifer System.

Data For All Wells in the Kamaole Aquifer (Comment 10)

Figures 1 to 5 are maps which show the locations of all wells known to the State Commission on Water Resource Management (CWRM) in the 89-square mile Kamaole Aquifer System. Table 1 is the CWRM's listing of these wells with dates of construction, as-built dimensions, and reported water levels and chlorides as measured during initial sampling of these wells. There are a total of 134 wells in this table, many of which are more than 60 years old and no longer in use.

Inland to at least the 1700-foot elevation contour, groundwater in the aquifer occurs as a basal lens. The direction of groundwater flow in the basal lens is mauka-to-makai. For this reason, it is instructive to group the aquifer's wells in three categories: (1) Wells in the mauka-makai corridor that may be affected by the Honua'ula project's wells; (2) wells to the north that will not be affected by the project's wells; and (3) wells to the south that also will not be affected by the project's wells. Table 1 groups the aquifer's wells in these three corridors and Table 2 is a summary of the status of wells in the three mauka-to-makai corridors.

Figures 6, 7, and 8 depict pumpage information for wells in the Kamaole Aquifer that has been reported to the CWRM since January 2000. Figure 6 shows the pumpage of the nine active wells that provide irrigation supply for Wailea Resort's three golf courses. Pumpage reporting for these wells stopped in June 2007. Figure 7 is a similar depiction for the nine active Makena Resort wells that irrigate two golf courses. Its reporting of pumpage stopped in September 2009. Figure 8 depicts all other well

pumpage as reported to the CWRM. It amounts to just six wells, only three of which continue to report pumpage. In other words, only three of the 43 wells in the aquifer that are known or presumed to still be active (Table 2) are presently reporting their pumpage.

Figure 9 combines the pumpage totals on Figures 6, 7, and 8. During the period when reporting of the Wailea and Makena Resort wells was consistent, their combined total averaged 3.4 MGD. If other reported pumpage plus plausible estimates for other known or presumed active wells are added to the total for the golf courses, it appears that current total pumpage could be about 4.7 MGD but is probably closer to 4.0 MGD. Of this amount, about 1.9 MGD is occurring in the 3.8-mile wide mauka-makai corridor that may be affected by the Honua'ula project's existing and future wells.

Reporting to the CWRM of water levels and chlorides has been essentially non-existent. Only the three wells still reporting to the CWRM provide that information. For Well 4226-16 (Maui Kamaole AOAO), the chloride data is obviously incorrect (an order of magnitude less than actual) and depths to water are listed in the column where water level should be provided. For Wells 4326-11 and -12 (Ke Alii's two wells), the chlorides appear reasonable (1200 to 1350 mg/l), but depths to water rather than water level are reported.

Figure 10 illustrates data for the chlorides of the six most consistently used Makena golf course wells (chloride analyses were done in my office). These depict stable chlorides for a decade of monthly sampling.

"Level of the Transition Zone" for the Kamaole Aquifer (Comment 11)

The short answer to this comment is that no actual data exists on the aquifer's "level of the transition zone". No well has been drilled to sufficient depth through the basal lens to define the depth and character of transition zone anywhere in the aquifer. However, what is known or can be reasonably surmised regarding the transition zone is as follows:

- From the shoreline inland to the 1700-foot elevation contour across the Kamaole Aquifer, groundwater exists as a basal lens.
- Groundwater levels along the 1700-foot contour are about 6 feet above sea level (Well Nos. 4422-01, 4621-01, and 4622-02). That translates to the midpoint of the transition zone being about 240 feet below sea level.

- Wells along or just below the 600-foot elevation contour (Nos. 4125-01, 4125-02, 4225-02, 4225-03, 4424-01, 4425-01, and 4524-01) have water levels from 2.6 to 3.1 feet above sea level, indicating a mid-point of the transition zone between 100 and 125 feet below sea level.
- The stability of the transition zone, although obviously not directly measured, can be inferred from the stability of chlorides pumped by wells. Figure 10 provides the most accurate and complete record of this.

Need For a Monitor Well Before Production Wells are Utilized in the Kamaole Aquifer (Comment 9)

Nothing in the available data from wells across the entire aquifer and more specifically in the mauka-makai corridor that may be affected by the Honua'ula project's wells suggests that a monitor well is needed. Nevertheless, Honua'ula will construct its upgradient golf course monitor well to a depth that will allow it to also be used to monitor the transition zone below the basal lens. The well will be installed prior to the start of use of the project's production wells. Periodic profiling of salinity and temperature through the monitor well's water column will be done. These data will be used to track salinity in the basal lens and the movement, if any, of the transition zone.

Attachments

Table 1. CWRM Listing of All Wells in the Kamaole Aquifer System (No. 60304)

Well No.	Well Name	Owner/User	Year Drilled	Latitude	Longitude	Type	Case Dia. in.	Total Depth ft.	Ground Elev ft.	Bottom Solid Casing ft	Bottom Perf Casing ft	Bottom of Hole ft MSL	Static Head ft MSL	Chloride mg/l	Temp °F	Installed Capacity (MGD)	Use
WELLS TO THE SOUTH THAT WILL NOT BE IMPACTED BY THE HONUA'ULA PROJECT WELLS																	
3725-01	Moomuku 1 Cluc Inc.	Hawaii VIP Country	2004	203748	1562552	ROT	6	280	264	4	-16	-16	2.1			0.432	AGRCP
3726-01	Kanahena	Romachak E	1975	203719	1562626		4	31					0				IRR
3726-03	Millar	Millar C F	1985	203745	1562625		4	125	110			-15	1				IRR
3726-04	Kanahena-Erniss	Ernisse D & E	1990	203728	1562630	DUG	48	19						4		0.014	IRR
3824-01	Berkowicz		2005	203840	1562442	ROT	6	1322	1294	-8	-28	-28	5.16		77	0.065	MUNPR
3826-01	Seibu 2	Honua LLC	1978	203840	1562612	PER	12	222	200	6	-22	-22	2.21			0.576	IRRGC
3826-02	Seibu 3	Makena Resort Corp	1978	203841	1562612	PER	12	220	197	7	-23	-23	2.08			0.576	IRRGC
3826-03	Seibu 4	Makena Resort Corp	1978	203852	1562615	PER	12	228	205	7	-23	-23	1.58	1100		0.576	IRRGC
3826-04	Seibu 7	Makena Resort Corp	1985	203828	1562622	PER	12	195	173	128	45	-22	0			0.216	IRRGC
3826-05	Seibu 12	Makena Resort Corp	1989	203852	1562618	PER	12	231	203	10	-20	-28	2.57	1900			UNU
3925-01	Makena 68	State DLNR-Eng	1964	203912	1562559	ROT	8	382	352	9	-11	-30	0.8	465	21.4		OBS
3926-01	Makena	Garcia S	1972	203904	1562639	ROT	4	32						1080			
3926-02	Seibu 1	Seibu Haw Inc	1977	203932	1562613	PER	12	211	189	9	-21	-22	1.75			0.576	IRRGC
3926-03	Wailea 8	Wailea Golf LLC	1976	203947	1562613	PER	12	208	179	-1	-21	-29	1.57	666		0.504	IRRGC
3926-04	Seibu 5	Makena Resort Corp	1984	203922	1562611	PER	12	230	211	11	-19	-19	0			0.576	IRRGC
3926-05	Seibu 6	Makena Resort Corp	1984	203928	1562612	PER	12	224	200	6		-24		668		0.576	IRRGC
3926-06	Seibu 8	Makena Resort Corp	1988	203915	1562610	PER	12	263	244	11	-19	-19	1			0.576	IRRGC
3926-07	Seibu 9	Makena Resort Corp	1988	203945	1562607	PER	12	242	220	8	-22	-22	1			0.576	IRRGC
3926-08	Seibu 10	Makena Resort Corp	1988	203903	1562614	PER	12	290	266			-24	0.93				IRRGC
3926-09	Seibu 11	Makena Resort Corp	1988	203909	1562613	PER	12	278	258	10	-20	-20	2			0.288	IRRGC
3926-11	Makena Surf	Makena Surf Assoc	2002	203936	1562640	ROT	6	55	41	-4	-14	-14	0.93			0.331	IRRLA
4019-01	Polipoli Tunnel	Ulupalakua Rch		204049	1561958	TUN			6200								
4020-01	Waikaukane Tun	Ulupalakua Rch		204022	1562031				5750								
4020-02	Cornwall Tunnel	Ulupalakua Rch		204044	1562055				4850								
4020-03	Morton Tunnel	Haleakala Rch		204056	1562051				4850								
4021-01	Waikaahi Tunnel	Ulupalakua Rch		204054	1562104				4600								
4026-01	TMK 2-1-11-3	Churchill F	1950	204037	1562644		8	24					10.8				UNU
4026-02	Tmk 2-1-11-1	Polo Beach Club	1950	204042	1562644		8	32									IRR
4026-03	Makena	Harkins W	1951	204033	1562645		8	32	OTH								
4026-04	Wailea 4	Wailea Golf LLC	1972	204043	1562625	ROT	12	210	179	0	-21	-31	1.04	363		1.008	IRRGC
4026-05	Wailea 6	Wailea Res Co	1975	204022	1562626	PER	12	189	158	8	-12	-31	2	600		0.259	OBS
4026-06	Wailea 7	Wailea Golf LLC	1975	204007	1562622	PER	12	204	184	5	-15	-20	2	620		1.008	IRRGC
4026-07	Wailea 6A	Wailea Golf LLC	1994	204025	1562615	ROT	12	272	252	0	-20	-20	0.5	460	20.6		IRRGC
4026-13	Kea Lani Irr	KEA LANI MAUI	2002	204041	1562633	ROT	6	94	83	-2	-11	-11	0.9			0.331	IRRLA
WELLS WITHIN THE MAUKA-TO-MAKAI CORRIDOR THAT MAY BE IMPACTED BY HONUA'ULA PROJECT WELLS																	
4122-01	Keawakapu	Tavares H		204115	1562202											0.144	IRR
4125-01	Wailea 670 1	Palauea Part	1991	204137	1562534	ROT	10	559	522	-27	-37	-37	2.8			0.72	IRRGC
4125-02	Wailea 670 2	Palauea Part	1991	204131	1562535	ROT	10	550	523	-6	-26	-27	3.7			0.72	IRRGC
4126-01	Wailea 1	Wailea Res Co	1950	204137	1562637	PER	10	90	85		-5	-5	7	590	20	0.036	OBS
4126-02	Wailea 2	Wailea Golf LLC	1969	204128	1562621	PER	12	198	181	3	-17	-17	2	490		1.008	IRRGC
4126-03	Wailea 3	Wailea Golf LLC	1969	204108	1562622	PER	12	174	153	0	-20	-21	1	555		1.08	IRRGC
4126-04	Grand Wailea Salt		1991	204101	1562632		4	80								0.36	AGRAQ
4126-05	Wailea Ike Irr	Grand Champion Villas	2004	204138	1562616	ROT	6	206	189	-2	-17	-17	1.77		73	0.216	IRRLA
4225-01	Maui Meadows		2006	204227	1562516	ROT	14	802	763	-17	-39	-39	0.29		68.9		UNU
4225-02	Wailea 670 No. 1		2007	204251	1562529	ROT	12	581	545	7	-33	-36	2.22		69.9		UNU
4225-03	Wailea 670 No. 2		2007	204302	1562522	ROT	12	604	573	9	-31	-31	3.15		67.4		UNU
4226-01	Tmk 2-1-10-07	Correl A	1946	204212	1562650			41									IRR

Well No.	Well Name	Owner/User	Year Drilled	Latitude	Longitude	Type	Case Dia. in.	Total Depth ft.	Ground Elev ft.	Bottom Solid Casing ft	Bottom Perf Casing ft	Bottom of Hole ft MSL	Static Head ft MSL	Chloride mg/l	Temp °F	Installed Capacity (MGD)	Use
4226-02	2-1-10-05	Texeira J	1946	204213	1562650			45									IRR
4226-03	Tmk 2-1-10-04	Pabst W	1946	204215	1562651			31									IRR
4226-04	2-1-10-20	Crouse J	1946	204216	1562651			30									ABNSLD
4226-05	Tmk 2-1-10-01	Carter C	1949	204217	1562653		8	22									UNU
4226-06	Tmk 3-9-04-98	Tom Tf	1949	204255	1562649		6	59									UNU
4226-07	Tmk 3-9-04-75	Kurihara H	1951	204229	1562641		8	65									UNU
4226-08	Tmk 3-9-04-78	Kiyan S	1951	204231	1562643		8	75									ABNSLD
4226-09	Tmk 3-9-04-81	Teruya F	1951	204241	1562642		8	114									UNU
4226-10	Tmk 3-9-04-86	Kurihara H	1951	204249	1562647		8	63									UNU
4226-11	Tmk 3-9-04-125	Harada L	1956	204257	1562630		10	157									IRR
4226-12	Wailea 5	Wailea Golf LLC	1972	204201	1562624	ROT	12	202	179	0	-21	-23	1.04	1050		0.36	IRRGC
4226-13	Wailea 9	Wailea Golf LLC	1989	204227	1562622	PER	12	222	202	0	-20	-20	1.4			0.576	IRRGC
4226-14	Wailea 10	Wailea Golf LLC	1990	204218	1562620	PER	12	248	234	6	-14	-14		600		1.008	IRRGC
4226-15	Hale Kamaole Assc.	Hale Kamaole	1999	204247	1562646	ROT	6	105	77	-8	-28	-28	3.72		21.6	0.18	IRRLA
4226-16	Maui Kamaole AOAO	Maui Kamaole AOAO	2001	204225	1562637	ROT	6	155	129	4	-16	-26	0.23		70.5	0.331	IRRLA
4226-17	Kamaole Sands	Maui Vista AOAO	2002	204258	1562649	ROT	6	59	52	-1	-7	-7	2.2		72	0.216	IRRLA
4226-18	Maui Hill AOAO	AOAO Association	2003	204242	1562634	ROT	6	147	134	-3	-13	-13	1.18		70	0.216	IRRLA
4226-19	Kilohana Waena		2006	204232	1562633	ROT	6	135									UNU
4326-01	Tmk 3-9-20-26	Akina A	1945	204332	1562659		6	28									UNU
4326-02	Tmk 3-9-20-17	Akina J	1946	204324	1562658		8	23									UNU
4326-03	Tmk 3-9-20-14	Kuaana W	1947	204320	1562657		8	34									UNU
4326-04	Tmk 3-9-19-02	Shigeta D	1948	204312	1562640		7	103									IRR
4326-05	Tmk 3-9-20-20	Akina A	1951	204327	1562655		8	47									UNU
4326-06	Tmk 3-9-18-09	Lindley C	1959	204342	1562645		8	110	-19			-35					ABNLOS
4326-07	Kamaole-Bosa	Bosa Corp	1990	204306	1562642	ROT	6	84	64	0	-20	-20	2.9	60	22.2		IRR
4326-09	Kihei-Maui Vista	Maui Vista AOAO	2001	204346	1562654	ROT	6	95	64	-7	-27	-31	1.58			0.288	IRRLA
4326-11		Ke Alii , LLC	2004	204325	1562647	ROT	6	100	83	3	-17	-17	1.91		72.7	0.432	IRRLA
4326-12		Ke Alii , LLC	2004	204317	1562640	ROT	6	95	80	5	-15	-15	1.92		73.1	0.216	IRRLA
4326-13	Aloha Village		2005	204318	1562646	ROT	6	80	66	4	-14	-14	1.56		72.3	0.18	IRRLA
4327-01	TMK 3-9-16-25	Dang Y O	1947	204352	1562702		8	38									UNU
4327-02	TMK 3-9-17-37	Toba J	1947	204356	1562707		10	31									IRR
4327-03	TMK 3-9-05-51	Flood E	1949	204334	1562703		8	26									IRR
4327-04	TMK 3-9-05-25	Brown J	1949	204337	1562703		8	22									IRR
4327-05	TMK 3-9-05-22	Murphy F	1949	204341	1562704		8	38									OTH
4327-06	TMK 3-9-16-03	Machida S	1967	204352	1562705			45									IRR
4327-07	Kihei-Akahi	Kihei Akahi Condo Assc.	2000	204344	1562705	ROT	6	80	56	5		-24	1.12		73.4	0.216	IRRPA
4327-08	Kalama Beach A1		2009	204400	1562717	ROT	2	16									OBS
4327-09	Kalama Beach A2		2009	204400	1562717	ROT	2	45									OBS
4327-10	Kalama Beach A3		2009	204400	1562717	ROT	2	70									OBS
4426-02	Kihei Injection	Maui DPW	1974	204406	1562626	PER	18	230	109	-51		-121	4				OTH
4427-01	TMK 3-9-05-52	Maui County		204414	1562722												IRR
4427-04	TMK 3-9-11-38	Nishiji R	1949	204423	1562725		8	24									IRR
4427-05	TMK 3-9-02-02	Akina F	1950	204417	1562701		8	82									UNU
WELLS TO THE NORTH THAT WILL NOT BE IMPACTED BY HONUA'ULA PROJECT WELLS																	
4422-01	Waiohuli	U S G S	2001	204419	1562205	ROT	4	1940	1864	30	-60	-76	5.58				OBS
4424-01	Keokea Highlands 2	Maui Highlands Prop, LLC	2005	204459	1562502	ROT	8	577	553	-4	-24	-24	2.6			0.432	MUNPR
4425-01	Keokea Highlands	Maui Highlands LLC	2004	204459	1562502	ROT	6	570	551	1	-19	-19	2.76			0.432	MUNPR
4426-01	Kihei Inject TH	Maui Dpw	1972	204420	1562641	ROT	2	203									OBS
4426-03	Kihei-Maui R&T	Maui R&T Part	1990	204456	1562641	ROT	8	157	124	-3	-33	-33	1.87	369	20		IRRLA
4427-02	TMK 3-9-02-8	Akina F	1945	204429	1562707		8	30									UNU
4427-03	Medo	Miranda H	1948	204438	1562718		10	22									UNU
4427-06	Kihei Fire B1	2009	204416	1562722	ROT		2	16									OBS
4427-07	Kihei Fire B2	2009	204416	1562722	ROT		2	40									OBS
4427-08	Kihei Fire B3	2009	204416	1562722	ROT		2	70									OBS

Well No.	Well Name	Owner/User	Year Drilled	Latitude	Longitude	Type	Case Dia. in.	Total Depth ft.	Ground Elev ft.	Bottom Solid Casing ft	Bottom Perf Casing ft	Bottom of Hole ft MSL	Static Head ft MSL	Chloride mg/l	Temp °F	Installed Capacity (MGD)	Use
4427-09	Kihei Baptist Chapel	Kihei Baptist Chapel	1978	204433	1562721	DUG	20	15								0.021	IRRLA
4527-01	TMK 3-9-02-36	Akina R	1945	204529	1562716		6	30								0.17	AGRCP
4527-02	Tmk 3-9-02-32	Yee W	1946	204519	1562714		8	35									IRR
4527-03	Tmk 3-9-01-02	Perreira L	1947	204533	1562740		8	20									UNU
4527-04	Tmk 3-9-08	Maui County	1948	204504	1562737		7	47									UNU
4527-05	Tmk 3-9-08	Maui County	1948	204503	1562738			70									UNU
4527-06	Tmk 3-9-01-9	Teruya E	1948	204550	1562721		6	28									IRR
4527-07	Tmk 3-9-23-30	Uyeno H	1949	204540	1562717		8	42									UNU
4527-08	Kihei-Piilani	Blackfield Haw	1990	204544	1562711	ROT	10	71	41	3	-17	-30	0.75	27	23.3	0.057	IRR
4527-10	Kihei-Koa	Koa Res Assoc	1992	204555	1562737	DUG	24	14	7	0	-5	-7		335	24.4	0.043	IRRLA
4527-12	Waiohuli 1	Baldwin Malama	1989	204526	1562708	DUG	60	20									ABNSLD
4527-14	Kauhale Makai	Kauhale Makai	2001	204547	1562740	ROT	6	86	9	-48		-77	1.69		74	0.216	IRRPA
4527-16	St. Theresa Church		2007	204459	1562729	ROT	6	45	71							0.086	IRRLA
4527-17	Kihei			204513	1562716	DUG	66	11									UNU
4527-18	Kaonoulu 5		2007	204559	1562726	ROT	6	50	18	-2	-32	-32	3.14			0.086	IRRLA
4621-01	Kula 1800 No. 1		2007	204630	1562116	ROT	16	1832	1760	8	-72	-72	5.19		70.3		UNU
4621-02	Kula 1800 No. 2		2008	204638	1562114	ROT	16	1815	1737	4	-56	-78	6.31		70		UNU
4627-01	Tmk 3-9-01-24	Uehara T		204646	1562737												OTH
4627-02	Tmk 3-9-06-08	Ventura J	1946	204654	1562748		8	20								0.119	IRR
4627-03	Tmk 3-9-01-54	Ting L	1947	204628	1562734		10	29									OTH
4627-04	Tmk 3-9-06-07	Agirogi R	1947	204650	1562747		10	18									IRR
4627-05	Tmk 3-9-06-09	Watson H	1947	204655	1562748		10										IRR
4627-06	Tmk 3-9-06-13	Clark C	1947	204657	1562747		6	23									IRR
4627-07	Tmk 3-9-01-29	Pimental A	1947	204658	1562744		10	24									UNU
4627-08	Tmk 3-9-01-33	Hashimoto T	1948	204634	1562711		6	116									IRR
4627-09	Tmk 3-9-01-50	Gusukuma T	1948	204653	1562741		4	35									IRR
4627-10	Tmk 3-9-06-06	Fujimoto I	1948	204648	1562747		7	19									IRR
4627-11	Tmk 3-9-01-99	Alo S	1949	204626	1562733		8	19									IRR
4627-12	Tmk 3-9-15-12	Fedalizo C	1950	204642	1562738		8	31									IRR
4627-13	Tmk 3-9-15-14	Bosque J	1950	204643	1562738		8	29	20	9		-9	3.1				IRR
4627-14	Tmk 3-9-01-34	Hashimoto T	1969	204635	1562701	ROT		200	130			-70					IRR
4627-15	Tmk 3-9-26-43	Neubauer A	1969	204643	1562703	ROT	4	110									IRR
4627-16	Tmk 3-9-26-67	Batoon A	1969	204648	1562701	ROT	4	161									IRR
4627-17	Tmk 3-9-26-66	Tavares H	1969	204651	1562701	ROT	4	120									IRR
4627-19	Maui Lu	Maui Lu Resort	1956	204623	1562739	DUG											IRRLA

Table 2

Summary of the Status of Wells Pumping From the Kamaole Aquifer's Basal Lens

Categories of Well Status	Tabulation of Wells in Mauka-to-Makai Corridors			All Wells in the Kamaole Aquifer
	Wells to the South That Will Not Be Impacted by the Honua'ula Project's Wells	Wells That May Be Impacted by the Honua'ula Project's Wells	Wells to the North That Will Not Be Impacted by the Honua'ula Project's Wells	
Total Number of Wells	34	55	45	134
Wells Known or Presumed to be in Use	17	16	10	43
Wells Known to No Longer be in Use or Do Not Draw From the Basal Lens	11	20	16	47
Wells of Unknown Status Relative to Their Use	6	19	19	44
Estimated Average Pumpage in MGD	2.4	1.9	0.4	4.7

Notes:
1. Locations of all the wells are shown on Exhibit A and Exhibit B is a complete listing of all wells.
2. Wells known to no longer be in use or do not draw from the basal lens include: those listed as unused, abandoned, sealed, or lost in Exhibit B; high elevation tunnels which tap perched groundwater; wells used for observation only; and production wells not yet in service. This latter group includes the Honua'ula project's four completed wells.
3. Pumpage amounts were estimated from reported pumpage (Figures 1, 2, and 3) and assigning an average of 0.075 MGD for condominium and hotel irrigation wells and lesser amounts to wells serving smaller parcels.

Groundwater – Supplement Report July 20, 2010

TNWRE
Tom Nance Water
Resource Engineering

No. of pages: 3
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Original ☑ will ☐ will not be mailed to you.

July 20, 2010
10-157 | 10-04

MEMORANDUM

To: Tom Schnell - PBR
Charlie Jencks - Honua'ula Partners

From: Tom Nance

Subject: Cost of the Potable and Non-Potable Systems

This memo provides estimates of the cost to construct and operate the Honua'ula project's potable and non-potable systems in order to address Comment 17 of the Planning Commission. You can use Figure 4 in my December 2009 Water Systems master plan report in creating the map requested in Comment 12.

A number of assumptions had to be made to create cost estimates for the project's consumers at this stage of the project's planning. The most significant of these are:

- The analysis is based on full build-out of the project.
- The estimated potable and non-potable infrastructure cost is $21 million (refer to Table 1). Not included in this estimate are: construction and installed pumps in the two onsite wells (these were done in the early 1990s); and all onsite potable and non-potable pipelines throughout the project.
- The $21 million infrastructure cost is recovered in water sales at 6 percent over 20 years.
- Groundwater pumpage and RO treatment are 10 percent greater than actual water sales to account for leakage and unmetered use.
- Power for well pumps, booster pumps, and the RO plant is purchased from MECO at an average of $0.30/KWH.
- Pump efficiencies are 78 percent and the motors driving them are 87 percent efficient.

- Sixty-seven (67) percent of the feedwater through the RO plant is recovered as drinking water and 33 percent is concentrate which is reused for golf course irrigation.
- Costs for operating personnel, administration, and miscellaneous supply and maintenance will be 40 percent of the power to operate the pumps and RO plant.
- Purchase of non-potable (brackish) and RO-treated potable water by customers throughout the project will be distributed as follows:

Projected Water Sales in Average MGD

Water System	Service Pressure Zone		Both Zones
	640' Zone	810' Zone	
Potable	0.260	0.082	0.342
Non-Potable	0.556	0.254	0.810
Total for Both	0.816	0.336	1.152

Based on the foregoing set of assumptions, the daily operating cost for both systems in both service zones would be $3,000. The daily cost of capital recovery would be $4,950. Generally where dual water service is available, the sale price for potable water is about double the price for non-potable water. Using that as a guideline, the cost to consumers, with and without capital recovery and ignoring a profit to the utility, would be as follows:

Estimated Cost in Dollars Per Thousand Gallons

Cost Items Included	Potable Water	Non-Potable Water
Based on Operation and Maintenance Exclusively (No Capital Recover)	$ 4.00	$ 2.00
Based on Operation, Maintenance, and Full Capital Recovery	$ 10.64	$ 5.32

Attachment

Table 1

Estimated Cost of the Honua'ula Water System Infrastructure

Infrastructure Item	Amount
Construction and Testing of Kamaole Wells 1 to 4	$ 1,570,000
Outfit Kamaole Wells 1 to 4	3,000,000
Offsite Pipeline and Access Road, Wells to 640' Tank	6,500,000
RO Plant and Potable and Non-Potable Tanks at 640'	4,200,000
Potable and Non-Potable Booster Pumps at 640' Tank	500,000
Pipelines and Access Road, 640' to 810' Tanks	750,000
Potable and Non-Potable Tanks at 810'	1,850,000
Total for Construction	$ 18,370,000
Engineering and Construction Management	2,630,000
Total	$ 21,000,000

Appendix C

Golf Course Best Management Practices

DRAFT

BEST MANAGEMENT PRACTICES FOR THE HONUA'ULA GOLF COURSE

Prepared By:

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Wheaton, MD

Prepared for:

Honua'ula Partners, LLC

March 30, 2007
Revised March 4, 2010

EXECUTIVE SUMMARY

Honua'ula Partners, LLC is proposing to develop an 18-hole golf course in the Kihei-Makena region of south Maui. It would be located in the Wailea area, associated with 1150 homes and related amenities. The original project was approved for two golf courses by the Maui County Council in 1993 and the State Land Use Commission (SLUC) in 1994. The current project design is for an 18-hole homeowner's golf course and related facilities including a driving range and clubhouse.

The overall goal of this document is to reduce the turf chemical and water inputs required to manage the 18-hole golf course, and to minimize waste generation. This document exceeds the minimal requirement of SLUC approval condition #5 (Docket No. A93-689). This condition required compliance with the Hawaii Department of Health's (DOH) guidelines for new golf course development. The DOH published a much more comprehensive guidance document for new golf courses in November 2005, "Golf Course Best Management Practices." As of July, 2009, this is the first document developed to comply with the new draft guidelines. In addition, this document complies with a portion or all of condition numbers 12, 14, and 18, and it describes compliance with condition 20, pursuant to the County of Maui Ordinance No. 3554, 2008.

Design and Operations

The most important Best Management Practice (BMP) in this plan is the use of seashore paspalum throughout the golf course. Traditionally, Hawaii golf courses have used Bermudagrass, which presents an excellent playing surface under typical Hawaii conditions. However, the new varieties of seashore paspalum have the potential to reduce nitrogen requirements by two-thirds and reduce the needs for herbicides and fungicides.

Construction BMPs are recommended in nine subtopic areas, including site layout and erosion control. Guidelines are provided for irrigation operations and irrigation system design. Green waste (plant material) will be managed with a general goal toward sustainable development and operations. This document identifies 11 insects, 42 weeds, and 12 diseases that are potential pests; however, only seven of these are considered 'key' (i.e., they are likely to occur at infestation rates sufficiently high to require some combination of mechanical, chemical, and biological controls). The recommended pesticides were risk assessed in this document, which updates an assessment approved by the DOH in 1993. Six of the recommended pesticides are classified as "Reduced Risk" and/or 'natural'/'organic'/'biorational'. Detailed pest infestation thresholds are also provided (i.e., pest infestation densities that should be met or exceeded before pesticides are applied).

A facility operations manual is included as an appendix that should be consulted during the design and construction phases. It satisfies several of the State and County approval conditions as stated above and throughout this document.

Waste management and emergency response procedures are provided. Some general guidance for education and outreach are also provided.

Water Quality Monitoring

Ground Water. Tentatively, two monitoring wells are proposed for installation onsite. An existing irrigation well will also be sampled. Baseline sampling and semi-annual operational phase sampling will be done. Analytes will include pesticides and any relevant key metabolites, standard field parameters, nitrate, and inorganic substances relevant to the ongoing nearshore monitoring program described immediately below. The ground water monitoring program, as designed in the ground water monitoring protocol, satisfies conditions 18 'a' and 'b' of the Unilateral Agreement and Declaration for Conditional Zoning (Zoning Condition), and conditions 1-3 of the DOH's '12 Conditions' Applicable to all New Golf Course Development (1992, version 4; since amended with a condensed list of 10 guidelines/conditions; this project also complies with the newer version).

Nearshore Coastal Water. Six rounds (2005, 2006, 2008, and 2009) of baseline monitoring of nearshore coastal water and associated well water that specifically considers this project began in 2005. This was done in the context of related and indirectly related monitoring that was done in the same area in 1990 and from August 1995 to February 2003 for the Wailea Resort. Samples are collected from seven stations along each of five transects perpendicular to the shoreline (35 sampling locations). Analytes include nutrients and standard marine chemistry parameters. [This complies in part with Zoning Condition 20 and SLUC Condition 13.]

This BMP should be considered a 'living' document. Therefore it should be reviewed and revised - - if needed - - soon after the golf course is built, and every year or two thereafter.

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LIST OF FIGURES AND TABLES

INTRODUCTION & PURPOSE

Honua'ula Partners, LLC requested the preparation of this Best Management Practices (BMP) document adhering to the Hawaii Department of Health's "Golf Course Best Management Practices" guidelines (BMPs; DOH, 2005. See Appendix A.1.) to ensure this project is developed in an environmentally responsible manner. This document also satisfies the recommendations in "Guidelines Applicable to Golf Courses in Hawaii" (Version 6; DOH, 2002. See Appendix A.2.), and "Twelve (12) Conditions Applicable to all New Golf Course Development" ('12 DOH conditions;' Version 4; DOH, 1992. See Appendix A.3.). Compliance with the latter document is a State Land Use Commission (SLUC) approval condition (#5; Docket No. A93-689) as well as a County of Maui approval condition (#18[a-c], 2008). This document also specifically satisfies the County of Maui Ordinance No. 3554, 2008 conditions ("Conditions of Zoning"): 18 'a', 'b', 'e', 'f', 'h'; and, in part, it satisfies conditions 18 'd', 'g', and 'i' (Exhibit 2); and it describes compliance with condition 20. Parts of this document are also relevant to County conditions 12(b) and 14. These conditions are noted throughout the document and/or in the facility operations manual (Appendix B).

Thorough environmental considerations and scrutiny of developmental standards must be met so that the Honua'ula golf course is constructed with minimal impacts on the surrounding environment (terrestrial, ground water, and marine systems). An Environmental Impact Statement was completed by PBR Hawaii (EIS, 1988) in 1988 for the original project, which was proposed to contain two golf courses and approximately 2000 residential units. Pre-development aspects of this site have not changed significantly since 1988 (e.g., geology, hydrology, climate, flora and fauna, existing conditions, etc.). As part of the approval process for the previous, more intensive proposal, Environmental & Turf Services also developed and submitted the following: a water quality risk assessment, an Integrated Golf Course Management Plan© (IGCMP), and a ground water monitoring protocol. The first two products were submitted in one document in 1992 (Durborow et al.), and reviewed and approved by the DOH in 1994 (Appendix C). This current document comprehensively updates the 1992 submission, as well as the 1992 ground water monitoring protocol.

This BMP document has been written for the 2010 Project District Phase II permit submission, long before the first tee shot is hit. In order for this plan to be effective, we recommend that it be considered as a 'living' document. Accordingly, this should be revised during or shortly after (within six months) of the grow-in, and it should be revised again after two years of operation. This would enable site-specific conditions and activities to improve the relevance and feasibility of the BMP, which should aid in compliance and the attainment of the ultimate goal - - environmental protection.

PART 1: SITE SELECTION, DESIGN, AND CONSTRUCTION

The organization of this document follows the arrangement of the DOH BMP guidelines (2005) noted in the introduction above (Appendix A.1).

A. Site Selection

Honua'ula Partners, LLC proposes to develop a recreational golf community in the Kihei-Wailea-Makena region of the leeward side of south Maui. It would consist of one 18-hole golf course, 1150 residential units, and related facilities. The 670 acre project site is located on the lower slopes of Haleakala, immediately south of Maui Meadows, mauka of the Wailea Resort (Figure 1).

The soils on the site are primarily stony to extremely stony aggregated clays over fragmental aa lava. The site overlies a freshwater aquifer system most of which is below the Underground Injection Control (UIC) no-pass line. The ground water likely discharges to the ocean, and may flow within the zone of influence of at least five Wailea Resort irrigation wells. Also, runoff from peak storm events may hypothetically flow to the ocean, but this infrequent runoff will be mitigated by detention basins. Homes and other community buildings are proposed in locations that could be downwind of areas where pesticides may be sprayed (approximately 100-150 foot setbacks; Part 4: section E.3); however, the distances are relatively large, and proper development of pesticide application timing and scheduling will be completed to minimize risk of human exposure (Part 3: sections D & F; Part 4: sections D & E).

Honua'ula Partners, LLC will employ a qualified golf course superintendent with the capability to implement the best management practices (BMPs) described herein, and demonstrate sensitivity as it relates to environmental issues. This will include consistent compliance with federal, State, and County environmental regulations, on-site water quality monitoring of ground water resources, the protection of wildlife and environmentally sensitive areas, and continued leadership in addressing environmental concerns as it relates to public safety and overall environmental stewardship. In addition, nearshore marine environment monitoring is being done.

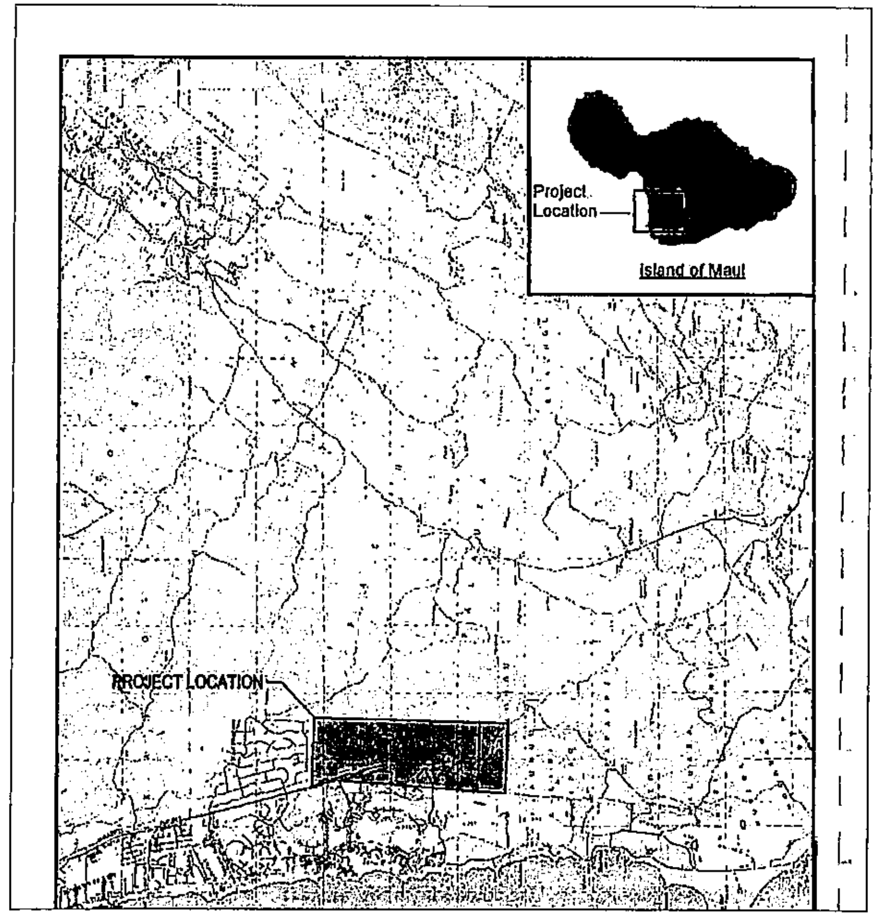

FIGURE 1. Project Site Location

B. Site Design and Management Goals

The goals of the design and management of the Honua'ula Golf Course are as follows:

1) Be leaders in environmental management and environmental monitoring.
2) Be protective of the physical and environmental resources of the site.
3) Develop pest management strategies with an emphasis on reducing the use of pesticides.
4) Provide water conservation materials and methods to maximize usage of water efficiently.
5) Hire and maintain qualified personnel sensitive to the environmental issues of the site.
6) Establish earthen berms and vegetative swales functioning as buffers to prevent surface discharge off the site.
7) Minimize the amount of waste products generated on-site as well as the exporting of materials off-site.

It is important, when possible, to maintain natural vegetation and wildlife habitat while incorporating the site design goals. The golf course will be designed to minimize impact on the surrounding environment and provide enhancement of ecological functions (i.e., buffer zones/strips, water features, natural topography, wildlife habitat). The site is currently characterized by a light to moderately dense growth of Kiawe trees and, to a lesser extent, Wiliwili trees. There are also meadow-type grasses and low shrubs. The makai side of the property is approximately one mile from the ocean.

The design and construction of the golf course will allow for structural elimination of many potential environmental problems. For example, there are no perennial streams on the project site, although there is evidence of soil erosion from rainwater runoff. The installation of turfgrass as a soil stabilizer and the shaping of land features to match intermittent gulches will assist in retaining soils, preventing movement off-site, and slow the movement of surface runoff. The transformation of the kiawe/buffelgrass pastureland into nodes of noninvasive turfgrass will result in better use of the existing land and provide a more diverse set of living spaces for plant and animal life. The incorporation of these environmentally conscious techniques into the design will maximize the overall environmental quality, playability, and aesthetics of the course.

Water use is an important consideration in the design of a golf course. Irrigation, drainage, and retention systems will be designed to provide efficient water usage while protecting water quality. Stormflow retention systems and water collection and reuse strategies will be incorporated into the overall management plan of the Honua'ula golf course in order to

provide for both short and long term irrigation needs while protecting the natural resources of Maui County (see also Part 2: Water Use, and Part 5: Surface and Ground Water Protection below).

C. Construction

This section specifically addresses the control of soil runoff during construction, which satisfies Zoning Condition 18 'i' in part (also condition 12 of the DOH's '12 Conditions' is satisfied below. See Appendix A.3.).

The primary concern throughout the construction process will be preserving existing natural resources, establishing healthy turfgrass as quickly as possible, and using construction methods (e.g., following USGA specifications and recommendations) that ensure environmentally sound management in the future (e.g., erosion controls, soil preservation, reducing compaction from machinery, etc.).

1. Surveying and Layout of Work

The project engineer or surveyor will be responsible for the initial location of boundaries, benchmarks, and control points with special concern given to delineating environmentally sensitive areas.

2. Sediment and Erosion Control

A National Pollution Discharge Elimination System (NPDES) permit will be obtained before construction of the golf course begins. Erosion control drawings and specifications will be provided by the contracted engineer as required by the County of Maui. Federal, State, and Maui County regulations and guidelines will be observed at all times.

The contractor will be responsible for the maintenance of all erosion control features (e.g., silt fencing, sediment ponds, etc.) during construction and for the removal of all such materials upon project completion. Dust control measures will also be used to prevent the migration of fugitive dust particles. Those measures include, but are not limited to, sprinkling water, provide barriers, and mulch where appropriate as to not interfere with turfgrass establishment (IDEQ, 2005).

3. Clearing, Grubbing, and Tree Protection

This work includes the satisfactory removal and disposal of grass, roots, rocks, unsalvageable trees and plants, brush, and stumps in areas designated for disturbance. Equipment will be limited to designated work areas, easements, and haul roads. Disposal of all debris will be done in accordance with all State and county regulations. Recycling, where feasible, for all these materials will be incorporated into the final design specifications.

All preserved plant material will be protected from injury to roots and tops by bright colored (e.g., orange) construction fencing placed 10 ft outside the dripline. No grading, trenching, or storage of machinery and materials will be permitted in these areas. Transplanting preserved plant material will be done by qualified nurserymen and/or arborists.

4. Topsoil Preservation and/or Selection

Topsoil is limited on the Honua'ula property. Good topsoil is critically important to grow and maintain healthy turfgrass. Every possible measure will be taken to preserve soils on this site and amend poor soils through fertilization, addition of organic matter and compost, and adjusting soil pH.

5. Earthwork and Rough Grading

All cuts and fills shall closely follow the designer's contour plans. Fill material shall be relatively clean of debris, suitable for grading, and compacted to ASTM D-1557 90% modified proctor (http://www.astm.org/Standards/D1557.htm) so that no future settling or sloughing occurs. All grading will be done in a manner such that no water-holding pockets are produced. Fairway and rough slopes should be no greater than 3:1, and green, tee, and bunker slopes should be no greater than 5:1 unless specified by the designer. Sufficient subsurface drainage should be installed if surface drainage is not possible. This will be completed under the direction of the contracted engineer(s).

6. Irrigation

Irrigation installation can begin once golf course features are rough graded. A functional irrigation system is essential to quickly establish healthy turfgrass. Poor irrigation during grow-in can eventually lead to the increased use of pesticides and fertilizers. All trenches must be

sufficiently compacted to prevent future settling and sprinkler heads can be installed above grade until final grades are established allowing irrigation installation to closely follow rough grading. The irrigation system will be designed, or at the very least, reviewed, by a qualified golf course irrigation consultant. Detailed irrigation specifications will be provided under a separate cover.

7. Fine Grading and Topsoil Cleaning

After topsoil is re-spread, all stones, roots, and debris greater than 3/4" in diameter will be removed by stone pickers, rakes, or other devices that do not disturb grade or create water-holding pockets.

The project will be coordinated so that finish work begins in the corners of the property, never allowing construction traffic to cross over fine graded 'finished' work.

8. Tees

Tees will be built to the designer's plans and specifications. Tee surfaces should be flat. This construction method requires internal drainage with the sub-grade pitched a minimum of 1% toward the drainlines. All tees will be built with the same rootzone mix used in greens to a depth of six inches.

9. Greens

The designer's instructions regarding greens specifications will be closely followed according to field drawings. The method of construction will conform to current United States Golf Association's (USGA) "Specifications for a Method of Putting Green Construction." Slope on the pinnable areas of the green shall not exceed 1.5%.

The USGA method of putting green construction is the standard of the industry. The method includes a very specific mixture of sand and organic matter with an underlying drainage system of gravel and drainpipe. The sand rootzone resists compaction, drains readily, and provides the ideal medium for healthy turfgrass if specifications are followed closely. Details of the construction methods are provided as Appendix D.

D. Physical Barriers

A complete archaeological reconnaissance survey has been completed on the Honua'ula project site. Honua'ula Partners, LLC has agreed that if subsurface remains such as artifacts, burials, or deposits of charcoal or shells are found during construction activities, that work will stop in the immediate vicinity or the find and the find will be protected from further damage. The State Historic Preservation Division will be contacted to assess the significance of the find and recommend appropriate mitigation measures, if necessary (EISPN, 2009).

PART 2: WATER USE

This section addresses Zoning Conditions 14 and 18 'd' (noted as condition 5 of the '12 DOH conditions'). It is important that the superintendent consider the results of the soil analyses (Appendix E) when planning the irrigation strategy.

A. Water and Ecological Conservation

Water conservation is central to the economic viability of the golf course. Water resources are important means by which a golf course maintains all essential functions. Therefore careful examination and monitoring of water usage must be appropriately maintained to reduce the impact on the surrounding environment. Turf selection, efficiently planned irrigation, water retention systems, and reuse plans are important design criteria considered while planning sustainable water use. These factors contribute to the overall consumption and discharge of water from the golf course, as well as the surrounding lands comprised within the Honua'ula property. All uses of water (including landscape features, indoor activities, chemical wash areas, maintenance areas, etc.) must be considered and properly managed to appropriately treat and divert runoff to detention basins or ponds whenever possible. Nonpotable water will be used, which satisfies Zoning Condition 14 (Exhibit 2)and condition 5 of the DOH '12 Conditions'.

B. Irrigation Plan

The design and implementation of a detailed irrigation plan satisfies Zoning Condition 18 'd' (noted as condition 5 'a' of the DOH '12 Conditions').

Modern irrigation systems are extremely complex and very efficient. They are closely related to communication systems and share much of the same technology, including wireless technology. Total automation is quite possible, where a weather station calculates evapotranspiration (ET) losses and a central computer calculates how much water is needed to replace that loss as well as how long each sprinkler will run.

The key component is the central computer. Information is stored for every sprinkler on the property including the type of sprinkler, nozzle sizes, location, soil type, slope, infiltration, exposure, etc., so that the exact amount of water needed is applied (not just, e.g., 10 minutes per sprinkler every night). Cycle/Soak features prevent runoff when heavy irrigation is needed. Flow management features ensure optimum pressure and amount to every sprinkler. Computer control saves electricity and extends the life of pumps and equipment, often irrigating the course in half the time required by the older, electromechanical, timer-based systems. This reduced run time or watering 'window' can easily be accomplished at night when winds are low, temperatures are cooler, and humidity is higher. These systems also print out detailed records of daily water consumption and operation.

Manufacturers have developed wireless radio and palm pilot devices that can be used to activate individual sprinklers or start entire programs within seconds when water stress is detected. In the event of computer failure, field or 'satellite' controllers have similar stored data and programs and can operate sprinklers in their respective zone.

The major irrigation system manufacturers are Toro and Rainbird. Toro Site Pro, Rainbird Nimbus, and Rainbird Cirrus systems have all the features listed above and more. The field is quite specialized, and while the manufacturers offer design services, it is fairly common to employ a certified irrigation designer, as well as an irrigation contractor. Because irrigation installation follows so closely behind earthmoving and shaping, many golf course builders employ their own irrigation installation crews. The irrigation system is a significant investment, usually between one and two million dollars. Like all underground utilities, the trenching and installation is laborious and slow. Historically, there is a 50/50 differential between the costs of equipment (pipe, fittings, wire, sprinklers, and controls) and the cost of installation. Field change orders are inevitable and the installer must provide an accurate, as-built drawing of the final irrigation system.

Water quality is an extremely important issue for the project. Initial test results are extremely favorable for the wells. We anticipate that ground water quality at this location, following development, will be consistent with these concentrations. Irrigation for the golf course will include two on-site and two off-site brackish water wells mixed with recycled wastewater (R-1) and the concentrate from the RO treatment of the potable water supply system. Water from the wells and/or the reclaimed wastewater system will be pumped into a holding pond. The parameters listed below are ideal for irrigation water. However, the selection of seashore paspalum turfgrass for the golf course means that the quality of irrigation water is less critical. (Turfgrass selection is discussed in Part 3(B) below.)

- pH (5.5 - 8.0)
- Conductivity (ECw) $\leq$ 0.75 dS/m

- TDS (total dissolved salts) $\leq$ 500 ppm
- SARw (sodium absorption ratio) $\leq$ 10 meq/L
- RSC (residual sodium carbonate) $\leq$ 1.0
- Dissolved Nutrients: Na $\leq$ 138 ppm, Ca $\geq$ 20 ppm, chlorides $\leq$ 335 ppm, Mg $\geq$10 ppm, bicarbonates $\leq$ 122 ppm, carbonates $\leq$ 15 ppm

Records of irrigation procedures must be maintained for each management zone and kept with other detailed management records in the maintenance facility. Each management zone is treated independently; the highest priority zones (greens, tees, fairways) will receive the highest amounts of water, while lower priority zones (secondary roughs, natural areas) will receive less water. These priority designations help to efficiently manage the overall water use on the golf course, providing the highest level of playability and aesthetics while incorporating environmentally sustainable management practices.

C. System Layout and Leak Detection

Irrigation designers calculate the hydraulic information needed to size pipelines and route them in appropriate directions. Proper selection reduces the friction losses associated with moving water and ensures adequate volume and pressure at the sprinkler head. Individual head control with valve-in-head sprinklers is desired for maximum efficiency. In general, smaller sprinklers, placed closer together at a lower operating pressure, are more efficient than larger, high pressure sprinklers at a greater spacing. A wide range of adjustable arc and radius sprinklers are available and are particularly useful on small tees which are easy to 'overshoot' with conventional sprinklers.

Gasketed PVC piping with ductile iron fittings in sizes greater than 2" produce the best results with fewer leaks. Solvent-welded or 'glued' joints should be restricted to smaller pipes. Isolation valves should be located so that no more than one green, tee, or fairway should be turned off at any given time for repair. Snap valves, for easy hand watering, should be installed at every green, tee, and several on each fairway.

Pump stations are also highly efficient. Variable frequency motors are preferred because they run at a speed comparable to the output needed, consuming much less electricity. Low pressure discharge features are able to detect major leaks and blowouts, automatically shutting down the system. Digital flowmeters will be used to track water usage. Prefabricated, steel floor pump stations are the norm, such as those manufactured by Flowtronics/PSI.

Maintenance is minimal but still required. Most golf clubs employ a competent irrigation technician to perform these duties. Periodic inspection with the manufacturer's authorized personnel is desirable.

PART 3: OPERATIONS, MAINTENANCE - MANAGEMENT PLAN

An Integrated Golf Course Management Plan® (IGCMP) and Risk Assessment was developed by Environmental & Turf Services, Inc. in 1992 for the originally proposed Wailea 670 project consisting of two 18-hole golf courses (Durborow et al., 1992). As part of the approval process for the original Wailea project, Environmental & Turf Services developed and submitted a water quality risk assessment, an Integrated Golf Course Management Plan© (IGCMP), and a ground water monitoring protocol. The first two products were submitted in one document in 1992 (Durborow et al.), which DOH reviewed and approved (Appendix C) in 1994. This current document comprehensively updates the 1992 submission, as well as the 1992 ground water monitoring protocol.

The most important BMP in this plan is the choice of turfgrass varieties (seashore paspalum specified in section A(2) below). Seashore paspalum turfgrass varieties will enable the golf course to use significantly less fertilizer and pesticides than bermudagrass at this location. These turfgrass varieties were not available to Hawaii golf courses in 1992.

This part of the BMP document satisfies condition 11 of the '12 DOH conditions' (as amended by DOH), which is part of Zoning Condition 18 'f'. Specifically, sections F & G below satisfy condition 11 with respect to handling and application of chemicals according to label requirements. Also, methods that reduce off-site drift during chemical applications are addressed in Part 4(E)(3) below.

A. Site Description and Site Evaluation

The project is on the lower slopes of the Haleakala volcano near Makena in south Maui. Elevations range from approximately 320 ft to 710 ft. There is an approximate 250-300 ft elevation change from the makai property boundary (western) to the mauka property boundary (eastern) and little elevation change from the northern property boundary to the southern boundary.

The property contains of four soil classifications: Kaewakapu stony silty clay loam; Makena loam; Oanapuka stony silt loam; and very stony land. The Keawakapu soil type comprises the majority of the property (approximately 56%) with slopes of 3-25% (USDA/NRCS, 2006). "Very stony land (rVS)" comprises the next largest percentage at approximately 32% of the entire property located in the southern portions of the parcel. Makena loam comprises 12% of the property mainly in the northwestern portions, with slopes of 3-15% (USDA/NRCS, 2006).

There are no existing surface water features. The golf course will include several ponds and drainage ditches serving multiple functions, from stormwater retention and hydrologic regulation to aesthetics and wildlife habitat.

The project site climate tends to be semi-arid with mild temperatures throughout the year (with limited seasonal variability), moderate humidity, and an average annual rainfall of 12-15 inches (EIS, 1988). The limited seasonal variability and a low amount of rainfall affect the choices and recommendations of turfgrass types for the golf course.

A hole-by-hole description of the golf course, complete with aerial photos, will be produced after build-out of the golf course. These photos and description will highlight the site drainage patterns and indicate which environmentally sensitive areas, if any, must be protected during routine maintenance operations. This will help the management team pinpoint potential concerns so that management strategies can be appropriately updated.

B. Turfgrass Selection

The most desirable turfgrass for this project, in an environmental context, is seashore paspalum. The selection of this plant implements guidance in the DOH's BMP document to "Use turf grasses that are best adapted to local conditions..." (Part 1), and "Select appropriate turfgrasses..." (Part 2). Bermudagrass has been the turf of choice for years in Hawaii, but seashore paspalum is slowly replacing bermudagrass. Newer varieties of seashore paspalum rival hybrid bermudagrass in turf quality and have many additional environmental attributes including the tolerance of:

- Alternative water sources including, effluent, gray water, brackish, and even ocean water for short periods.
- High salt and sodium levels.
- Low light intensity (shade).
- Waterlogged and poorly drained soils.
- High and low pH soils.

Other desirable features of seashore paspalum are:

- Lower fertilizer requirements, approximately 1/3 the nitrogen required for bermudagrass.
- Minimal pesticide requirements, especially herbicides. Weeds cannot compete well in the thick turf produced with seashore paspallum. Fungicide use requirement is lower, there is no battle with the 'bermuda decline' disease complex when using poor quality water, and there are fewer insect pests.
- Withstands prolonged droughts better than bermuda.
- Darker green color than bermuda.
- Stripes like cool season grasses when mowed.
- Allows the same turfgrass to be used on greens, tees, and fairways.
- Waxy leaf surfaces repel dew and enhance playability and mowing quality in the early morning.
- Can be used throughout all playing surfaces of the golf course.

Seashore paspalum is now widely used where irrigation water is less than desirable (e.g., salt affected soils). Improved varieties of seashore paspalum are fine textured and superior to hybrid bermudagrass. Seashore paspalum can be used throughout all playing surfaces of the golf course (greens, tees, fairways, and roughs) showing the versatility of this specific turfgrass. ***The variety SeaIsle 1 Supreme™ is a good choice at this time.*** The golf course designer will have considerable input into the specific variety selected for the course.

C. Turf Management and Cultivation Practices

Selecting the right turfgrass is nullified if it is not properly maintained. The complexities of management strategies for a golf course are far greater than for many other areas of agriculture or forestry. This is due to the intensity of the intended use and the need for the turfgrass to resist and recover from damage incurred during normal daily play and maintenance. These management strategies (e.g., mowing, fertilizing, irrigation, etc.) are referred to in this report as cultivation practices.

The following cultivation practices and golf course management techniques should be used as a guideline. These are recommendations for the use of effective and low impact methods and materials, as well as current industry standards used to successfully build and operate a golf course in an environmentally responsible way. These practices involve cultivation, mechanical, and biological methods which modify the environment so that it is less suitable for pests (Durborow et al., 1992).

The positive results of cultivation practices and biological controls may not be readily apparent. Both are much more effective over the long-term. However, the goal of cultivation management is to maintain healthy turf that keeps the incidence of weeds, insects, nematodes and disease at a minimum without the use of chemical treatments. New technology is continually on the rise, enhancing cultivation techniques and providing a superintendent with more efficient strategies for managing turf on the golf course. As this newer technology becomes available, and these methods recommend safe and efficient materials, the plan will adjust and expand to incorporate the newest and best technology advancements.

Below is an outline of the cultivation practices expected for use on the Honua'ula golf course.

- Proper pH and electrolytic balance of soils and irrigation water will be established, monitored, and maintained to provide optimum growing conditions.
- Adequate air circulation, thatch control, and exposure to sunlight will be analyzed and improved in areas under stress, if necessary.
- Advanced soil aerification techniques to maintain healthy root zones with less than desirable irrigation water, including shallow and deep tine machinery with adjustable spacing, patterns, depth, and tine sizes.
- Adequate tee and green size will be provided to accommodate traffic, wear, and compaction.
- Misting by means of the irrigation system will be used to provide effective control on the rate of evapotranspiration and heat stress.
- Selection and planting of the appropriate turfgrass for the climatic zone is important in helping with the natural resistance of certain species to pest infestations.
- Daily inspection by the golf course management team helps identify potential pest problems as early as possible.
- Action threshold levels will be established to limit the unnecessary use of pesticides.
- Careful attention paid to mowing operations. Mowing is the single most important daily operation on golf courses. This involves careful selection of equipment, intense maintenance to maintain razor sharp edges and height of cut, not removing more than 1/3 of the leaf blade in any single mowing, avoiding mowing in wet conditions when soil compaction is possible, and changing the direction of cut daily to avoid grain and wear patterns.

D. Safety Details and Worker Protection

1. Pesticide Storage

Pesticide storage will be in a pre-fabricated (pre-fab) pesticide storage building specifically designed to be ventilated, fire resistant, vapor explosion resistant, vandalism protected, spill self-containment, and climate controlled. The pre-fab building like those produced by US Hazmat Storage Inc. or Hazvault Inc. can be customized for any hazmat storage need. Often these buildings exceed code requirements for safe storage of hazardous materials. Storage should be limited to a minimal amount of materials needed for one application. Typically a 400 sq ft building is sufficient for an 18-hole golf course. Further storage procedures and recommended facilities are included in the Facility Operations Manual and Emergency Procedures (Appendix B). Also included in the operations manual is a facility checklist for the pesticide storage buildings.

2. Disposal and Record Keeping

The disposal of pesticides, pesticide containers, and residual wash waste will be managed and treated in accordance with label instructions. There will be an up-to-date record of all pesticides used on the golf course, as well as MSDSs (Material Safety Data Sheets) for all chemicals on site. The MSDSs will be stored in a separate building, preferably the superintendent's office.

3. Worker Protection

The golf course superintendent should implement a worker-training program in which workers are trained in safety procedures for operating equipment and handling fertilizers and pesticides. Other areas of training include spill response, first aid, blood borne pathogens, proper golf course etiquette, maintenance techniques, employee benefits, turf management, fire safety procedures, and use of safety devices. Training should take place when workers begin employment and continue on a regular basis.

First aid kits, safety stations, wash stations, personal protective equipment (when appropriate) should be readily available in designated areas so employees can effectively protect themselves against hazardous situations and efficiently perform their duties.

E. Operation Procedures and Emergency Response

The Facility Operations Manual and Emergency Response (Appendix B) provides details for routine and non-routine maintenance of the golf course and the facilities on the property, including emergency response procedures and contingency plans.

F. Chemical Management

Pesticides can safely be used on the golf course, minimizing potential dangers to humans and the environment. However, care and attention must be paid toward the proper application of chemical controls to prevent contamination of drinking, ground and surface waters, as well as to limit impacts on of wildlife and aquatic populations.

The strategy for minimizing pesticide use at Honua'ula will include but not be limited to the following.

1) Plant turf species adaptable to climatic conditions found on the leeward coast of eastern Maui.
2) Use sound cultivation management practices and irrigation management to minimize pesticide use (section C above).
3) Use best management practices and sound environmental technology for inclusion in the baseline data of pest management practices.
4) Use spot treatments to provide early, effective control of problems before damage thresholds are reached.
5) Minimize transport to surrounding environments (e.g., do not apply during periods of heavy rainfall, high winds, or periods when there is high potential for chemicals to be quickly transported away from the designated areas).
6) The golf course superintendent will employ the necessary assistance, support, and technology that will be needed to provide the very best in turf management.

Licensed applicator(s) and their registered employees will be the only individuals applying pest control products to ensure that appropriate application and safety measures are performed. Suitable personal protective equipment (PPE) will be worn whenever chemicals are used.

Additional pesticide application recommendations can be found in Part 4 of this report.

G. Waste Management and Waste Reduction

This section satisfies Zoning Condition 18 'h', which is also condition 10 of the DOH's '12 conditions.' These conditions relate to the County of Maui's Department of Environmental Management's concerns and recommendations relating to solid waste disposal, and solid waste management. This section describes methods that Honua'ula will use to reduce the amount of solid waste produced and strategies to reuse waste products.

There are several strategies that managers can implement to minimize waste and maximize recycling. The neighboring Grand Wailea Resort prides itself on being 'green.' This means they reduce waste, recycle waste products when possible, and conserve natural resources when possible. The Wailea Resort also incorporates their landscape waste (grass clippings, mulch, trees, etc.) into a composting program. For example, EKO (located in Puunene, Maui) manufactures and sells compost. The Wailea Resort collects all greens waste (e.g., grass clippings, landscape waste, etc.) and incorporates them into EKO's manufacturing process, which the Wailea Resort eventually buys back as high quality fertilizer. The golf facility at Honua'ula will strive toward a program similar to The Wailea Resort for managing green waste. Maui Recycling Group, Inc., Pukalani, Maui, is a firm that can be contracted to design and implement a facility-wide reduction and recycling program. This will provide the Honua'ula facility with an effective resource conservation program.

Strategies that the facility can apply to reduce the amount of products that eventually accumulate in discarded trash include reducing the use of paper products, and converting to computerized tracking and send/receive electronic communications. Other strategies that reduce waste exportation include the use of refillable containers that can be recycled after use, drinking fountains that need no cups, investing in more durable equipment or products, and bulk purchases of fertilizer and amendments to reduce the number of bags and packages.

1. Green Waste

The use of organic waste material generated on-site is a central part of an environmentally sound waste management and waste reduction strategy. Consistent with reducing the amount of waste generated, every attempt should be made to export as little as possible. A company such as Maui Recycling Group, Inc., Pukalani, Maui, can design and incorporate a green waste, composting, and recycling program for Honua'ula.

Grass clippings will not be removed in fairways, roughs and other turf areas. Clippings will be removed from greens and tees. They will be incorporated into the final compost pile (location TBD) or placed in a bulk spreader and spread in rough areas every couple of days. The final composted product can be applied as topdressing and has been proven to reduce the dependency on chemical treatments. For example, Mike Burgett, Landscape Director at Wailea Resort, has cut his insecticide treatments by 80%, after using EKO compost (Burgett, 2006), most likely because the improved health and vigor of plants increase their tolerance to insect pests.

2. Chemical Waste

Applicators use specific techniques to minimize the amount of chemical waste and/or overuse of chemicals. Pesticides are very expensive; therefore efficient managers tend to mix and load only what is needed. Often the excess solution is sprayed on roughs or used in the next spray tank. Small quantities of remaining spray solution and wash-down water from the wash area should be drained into a closed loop retention sump and treated for future use. Examples of effective wash-down water treatments are carbon filters and Waste2Water™ ozone treatment systems. The list below includes recommended techniques that will minimize the amount of chemical misapplications and reduce the amount of waste produced.

- Select spraying equipment that is appropriate and versatile (i.e., to prevent the over spraying and waste of chemical material).
- Use computerized control systems to achieve the exact gallons applied and ground speed of spraying equipment such as the Toro ProController™.
- Ensure that all spraying equipment is properly calibrated and checked at least once a year by a licensed pesticide applicator or a representative from the manufacturer of the equipment.
- Use spray-dye indicators and/or foam makers to avoid overlaps and misses during applications.
- Select the appropriate size of spray nozzles to cover intended acreage with the appropriate number of spray tanks (i.e., select nozzles which maximize efficiency).

Chemical waste that is generated will be disposed in accordance with the label directions, e.g., triple rinsing, recycling, or returning to the manufacturer. Rinse-water must be disposed in such a way as to avoid point and non-point source pollution, through recycling or spraying out diluted compounds in previously untreated areas. Used motor oil, electric batteries, or unused solvents are examples of other waste products that will be recycled or disposed according to State of Hawaii law and community disposal techniques (§342H, HRS) (DOH, 2006).

H. Botanical and Wildlife Resources Management

Honua'ula will not impact any Federal or State of Hawaii listed rare, threatened, or endangered plant species, as none were identified on the property. One plant species, the native *'āwikiwiki* (*Canavalia pubescens*), is listed by the United States Fish and Wildlife Service (USFWS) as a candidate endangered species.

Honua'ula is not expected to significantly impact any endangered animal species. Evidence of the endangered Blackburn's sphinx moth (*Manduca blackburni*) was found within the Honua'ula property and a single endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) was sighted flying seaward over the property. No other Federal or State of Hawaii listed rare, threatened, or endangered animal species were identified on the property.

A Habitat Conservation Plan (HCP) will be prepared under Section 10(a)(1)(B) of the Endangered Species Act and in collaboration with the State of Hawaii Department of Land and Natural Resources and the USFWS. The HCP will provide for a partnership between Honua'ula, the State, and the Federal government to conserve the ecosystem upon which listed species depend, and will ultimately contribute to their recovery.

Honua'ula Partners LLC will comply with the County of Maui Ordinance No. 3554 regarding conditions 7, 8, and 9 (see EISPN, 2009 for details).

I. Education and Outreach for Regular Golfers & Maui Junior Golf

It is important to incorporate the daily golfer into the management plan; golfers must recognize that golf courses are managed land areas that complement the natural environment. Golf courses are much more than the stereotypical green grass, blue water, and white sand that most people envision. The superintendent and maintenance staff should produce literature to inform daily patrons and/or annual members about the specifics of the golf course management techniques. Golfers must be encouraged to respect environmentally sensitive areas within the course, and accept the natural limitations and variations of turfgrass plants growing under conditions that protect environmental resources (e.g., brown patches, thinning, loss of color, etc.). Environmental conservation plans -- consistent with the golf course's overall goal of existing as part of the surrounding environment -- must extend beyond the immediate maintenance and management staff to the golfers who use the services of the golf course. It is the responsibility of the superintendent and his or her maintenance team to inform golfers about environmentally friendly maintenance practices such as reduced pesticide use, reduced fertilization, limited play on sensitive turf areas, and reduced watering. This can be achieved through educational notes associated with the scorecards and poster signs. Additionally, golfers should educate other golfers and the general public about the benefits of environmentally responsible golf course management that they learn from the Honua'ula golf course.

Another opportunity for environmental education and outreach is through programs with the Maui Junior Golf Association. County approval conditions 12(a) and (b) require access to the golf course by junior golfers. (The specific details can be found in the two subsections/paragraphs.) This will be an excellent opportunity to educate the youngsters about the following measures implemented at the golf course: energy conservation, water conservation, habitat restoration, and habitat protection. We recommend that this be done via short, informal discussions, perhaps twice per year, led by the golf course superintendent and, perhaps, a biological consultant.

Finally, the golf course could prepare an 'environmental scorecard' to give to the junior golfers. This will be a list of wildlife that might be observed on the course during play. Such sightings should be recorded in association with the golf holes where they are observed. This will be an educational experience for the junior golfers, and it will help the golf course track the effectiveness of its habitat restoration and protection measures.

PART 4: INTEGRATED PEST MANAGEMENT (IPM)

This section satisfies, in part, condition 18 'f' of the Zoning Conditions with respect to chemical applications performed in accordance with label instructions. Further, incorporating modern Integrated Pest Management (IPM) strategies will optimize success of the employed pest control methods. (These methods satisfy condition 11 of the '12 DOH conditions.')

Please note that this Part is complemented by the text in Parts 1-3 above. This Part is not independent of the others.

A. Overview of IPM Strategies

Managing turfgrass in an economical and ecological manner requires the implementation of sound pest management strategies that use reasonable approaches to turfgrass quality and provide acceptable safeguards for human health and the environment. Integrated Pest Management (IPM) is an interdisciplinary program that manages pest control tactics in a single system to prevent unacceptable levels of pest damage. IPM uses the least toxic control approach to address pest problems, only using chemical controls when other strategies are not effective. ***Appropriate control methods are generally not designed to eradicate pest populations but to manage turfgrass in the most economical way with the least effect possible on people, property, and the environment.***

The successful use of IPM avoids the conventional spray approach to pest management and is likely to reduce pesticide usage by 30% or greater. This approach will ultimately develop hardier turfgrasses and increase the population of beneficial organisms and natural enemies to pests. Control tactics are implemented based on pest populations and not by spray intervals and calendar dates.

There is no single pest control method available that provides complete control of turfgrass pathogens (pathogens cause disease), but the multifaceted IPM approach provides the best and most economical control of pests. Golf courses, like other agricultural commodities, are susceptible to occasional attacks from a rather complex list of pests (see Appendix F). These pests and causal agents may be observed during various climatic conditions and life cycles. They may be controlled by a variety of turfgrass methods.

With the IPM system, pest populations are monitored such that an appropriate treatment is implemented when pest pressure exceeds the action tolerance level of damage to turf. A threshold is a level of damage or potential damage such as the number of insects or weeds per square foot of turf. Thresholds for pest infestations and turfgrass diseases are provided in Tables 2-5 of Appendix F (Pest Infestation Tables and Threshold Guidelines). The treatment may be one of a variety of pest control measures (e.g., mechanical removal, biorational products, chemical treatments, etc.). The IPM system will work on every defined management area but must be tailored for each tee, green, fairway, and rough.

B. Objectives of IPM

The following are inter-related guidelines that will help the golf course superintendent to achieve the goals of IPM, thereby enabling a strategy of pest control rather than pest eradication.

- Develop healthy turf and ornamentals that can withstand pest pressure.
- Keep damaging insects, weeds, and diseases at or below acceptable threshold levels.
- Use natural control methods (biological, cultivation, mechanical, and physical) that will maximize beneficial organisms rather than destroying them.
- Use chemicals more wisely, less often and/or in lower quantities.
- Develop a strategic approach for the continued presence of harmful species that will remain as host for aerobic fungi, bacteria, parasites, and predators.
- Time chemical treatments more precisely at vulnerable pest stages and thereby more effectively and economically control pests.
- Accept a certain level of loss or damage to the turf areas (develop a threshold of response).

C. Developing an IPM Incorporated into the Business Plan

The golf course superintendent must develop a time plan with a step-by-step approach that identifies the type of resources that will need to be available. The plan should include a statement and purpose on the level of maintenance that must be provided. There should be a sufficient level of technically trained staff available to carry out the plan.

The plan should include the following resources:

1) Knowledgeable staff trained to implement an effective Integrated Pest Management Program.

2) Sufficient staff time to consistently monitor each management unit (tee, green, fairway and rough).
3) Proper equipment for ease of transportation and identification.
4) Availability of a diagnostic laboratory or the assistance of an advisory firm responsive to proper pest identification and control.

A calendar that includes a list of all tournament play and normal play functions will assist in the proper timing of cultivation practices. This allows for control methods to be planned in advance providing the highest level of playability without hindering the control strategies in place. The calendar also should include a schedule for pest monitoring and provide documentation that a site-specific analysis has occurred.

The golf course superintendent should delegate a proper chain of command and appoint key personnel who will be trained as part of a monitoring team. It is best for at least three people to be designated as 'scouts' to avoid confusion and misdiagnosis of turf pathogens. These staff will report directly to the golf course superintendent and will be responsible for daily monitoring of each playing unit within the golf course system.

D. Monitoring Control Systems

Monitoring control systems will provide the basis for developing economic thresholds and determining any actions necessary for control. It is anticipated that a maximum of two hours per day will be needed in order to implement and effective monitoring control program. The system should be simple, accurate, and part of the daily regimen for turfgrass management. A thorough understanding of potential pest species will be required of each member of the monitoring team. An assessment of the role that beneficial organisms provide will be performed before any organism is identified as a pest. A secondary pathogen may be a pest under certain conditions but may also provide a balanced beneficial role in similar turfgrass situations. The observation team should note any visual reduction in turfgrass quality and accurately secure the proper information regarding the phenology (or life cycle) of the pest.

Pests may be defined as bacteria, plant pathogenic fungi, insects, nematodes, rodents, viruses, weeds etc. The information obtained through monitoring will provide site specific educational knowledge and limit the levels of predictable loss to turfgrass.

The golf course superintendent must require documentation of the location and the environmental condition of the causative agent affecting the plant species. The importance of the pest should be noted on a scouting form, which also should include the biological, environmental, and physical factors affecting the presence of the species. For example, an excellent time to observe mycelium is prior to removing the dew from the playing surfaces. The visible detection of sclerotia will provide a good indication of the potential for movement of the pathogen on the host biotic tissue. In the early stages of development, active disease is easier to identify, when dew is present on the turfgrass. This can be performed prior to mowing without interrupting the players.

The level at which the pest population or its damage endangers crop quality is often called the economic threshold (Bohomont, 1990). Detailed point sampling (i.e., number of insects), should measure the density of the pest population relative to their damage on the area of turfgrass. This information will be used to determine site-specific threshold levels for the golf facility at Honua'ula. Actual field observations can be used to fine tune the limits of the pre-determined threshold action levels.

Pest occupancy is very weather-dependent; therefore it is necessary to observe pest populations for several years to have a good idea about the range of pest problems. It will likely require at least three years for development of a comprehensive database to establish site-specific baseline pest occupancies.

Additional samples should be taken to determine the level of infestation (high and low). Random sampling will provide additional documentation on the potential impact to the entire acreage. Accurate field data will allow the golf course superintendent to make reasonable and timely decisions about when to apply the appropriate method for control. The monitoring process will gain confidence and experience in all levels of the management personnel.

The experience using IPM will produce effective control and tolerance of pest population outbreaks. It will be through this knowledge that the golf course superintendent will be able to realize the fallacy of relying solely on chemicals for control.

The golf course superintendent will develop a tracking procedure to evaluate and predict when conditions exist that would encourage damaging pest populations. The skills obtained will allow the superintendent to be a leader in pest management control. This will also generate information on the success of the applied control measures against the pest(s).

An example of a monitoring and scouting summary report is provided as Appendix G. This can be used to determine the appropriate treatment based on specific areas.

E. Control Measures

Pest infestation tables and guidelines for managing these infestations (thresholds) are described in Appendix F. The different types of actions (cultivation, biological, and chemical controls) which are used to efficiently manage pest infestation are described in the following sections.

1. Turf Cultivation and Nutrient Management

An overview of cultivation techniques was provided in Part 3(C) above.

It is often assumed that the main reason that a golf course needs to be fertilized is to make it look green. The color of the grass is important, but it is only secondary to the many other important functions in the plant. A fertilizer/nutrient management plan provides a superintendent with the site-specific guidelines and plant requirements to maintain healthy turfgrass, avoiding the over-application of nutrients resulting in transportation of dissolved nutrients offsite. The goals of a fertilizer/nutrient management program are to:

- Be environmentally responsible.
- Produce a healthy stand of turf that can recuperate from damage caused by diseases, insects, as well as traffic from golfers and maintenance equipment.
- Produce a healthy, visually attractive playing surface, but not at the expense of the root system.
- Make the golf course competitive against the invasion of weeds.
- Provide the necessary amount of nutrients, being careful not to over-fertilize. Excess nitrogen can increase the need for irrigation and increase the potential for leaching. A fertilizer deficit can reduce the competitiveness of the turfgrass and lead to the invasion of weeds, insects, disease, and heavy traffic).
- Apply organic fertilizers (e.g., compost) that feed the soil stimulating naturally occurring microorganisms, and provide plants (turfgrass) with food and natural protection from harmful pests and diseases.

Approximately half of the nitrogen fertilizer applied to turfgrass is incorporated into the plant; the other half can be found stored in the soil and lost to the atmosphere. Thus there is limited fertilizer nitrogen remaining that can leach into ground water or be transported as runoff into surface water (e.g., Petrovic, 1990; Cohen et.al., 1999). Golf courses can be managed so nitrogen from fertilizers does not contaminate ground water supplies (Petrovic, 1990; Cohen et.al 1999).

Table 1 below provides the nutrient requirements for seashore paspalum. ***Seashore paspalum requires significantly less nutrients than bermudagrass turf.*** These nutrient requirements can be reduced with proper water management and traffic control.

Table 1. Seashore Paspalum Nutrient Requirements (Greens, Tees, Fairways, and Roughs)

Nutrient	Application rate
Nitrogen (N)	0.2 - 0.6 lbs per month*
Phosphorous (P)	0.1 - 0.3 lbs per month*
Potassium (K)	0.2-0.6 lbs per month*

* slightly higher applications for greens and tees because of clipping removal.

These nutrients can be obtained in a variety of organic and inorganic sources, and nitrogen is available in quick and slow releasing forms. Applications will be properly timed by the golf course superintendent and carefully applied for maximum benefit. A nutrient management plan will be developed by the golf course superintendent. To develop this plan, the superintendent should consider the soil analytical results in Appendix E, and the nutrient discussion in the original management plan (Durborow et al., 1992, section VI(F)).

2. Biological Controls

'Biorational'/'organic' products (fungi, bacteria, viruses, nematodes, and non-target insects) should be used whenever it is feasible, and there is a scientific basis to support their use (i.e., cost effective, efficient, amount of pest pressure, etc.). Biorational products can provide an effective and efficient method of eradicating disease and other pest pressures. Additional methods, such as applying composts containing microorganisms as top dressing and the use of compost teas may also suppress diseases before they harm turfed areas. EKO Compost manufactures and sells compost and compost-based mixtures. One of their branch locations is located in Puunene, HI on the Island of Maui. EKO compost, when applied as top dressing, has been shown to improve yellowing areas on tees and fairways (Burgett, 2006; EKO, 2006).

3. Chemical Controls

Chemical treatments should only be used when a pest is present at significant levels to cause damage and should only be applied when the pest is most vulnerable to the pesticide (i.e., in juvenile stages of development) and when the environment is best suited to manage the

application (e.g., do not apply pesticides when soil is saturated, or during windy or rainy weather, decreasing the amount of potential drift and surface water runoff). If the pest infestation is limited in scope, the superintendent is encouraged to use spot treatments when possible. It is also important when applying chemical controls that equipment is properly calibrated and adequately maintained. Table 2 below lists the pesticides that will likely be used on the golf course during the first five years of operation; however, they will not be used at the same time, but only as needed. (Appendix H contains information on the mobility, persistence, and toxicity of these pesticides.) This relatively small list includes three products that many call 'organic' or 'natural.' The recommended pesticides have undergone a water quality risk assessment (Appendix H).

Pesticide use should be rotated (use alternative chemicals, or alternative pest control methods and cultivation controls) to reduce the possibility of pests becoming resistant to the applied chemicals, and also to reduce the frequency of chemical applications.

Below are the policy recommendations that will be used when applying pesticides for the Honua'ula golf course.

- The pest will be properly identified. The use of disease, insect, and weed identification guides will be used. Diagnostic aid kits/methods will be used on pathogens.
- Extension service, commercial, and/or university laboratory assistance will be used to identify any unknown pathogen activity.
- The golf course superintendent will identify and document when the threshold of pest activity has been exceeded.
- Pesticide applications will be used only when there is no alternative measure for control.
- The actual application of a pesticide will be made under the direction of a certified, licensed applicator.
- The golf course superintendent will be a licensed applicator in the following categories: aquatic weeds, turf, and ornamentals.
- All pesticide applications will be made in accordance with label specifications.
- Minimizing drift from the target areas will require applications not be made in winds in excess of 15 knots. Winds in the vicinity of 5-15 knots are acceptable using a windfoil (shrouded) spray system.
- All protective clothing as specified by the label will be worn by the applicator (see Part 3(A)(4) above).
- Liquid application of a pesticide will be made using a low pressure boom-type sprayer with nozzles sized to produce fine to medium droplets resistant to drift. Boom height should be no higher than 18 inches above the turf.

Table 2. Preliminary Pesticide List for Use on the Honua'ula Golf Course*

Common Name	Trade Name	Recommended App. Rate lb/a.i./Ac	Projected No. of App./Yr (Max.)	Projected Maximum Annual Total a.i./Yr.	Max. Acres Treated	Areas Treated
HERBICIDES						
Glyphosate	Roundup	2.0	2	4	5.0	R
Foramsulfuron	Revolver	0.026	1	0.026	30	G T F
Quinclorac	Drive	0.75	2	1.5	60	T F R
2-4-D	Trimec	1.23	2	2.46	60	T F R
Dicamba	Trimec	0.65	2	1.3	60	T F R
MCPP	Trimec	0.12	2	0.24	60	T F R
Halosulfuron	Sedgehammer	0.062	2	0.124	50	F R
Oxadiazon	Ronstar G	4.0	2	8.0	60	T F R
Potassium Salts of Fatty Acids±	M-Ped	1.35	3	4.05	30	R
INSECTICIDES						
Bacillus thuringiensis±	Bio-bit	0.25	3	0.75	3	G
Spinosad±	Conserve	0.42	2	0.84	36	G T F
Fipronil±	ChipcoChoice	0.025	2	0.05	50	F R
Indoxacarb±	Provaunt	0.075	2	0.15	6	T G
Bifenthrin	Talstar	0.05	2	0.1	36	T G F
Imidacloprid	Merit	0.40	1	0.4	50	F R
FUNGICIDES						
Chlorothalonil	Daconil	4.1	4	16.4	6	T G
Propiconazole	Banner	0.44	2	0.88	36	T G F
Boscalid±	Emerald	0.35	1	0.35	36	T G F
GROWTH REGULATOR						
Flurprimidol	Cutless	0.25	4	1	33	F T

*Appendix H contains information on the mobility, persistence, and toxicity of these pesticides. This pesticide list should be appropriate for the first five years of golf course operations. It is likely that only a small subset of these will be needed during the first two years of operation. The application rates listed below are recommended; however, some products were risk assessed using a higher rate. Thus the potential risk to the environment would be lower (see Appendix H).
± These pesticides are commonly called 'natural' or 'organic' products and/or they have been registered by the US EPA under the Reduced Risk program.

- No pesticides will be applied within fifty feet (50') of any sensitive area.
- Notification of pesticide applications will be made to alert the facility staff and golfers.
- All pesticide applications will be posted prior to the application and will remain posted for a minimum of 24 hours.

The golf course superintendent will be responsible for the administration of the above policies.

a. Summary of Risk Assessment to Ground Water and Surface Water

The DOH reviewed and gave final approval of the original risk assessment and management plan in 1993 (Appendix C, finding #67). (The SLUC finding that this project was not expected to significantly impact the environment was based, in part, on that DOH-approval document.) However, this project has evolved, and it has been necessary to amend the pesticide list for two reasons: the pesticides registered for use in Hawaii and nationally have changed since 1992, and the turfgrass planned for this golf course has changed from bermudagrass to seashore paspalum (Part 3.B). Therefore the pesticide requirements are expected to be different, which affects the list of recommended pesticides. Thus, we reevaluated the pesticides that will likely be used on the golf course.

Our 1992 report (Durborow et al., 1992) thoroughly evaluated potential ground water and surface water contamination risks of 16 pesticides and metabolites using hundreds of site-specific and chemical-specific input parameters. The complex USDA model SWRRBWQ (subsequently renamed SWAT) was used for the stormwater runoff evaluation, and the US EPA's linked PRZM-VADOFT model was used to estimate potential ground water contamination impacts. This work required hundreds of person-hours of work. Therefore instead of using the more labor-intensive models, we decided to use two of EPA's tier I conservative screening level models to evaluate the newly proposed pesticides (Table 2): GENEEC (surface water) and SCI-GROW (ground water).

The details and results using the more conservative screening level models for the current pesticides proposed for use are presented in Appendix H. The new risk assessment results show that the pesticide proposed for use as presented in Table 2 pose no higher risk than the DOH-accepted results.

b. Aerosol Drift Control

There are windy conditions on Maui throughout the year. Particularly in the afternoons the wind tends to increase and shift directions. The potential for pesticide drift to adjacent properties and sensitive areas can be minimized by applying on days when wind is minimal and applying at the times of day (early morning, late evening) when winds are naturally diminished. The spray equipment should have lights suitable for use in low light conditions. Nozzle selection can also aid in drift reduction. Nozzles with larger droplet sizes such as Turf-Jet® nozzles reduce drift. Nozzles must be operated within an acceptable pressure range as well to avoid drift.

The use of drift control devices, such as the 'windfoil' shrouded sprayer made by the Rogers Sprayers Inc., gives the applicator more control and essentially eliminates the potential for drift of sprayed pesticides to non-target areas. Verification of wind and environmental conditions will be recorded by the environmental Pestcaster™ or from the irrigation system weather station. The Pestcaster™ will provide the superintendent with accurate weather information for proper timing of any application.

The use of an on-site weather station will be used to measure wind speed and direction. Boom sprayers (unshrouded) will not be used if winds exceed 8 mph. The use of a windfoil style sprayer will be allowed for pesticide applications during wind speeds ranging from 8-20 mph. No pesticides or irrigation will be applied if winds exceed 20 mph.

Pesticides are not likely to drift to homes and resort dwellings off-site (typically 100 ft to 150 ft away from managed turf areas). Approximately 65-70 ft of drift may be expected when crosswinds are 15 mph. All pesticide applications should be prohibited when wind speeds exceed 20 mph.

F. Evaluation of IPM

Periodic evaluation of the IPM strategies will be completed to determine the effectiveness of the plan. Evaluation will analyze treatment results, review pest records and record keeping, audit monitoring techniques, compare pre- and post-IPM implementation and treatment successes, as well as make any adjustments to the IPM plan as necessary. It is especially important to re-evaluate the pesticide list in Table 2 to determine whether it needs to be

supplemented and/or whether new products have entered the market that are low in risk and are cost-effective.

PART 5: SURFACE AND GROUND WATER PROTECTION

Surface and ground water protection is a priority for the Honua'ula golf course, and these considerations will be taken into account during the design phase to ensure the protection of the Island of Maui's surface and ground water resources. Previous Parts of this document (1, 2, and 3) included BMPs to protect water resources through the collection of runoff and reuse/recycling of the wastewater. Additionally, natural areas (described in Part 3(A)) will serve multiple functions including the protection of surface and ground water resources. These natural areas, requiring little maintenance, provide natural hydrologic regulation to prevent stormwater runoff from contacting waste and raw material storage areas. Waters discharging off the property will be appropriately managed to not impact the surrounding water resources of Maui. See Parts 1, 2, and 3 for specific design characteristics such as vegetative swales, recycled material, stormwater management, and construction (see Part 1(C)).

A. Erosion and Sediment Control

Erosion and sediment loading is a significant concern when developing and constructing a golf course. See Part 1: Site Selection, Design, and Construction, under the Structural Control Program.

Minimizing the amount of exposed soils at any one time will help to reduce the amount of erosion during construction. Semi-annual inspection of stormwater drainage pathways will be conducted to determine the location and extent of any erosion to further reduce soil erosion. In some cases, geomorphic modification of drainage ditches may be required to prevent future erosion problems. Preserving as much existing vegetation as possible can help to secure erosion prone areas.

B. Turf Management

See Parts 3 and 4 for appropriate management and control strategies for turfgrass areas, as well as pesticide applications for managing turfgrass infestations (see also Appendix F for pest infestation and threshold tables).

C. Equipment Maintenance, Chemical Storage and Mixing Areas

It is recommended that Honua'ula use a state-of-the-art boom sprayer (manufactured by the Toro Corporation or similar manufacturer) for pesticide applications. Computerized flow meters, independent boom separation, ground tracking speed, calibration for precise liquid applications, windfoil boom protection, and a sonar boom leveler will be provided on this vehicle. The sprayer will be maintained to the highest standards and will immediately cease operation if any failure is noted by the golf course superintendent or operator. This vehicle will be totally self-contained and will only be used to apply pesticides to the designated target areas.

For further details about the maintenance facility, equipment maintenance, chemical storage, etc. refer to Appendix B Facility Operations Manual and Emergency Procedures.

D. Spill Response

The Facility Operations Manual and Emergency Procedures (Appendix B) and the IGCMP (Durborow et al. 1992) contain emergency procedures and a spill response plan for the golf course.

E. Waste Management Plan

See Part 3(G) above: Operations, Maintenance - Management Plan; Waste Management and Waste Reduction.

PART 6: MONITORING PROGRAM

A ground water quality monitoring protocol was developed to satisfy the 2002 DOH Guidelines Applicable to Golf Courses in Hawaii (DOH, 2002; see Appendix A.2). The Protocol (Appendix I) satisfies Zoning Conditions 18 'a' and 'b' of Exhibit 2. Appendix I also satisfies conditions 1-3 of the DOH's '12 Conditions' (Appendix A.3) relating to water quality monitoring.

Nearshore water quality and ground water quality will be monitored until such time as the DOH certifies that no further monitoring is needed.

A. Ground Water

"Hawai'i State Department of Health Guidelines Applicable to Golf Courses in Hawai'i", July 2002, was used to develop the water quality monitoring protocol at the Honua'ula golf course. The protocol was prepared in accordance with the 2002 DOH guidance (Appendix A.2). The objective of the protocol is to present and implement a ground water monitoring study design that can produce reliable quality data.

The portion of the basal aquifer under the site appears to have a thin lens of fresh water. This conclusion is based, in part, on chloride concentrations measured in two of the irrigation wells. However, most of the site is below the Underground Injection Control (UIC) 'no-pass line', and chloride concentrations are likely to increase once the wells begin pumping heavily for irrigation.

Ground water discharges to the ocean and may flow within the influence of five irrigation wells of the Wailea resort complex, which is makai of the site. Therefore the purpose of this two-part study is to determine the extent to which turf chemicals may migrate from the Honua'ula golf course to ground water and to the coastline.

Tentatively, two monitor wells are proposed for installation onsite. In addition, an existing irrigation well will also be used for monitoring ground water quality. The irrigation well will be used as a background well and the remaining two wells will monitor ground water downgradient of managed turf.

Four rounds of samples will be collected from the selected monitoring wells and prior to construction to obtain baseline water quality data. One round will include a comprehensive pesticide list, inorganics, and field parameters. The remaining three rounds will include inorganic and field parameters only. Wells will be sampled semi-annually during the routine monitoring phase during golf course operation. The first routine monitoring samples will be collected six months after golf course operations begin.

The pesticide and nutrient analytes specified in Appendix I are based on the turf management program and the ongoing marine monitoring program (Appendix J). Standard field parameters such as pH, temperature, etc. will be included.

A contingency plan is proposed that would trigger pesticide use restrictions or bans if pesticides are detected at predetermined concentrations.

B. Nearshore Coastal Monitoring

The nearshore coastal monitoring described in this section and Appendix J satisfies Zoning Condition 20 and SLUC Condition 13. Hawaii DOH, which is the agency responsible for the TMDL program described in Zoning Condition 20, has not developed the TMDL program for any marine areas off of Maui.

Baseline monitoring of nearshore coastal water that specifically considers this project began in 2005 (Marine Research Consultants, 2005). This was done in the context of related and indirectly related monitoring that was done in the same area in 1990 and from August, 1995 to February 2003. The latter monitoring was done for the Wailea Resort, and future monitoring will be done specifically for Honua'ula.

Annual samples are collected from seven stations along each of five transects perpendicular to the shoreline (35 sampling locations). Well water is also sampled. Analytes include nutrients and standard marine chemistry parameters. Appendix J contains the most recent nearshore coastal monitoring that was completed in September 2009 (Marine Research Consultants, 2010).

There have now been six rounds of nearshore coastal and associated well monitoring done for the Honua'ula project, as of September 2009 (Marine Research Consultants, 2010) and will continue on an annual basis.

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APPENDIX A. Hawaii DOH Documents

A.1. DOH Golf Course BMPs (2005)
A.2. DOH "10 Conditions" (2002)
A.3. DOH "12 Conditions" (1992)

A.1. DOH Golf Course BMPs (2005)

GOLF COURSE BEST MANAGEMENT PRACTICES

Introduction

Golf courses impact the environment in which they are built and operated. During golf course construction, site clearance often disturbs the site and removes trees, shrubs and other vegetation. Site grading may cause loss of topsoil and erosion. Golf course management requires fertilizers, pesticides, herbicides and massive amounts of water applied to turf. Some potential risks from these activities include human exposure to chemicals, groundwater contamination, disturbance of ecosystems, and harm to plants and animals.

Golf courses should develop and implement a comprehensive environmental management plan to conserve water, protect surface and groundwater quality, minimize erosion, and preserve and protect native plant and wildlife habitats. The management plan should address water pollution prevention and abatement, Integrated Pest Management, nutrient management, irrigation, water quality monitoring, and wellhead and source water protection.

Best management practices (BMPs) can help prevent and alleviate some of the negative environmental impacts of golf courses. BMPs are effective and practical strategies to prevent pollution and reduce the amount of pollution generated by specific and non-specific sources. BMPs are based on science, holistic in approach, incorporate all possible strategies to address an issue and consider economic and environmental implications.

The Hawai'i State Department of Health has prepared guidelines for all golf courses to promote, protect and enhance environmental quality and public health. Please refer to the Department of Health's Guidelines Applicable to Golf Courses in Hawai'i, July 2002. If a golf course uses recycled water (treated wastewater), please refer to the Department of Health's Guidelines for the Treatment and Use of Recycled Water, May 15, 2002.

The following BMPs were developed for golf courses and are categorized into six parts: 1) Site Selection, Design and Construction, 2) Water Usage, 3) Operations and Maintenance, 4) Integrated Pest Management (IPM), 5) Surface and Groundwater Protection, and 6) Monitoring Program. Please refer to the specific sections for detailed BMPs.

Part 1: Site Selection, Design and Construction
Every golf course site will have environmental issues and conditions that need to be addressed. The site selection, design and construction of golf courses should use natural resources efficiently, enhance the community economically and ecologically, provide important green space benefits, respect adjacent land uses and create desirable playing conditions through practices that preserve environmental quality.

Part 2: Water Usage
Water source(s), water conservation, water usage, and water quality are important and critical components of golf course management. Effective golf course water management is essential given a limited supply of water, increasing water use demands and water restrictions during drought conditions. Golf courses should develop an Irrigation Plan that identifies management zones and irrigation requirements for each management zone. Precise and efficient irrigation will conserve water and result in healthy and stress tolerant turf.

Part 3: Operations and Maintenance
A comprehensive environmental management plan will provide a scientific, rational and responsible way to make decisions. Some operating and maintenance aspects of an management plan include: turf management, chemical management, water usage, facility operations, waste management, and wildlife management.

Part 4: Integrated Pest Management (IPM)
Most turf grasses are susceptible to a variety of pests including weeds, diseases, insects as well as rodents, birds and pets. Establishing a pest management program requires planning, knowledge of turf grass culture, an understanding of pests and the damages they cause, pest life cycle, pest cultural conditions, and methods of control. Integrated Pest Management (IPM) is a pest management system that incorporates all suitable control techniques to keep pest damage below an established threshold level. Various pest control options include biological, genetic, and chemical controls.

Part 5: Surface and Groundwater Protection
A number of design and management practices can help protect surface and groundwater. Buffer zones, stormwater management, erosion and sediment control, turf management, waste management practices can help protect surface and groundwater sources. In addition, the proper handling, storage and disposal of equipment and materials and timely response to spills and accidents can have significant impacts in protecting water quality.

Part 6: Monitoring Program
Monitoring programs help to demonstrate that environmental impacts are negligible, or that environmental impacts must be mitigated. Operational and environmental monitoring programs should be included as BMPs for golf courses. A water quality monitoring plan will help prevent and minimize surface and groundwater contamination by monitoring (1) runoff and leachate within the golf course, (2) the impacts of the golf course on adjacent water bodies, and (3) the impact or potential impact of the golf course on the underlying groundwater aquifer. The minimum parameters for groundwater monitoring are outlined in the State of Hawai'i' Guidelines Applicable to Golf Courses in Hawai'i, July 2002.

GOLF COURSE
BEST MANAGEMENT PRACTICES

Part 1: Site Selection, Design and Construction

Every golf course site will have environmental conditions that need to be addressed. Golf course site selection, design and construction should use natural resources efficiently, enhance the community, provide green space, respect adjacent land uses and create desirable playing conditions that preserve environmental quality.

Site Selection

- Hire and work with a golf course manager/superintendent early on in the site selection, design and construction process to develop sustainable maintenance practices.
- Work closely with local community and environmental groups, and regulatory/ permitting bodies during the planning, site selection, design and development phases to address local environmental issues and regulatory requirements that need to be met.
- Involve a team of qualified golf and environmental professionals to thoroughly analyze the positive and negative attributes of each site being considered and to determine the environmental, financial and management impacts of the site selection.
- Use extra precaution for certain types of sensitive environments such as wetlands, threatened or endangered plant or animal species, aquatic habitats and water bodies.
- Conduct a site analysis and site feasibility study to identify environmentally sensitive areas and other natural resources and incorporate them into the design to maximize environmental quality, playability and aesthetics.

Site Design

- Identify existing ecosystems; enhance and protect environmental resources that will allow efficient maintenance of the course and will likely reduce permitting and site development costs.
- Use experienced professionals to conduct a site analysis and feasibility study to identify environmentally sensitive areas and other natural resources so that the design can carefully balance environmental factors, playability and aesthetics.

- Minimize site disturbance where possible to maintain consistency with the topography and golf course design objectives.
- Site fairways to minimize cuts and fills, and avoid wetland crossings.

- Preserve existing vegetation such as forested or grassland areas as much as possible. Seek opportunities to create and/or preserve habitat areas that enhance local ecosystems.

- Use buffer zones to protect environmentally sensitive areas and to maintain high quality surface water. Consult with local regulatory agencies and environmental groups for advice on the design and placement of such zones.

- Use native or naturalized vegetation for areas that will not be in play. Use turf grasses that are best adapted to local conditions for areas that are in play. Both will maximize the efficiency of environmentally sustainable maintenance techniques.

- Design irrigation, drainage and retention systems to create efficient water usage and to protect water quality. Incorporate storm water retention and water reuse strategies to provide for short and long term irrigation needs to save resources.

- Design the course with sustainable maintenance in mind and incorporate integrated plant management and resource conservation strategies that are environmentally responsible, efficient, and cost effective. Integrated plant management should include integrated pest management and emphasize plant nutrition and overall plant health.

Construction

- Use qualified contractors who are knowledgeable and experienced in the special requirements of golf course construction.

- Develop and implement a construction sequence plan. Schedule construction to maximize efficient turf establishment, environmental conservation and resource management.

- Develop and implement strategies to effectively control sediment, minimize the loss of topsoil, protect water resources, and reduce disruption to wildlife, plant species and designated environmental resource areas.

- Minimize soil erosion by limiting the amount of exposed soil at any one time, using silt fences and mulching of exposed areas.

- Conserve topsoil during site grading and removal of existing vegetation. Use appropriate equipment such as excavators to remove stumps.

- Avoid soil compaction and keep rubber tire machinery except for landscape tractors to haul roads where possible. Use harrows, rotary tillers and or chisel plows to alleviate soil compaction.

- Amend soils low in organic matter with organic material to promote soil aggregation and increase water available to plants.

GOLF COURSE
BEST MANAGEMENT PRACTICES

Part 2: Water Usage

Water Conservation

Water conservation on golf courses is essential to its economic viability and should be addressed on a long term, sustainable basis. The following water conservation strategies provide numerous possibilities.

- ✓ Design golf course and landscape for water conservation
- ✓ Select appropriate turfgrasses and landscape plants
- ✓ Develop water conservation strategies for indoors and landscaped areas other than the golf course
- ✓ Use non-potable water sources for irrigation
- ✓ Design efficient irrigation system and use monitoring devices
- ✓ Schedule and operate irrigation system efficiently
- ✓ Provide continuing education for management, staff, golfers and general public
- ✓ Develop written conservation and contingency plans
- ✓ Monitor the effectiveness of conservation strategies and BMPs

Irrigation Plan

- Develop an Irrigation Plan that identifies management zones for greens, tees, fairways, roughs and landscape/natural areas, and irrigation requirements for each management zone.
- Identify BMPs for irrigation operations within each management zone.
- Specify irrigation patterns within each management zone.
- Utilize computerized irrigation management system with flow management to control and manage the timing, rate and frequency of irrigation to control runoff and leaching of water, to meet the needs of the plant materials, and to avoid over watering.
- Include soil-based irrigation scheduling that utilizes soil-based moisture sensors, including tensiometers, soil moisture blocks, soil moisture probes and other soil moisture sensing devices to time irrigation to replace available soil moisture.
- Establish an overall water conservation strategy that prioritizes turfgrass areas the require irrigation. Greens and tees should have the highest priority followed by fairways, roughs, ornamental plantings, and natural areas.

- Maintain accurate information on each management zone in the event that water restrictions occur.

System Layout and Leak Detection

- Design the irrigation system to allow individual sprinkler zones to operate independently
- Perform leak detection on a regular basis several times a year.
- Install water meters in critical locations throughout the irrigation system.
- Use isolation valves before all main lines and major laterals to be able to quickly shut off leaking areas before turf is damaged and water is lost.
- Make irrigation system design changes as needed to eliminate water going off target and excessive water application. Consider converting to valve-in-head (VIH) sprinkler control to reduce water use.
- Use irrigation consultants and Global Positioning System (GPS) software to conduct an irrigation system audit. Strive for 80 percent distribution uniformity (DU) to insure precise water application for optimal water conservation and turf health. A 10 percent DU improvement corresponds to 2½ percent to 5 percent water savings.

Irrigation Heads and Sprinklers

- Install low volume irrigation heads in new irrigation systems and in existing courses where feasible. Low volume sprinklers can reduce water loss due to evaporation, wind drift, leaching and runoff from sloping surfaces.
- Use low or adjustable trajectory nozzles to allow the irrigation manager the ability reduce the effects of wind evaporation during irrigation and to compensate for sloping areas.
- Choose sprinkler heads that do not exceed the lowest infiltration rate of the specific soil.
- Replace full-circle sprinklers with part-circle sprinklers to reduce water being applied to out-of-play areas.
- Use automatic controllers or portable hand-held devices, where feasible, to apply water more efficiently.
- Annually inspect and replace nozzles that are worn, partially clogged, or do not rotate freely.

- Use/replace correctly-sized nozzles in accordance with the position along the system, pressure head distributions and water requirements for the specific turfgrass and landscape position.

- Evaluate design criteria such as nozzle size, rotation speed, spacing, scheduling, and pressure selection to improve irrigation uniformity.

Irrigation Practices

- Apply enough water to turfgrass and plants to moisten as much of the root zone as possible without loss to drainage or runoff. Use a soil probe to determine the average rooting depth in a turf area.

- Recognize that all turf irrigation is not created equal. More water may be needed at the edge of a turf area to achieve equivalent turf quality compared to turf in the middle.

- Water at appropriate times to minimize evaporation and reduce potential for diseases. The most efficient time is late evening throughout early morning between 10 p.m. and 8 a.m. Night time is generally less windy, cooler and more humid, resulting in less evaporation and a more efficient water application. Irrigating at night does not stimulate disease development, contrary to popular belief.

- Use manual spot metering for high-priority management zone irrigation to conserve water.

- Keep accurate water use records along with weather data, such as high and low temperatures and wind speed. Accurate records enable fine tuning of irrigation operation for good stewardship of water resources.

GOLF COURSE
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Part 3: Operations & Maintenance

Management Plan
A comprehensive management plan should be well documented and structured to provide a scientific, rational and responsible way to make decisions and should include the following:

Site description and site evaluation
- ✓ physical setting (preferably hole-by-hole, with the surrounding environment, drawings, and/or aerial photos to delineate where concerns must be focused)
- ✓ topography (how it intersects with natural areas and affects management practices)
- ✓ soils mapping (soil classification, fertility, percolation rates, depth to bedrock and/or groundwater)
- ✓ surface water features
- ✓ climate conditions (temperature, rainfall, potential evapo-transpiration that affect the growth of turfgrass and impact pest management strategies)

Golf course cultural practices
- ✓ mowing factors (species, cultivars and golfers' expectations)
- ✓ irrigation factors (slope, type of grass, cutting height/frequency, rooting depth, weather factors, soil types, irrigation system performance, inspection and maintenance)
- ✓ chemical factors (fertilizers, pesticides, application rates and procedures, monitoring, spills and accidents)
- ✓ supplemental practices (aerification, top dressing, vertical mowing)

Safety details (storage, handling, disposal, record keeping of pesticides, worker protection, employee-right-to-know, and OSHA)

The management plan should include a operating manual as part of the BMPs for a golf course that:

- ✓ documents operating procedures for routine and non-routine maintenance (i.e. turfgrass, pesticide and fertilizer management)
- ✓ identifies a management and reporting structure
- ✓ documents emergency response procedures
- ✓ describes the details of the monitoring program
- ✓ describes triggers for management action
- ✓ describes contingencies to deal with unexpected environmental and management conditions

Turf Management*

- Choose grasses that are suited to the local climate and growing conditions, preferably native species.
- Choose grasses that are drought and disease resistant with minimal loss of nitrogen through volatilization, leaching and surface runoff.
- Set mowers to remove no more that 1/3 of the grass height to improve infiltration and soil moisture retention, reduce surface runoff, and encourage deeper root systems.
- Use sharp mower blades to maintain healthy turf.
- Retain grass clipping on the course to encourage better thatch and moisture retention.

Chemical Management*
Golf courses use a variety of chemicals (fertilizers and pesticides) on the turf. The most commonly used pesticides on golf courses are fungicides, herbicides and insecticides. With careful application, pesticides can be safely used on golf courses, and potential dangers to humans and the environment and be minimized or eliminated. The improper use of pesticides and fertilizers may result in human health problems, contamination of drinking, ground and surface waters, and reduction of wildlife and aquatic populations

- Always read and follow label instructions when using any chemical and nutrient products.
- Treat problems at the proper time and under the proper conditions to maximize effectiveness with minimal environmental impact.
- Use spot treatments to provide early, effective control of problems before damage thresholds are reached.
- Store and handle chemicals and nutrients in a manner that minimizes worker exposure and the potential for point and non-point source pollution.
- Store chemicals properly and use suitable personal protective equipment and handling techniques.

* See also Part 5: Surface and Groundwater Protection for additional BMPs.

- Use nutrient products and practices that reduce the potential for surface and groundwater contamination. Strategies include using slow-release fertilizers, selected organic products and/or fertigation, the application of nutrients through irrigation systems.

- Use trained, licensed applicators to apply all plant and pest-control products or to supervise personnel.
- Encourage continuing education for applicators including state licensing, professional association training and IPM certification.
- Monitor the soil regularly to ensure that turfgrass needs are being met and not exceeded.
- Inform golfers and guests about golf course chemical applications.

Water Usage

- See Part 2: Water Usage.

Facility Operations*

- Conduct an environmental assessment to develop and implement an overall environmental policy and/or long-range plan.
- Maintain ongoing records to measure and document progress toward environmental improvement.
- Adopt and implement environmentally-responsible practices for all areas of the facility and grounds. Adopt practices and technologies that conserve natural resources, including water and energy.
- Develop and initiate comprehensive programs for recycling, reuse and waste reduction.
- Store and dispose of solvents, cleaning materials, paints, and other potentially hazardous substances properly.
- Take active steps to educate golfers, neighbors and the general public about the golf course's environmental policies and practices.

* See also Part 5: Surface and Groundwater Protection: Equipment Maintenance, Chemical Storage and Mixing Areas for additional BMPs.

Waste Management*

- Leave grass clippings and other organic materials in place wherever possible. If clippings are removed, compost and recycle them if possible.

- Dispose of chemical rinse-water to avoid point and non-point source pollution by recycling rinse-water, or spraying out diluted compound(s) in previously untreated areas.
- Dispose of chemical packaging according to label directions, e.g. triple rinsing, recycling, or returning to manufacturer.
- Recycle or dispose of waste products such as used motor oil, electric batteries and unused solvents according to the law and available community disposal techniques.
- Purchase products that minimize unnecessary packaging to reduce waste.

Wildlife Management

- Provide buffer strips along watercourses to create habitats for wildlife species whenever feasible and environmentally desirable.
- Manage habitats to maintain healthy populations of wildlife and aquatic species.
- Adopt a policy of no application of pesticide or fertilizer in naturalized wildlife habitat areas.
- Replant any eroded areas with native plant species.
- Remove any direct discharge of stormwater to surface waters or wetlands in favor of discharge to vegetated filter strips or swales.

What Golfers Can Do

- Recognize that golf courses are managed land areas that should complement the natural environment.
- Respect designated environmentally sensitive areas within the course.
- Accept the natural limitations and variations of turfgrass plants growing under conditions that protect environmental resources e.g. brown patches, thinning, loss of color.

* See also Part 5: Surface and Groundwater Protection for additional BMPs.

- Support golf course management decisions that protect or enhance the environment and protect wildlife and natural habitat. Encourage development of environmental conservation plans.

- Encourage and support environmentally friendly maintenance practices such as aerification, reduced fertilization, limited play on sensitive turf areas, reduced watering, etc.
- Commit to long-range conservation efforts, e.g. efficient water use, integrated plant and pest management, etc. on the golf course and at home.
- Educate others about the benefits of environmentally responsible golf course management.

GOLF COURSE
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Part 4: Integrated Pest Management (IPM)

An Integrated Pest Management (IPM) system prevents and controls pests (e.g. (weeds, insects and diseases) by monitoring pests, identifying action thresholds, evaluating options, and implementing the most environmentally-beneficial control. IPM uses the least toxic control approach to address pest problems, and only uses chemical control when other strategies are not effective.

The fundamentals of an IPM plan include:

- ✓ Planning and managing turf
- ✓ Identifying potential turf pests
- ✓ Monitoring pest populations
- ✓ Establishing an action threshold
- ✓ Applying appropriate control measures
- ✓ Evaluating the effectiveness of pest control measures used

Planning and Managing Turf

- Ensure root zone mixture and subsurface drainage are properly constructed and properly drained to help minimize turf problems.
- Select appropriate turf species and cultivars for resistance to drought, insects and diseases.
- Irrigate at the appropriate time with the correct amount of water.
- Use soil testing to develop an effective fertilizer program and tissue testing to evaluate fertilizer requirements.
- Maintain the proper mowing height and remove no more than one-third of the leaf blade in a single mowing to help maintain a vigorous turf.
- Control thatch regularly by verticutting (de-thatching), topdressing and aeration (core cultivation) to alleviate compaction and improve water infiltration.

  Thatch is a tight, brown, organic layer of living and dead grass crowns, roots and stems that accumulate above the soil surface. Excessive thatch can lead to drought stress and susceptibility to insect and disease damage.

Pest Identification

- Routinely monitor for pests and correctly identify the damage and the pest.

- Determine which stage the pest is in and which stage is the most susceptible to pesticide treatment.

Monitoring

- Inspect the turf for pests regularly and systematically to determine the presence and activity of a pest before turf loss occurs.
- Keep track of weather conditions and know what conditions encourage disease and insect development.
- Monitor treatment to determine success in reducing pest population.
- Recognize that a relationship exists between temperature and insect development. The speed of insect development depends on the amount of heat accumulated above a certain base temperature.
- Establish a monitoring schedule and define monitoring units by subdividing a golf hole into green, tee and fairway. Determine how each area will be monitored.

Thresholds

- Use thresholds to determine the number of pests that turf can tolerate without causing unacceptable damage. Thresholds have been established for many common turf insect pests.
- Consider the overall health and vigor of turf when deciding if a treatment should be made.
- Maintain accurate record keeping and record all pesticide treatments made, application dates, active ingredients and treatment outcomes.

Control Measures

Cultural Control

- Select the best adapted, disease-resistant turf species for the intended use.
- Develop a nutrient management plan to address the timing and placement of fertilizers based on seasonal demand and usage of specific turf species, landscape position and weather.
- Take special care in the timing and placement of nutrients in areas of seasonally high water tables.

- Provide adequate and timely irrigation. See BMPs on Water Usage.

- Use appropriate cultivation techniques to alleviate compaction, manage thatch and maintain proper turf height.

Biological Control

- Consider using biological controls such as fungi, bacteria, viruses, nematodes and insects to inhibit turf pests.

- Apply composts that contain micro-organisms which may suppress diseases as a top dressing.

Chemical Control

- Use pesticide treatment when a pest is present in sufficient levels to cause turf damage and when the pest is most susceptible to the pesticide. Pesticides include fungicides, insecticides, nematicides, herbicides and any other chemical used to control pests.

- Use spot treatments when a pest problem is restricted to an isolated area.

- Apply pesticides with a properly maintained and calibrated equipment to insure the appropriate amount of pesticide is applied to the turf.

- Avoid spraying pesticides when the soil is saturated, or when heavy rains are imminent, or under any other conditions where surface runoff may result.

- Establish pesticide-free zones around water bodies and near drinking water wells.

- Spray pesticides when the wind is calm. Avoid drifting of pesticides towards sensitive water areas.

- Select the least toxic alternative with the least possibility of leaching and least persistence in the environment.

- Alternate pesticides with different modes of action to minimize the possibility of pests resistance to the pesticide.
- Combine cultural and mechanical practices with chemical control to reduce the frequency of chemical applications.

Evaluation

- Evaluate the Integrated Pest Management strategies periodically to determine if the plan is successful.

- Analyze treatment results, fine-tune monitoring techniques, and compare the number of treatments before and after IPM implementation.

GOLF COURSE
BEST MANAGEMENT PRACTICES

Part 5: Surface and Groundwater Protection

Design and management practices can help protect surface and groundwater and include buffer zones, stormwater management, erosion and sediment control, turf management and waste management practices. In addition, the proper handling, storage and disposal of equipment and materials and timely response to spills and accidents can have significant impacts in protecting water quality.

Buffer Zones

- Use existing woody vegetation to provide natural buffers. Protect and maintain existing woody vegetation during golf course construction and maintenance activities.
- Plant grasses and other herbaceous and woody vegetation in buffer strips where vegetation is lacking.
- Mow grass buffers infrequently, e.g. 1 or 2 times per year, to preserve the buffer and control vegetation. Remove clippings after mowing to help reduce the cycling of nutrients back into the buffer.
- Do not dispose of grass clippings or prunings in the buffer areas.

Stormwater Management

- Prevent stormwater contact with all waste and raw material storage areas.
- Discharge or divert surface runoff onto wide, flat, vegetated areas to promote infiltration and groundwater recharge. Use structural measures such as infiltration trenches, detention basins, filter beds or soaking pits. These may require site-specific, engineered design.
- Control surface runoff with appropriate filtration practices such as grassy swales, filter strips and constructed wetlands. Avoid runoff from parking lots, service areas, buildings and drives into wetlands.
- Minimize impervious surfaces by using pervious pavers for walkways, paths and parking lots. Incorporate landscaped areas in large parking lots to help maintain natural recharge.
- Use detention techniques such as wet ponds and detention basins to moderate surface runoff and store peak flows.

- Minimize the flow of runoff into natural waterways to reduce the possibility of nutrient and pesticide movement into those areas.
- Use a combination of vegetative swales, detention ponds and buffers to treat runoff from intensively managed areas like tees and greens.

Erosion and Sediment Control

- Inspect stormwater drainage pathways to determine the location and extent of any erosion.
- Use channel linings, increased channel cross-section and increased length of channel path to repair and prevent the erosion problems from recurring.
- Preserve as much existing vegetation as possible in erosion prone areas.
- Minimize the amount of exposed soil at any one time.
- Control cart traffic in highly erodible areas.
- Stabilize and maintain stream banks and ditches to limit erosion.
- Maintain roughs at 2" to 3" mowing heights to act as additional buffers.

Turf Management*

- Do not apply fertilize to soggy areas until the water table is lowered enough for the turf to be able to absorb the nutrients.
- Avoid spraying pesticides when the soil is saturated, or when heavy rains are imminent, or under any other conditions where surface runoff may result.
- Establish pesticide-free zones around water bodies and near drinking water wells.
- Spray pesticides when the wind is calm. Avoid drifting of pesticides towards sensitive areas or water.
- Locate compost piles away from surface waters, wetlands and floodplains and avoid steep slopes and areas with high water tables to reduce nutrient loads to waterways.

* See also Part 3: Operations and Maintenance for additional BMPs.

Equipment Maintenance, Chemical Storage and Mixing Areas*

- Store and maintain vehicles and equipment on covered, sealed, impervious areas.
- Locate fueling facilities on concrete paved areas and in paved, roofed areas equipped with spill containment and recovery facilities.
- Eliminate floor drains unless they drain to storage tanks.
- Keep containment booms and absorbent materials on hand for the remediation of spills.
- Provide secondary containment for all hazardous materials including liquid fertilizer storage areas.
- Store all hazardous materials in sealed, locked areas or buildings. Identify locations for these materials on the site plan. Register all materials with the fire marshal.
- Locate pesticide, fertilizer and hazardous material storage, mixing and loading areas in separate areas to avoid confusion with one another.
- Provide impervious surfaces in mixing areas.
- Dispose of hazardous materials according to the label and regulations.
- Buy fertilizer and pesticides in limited quantities and do not store large volumes of chemicals on site.
- Minimize the use of underground fuel storage tanks and eliminate chemical storage tanks in drinking water and groundwater supply areas.

Spill Response

- Develop plans to be followed in case chemicals are spilled. Identify all potential hazards; develop safe handling procedures; and incorporate appropriate spill response procedures into this plan.
- Clearly identify the appropriate responding authorities. Maintain a list of people to be notified in the event of a spill.

* See also Part 3: Operations and Maintenance for additional BMPs.

Waste Management Plan*

- Dispose of all non-hazardous wastes and litter in trash cans, dumpsters, or other appropriate receptacles.
- Properly store, recycle or dispose of waste products such as used motor oil, electric batteries, and unused solvents according to the law and available community disposal techniques.
- Use septic systems for domestic sewage waste only. Do not dispose of process waste water, hazardous waste, or raw chemicals down the drain because they can pass untreated to ground water.

* See also Part 3: Operations and Maintenance for additional BMPs.

GOLF COURSE
BEST MANAGEMENT PRACTICES

Part 6: Monitoring Program

Monitoring programs should be an integral component of golf courses to demonstrate that the environmental impacts are negligible or non-existent, and/or that environmental impacts must be mitigated. Operational and environmental monitoring programs are two types of monitoring programs that should be included as BMPs for golf courses.

An operational monitoring program tracks water usage, fertilizer application, turf management (seeding and cutting), and other routine management actions to improve golf course management. An effective operational monitoring program:

- ✓ identifies specific management requirements (watering rates, pesticide and fertilizer application triggers and rates) for each area of the golf course (tees, roughs, wetlands, buffers, fairways, etc.),
- ✓ includes emergency contingency plans and triggers for implementation, and
- ✓ identifies responsible employees and government agencies so that environmental problems can be dealt with quickly.

An environmental monitoring program tracks sensitive resources at risk, where mitigation may be required, or where public concern warrants it. This monitoring program will ensure that environmental safeguards are effective and identify unforeseen impacts.

Hawai'i Water Quality Monitoring Program

The Hawai'i State Department of Health has prepared groundwater monitoring guidelines for golf courses. Please refer to the Department of Health's Guidelines Applicable to Golf Courses in Hawai'i, July 2002, for more information. If a golf course uses recycled water (treated wastewater), please refer to the Department of Health's Guidelines for the Treatment and Use of Recycled Water, May 15, 2002.

In addition, the following water quality monitoring BMPs are recommended.

- Develop a water quality monitoring program that is scientifically based, include action thresholds, provide corrective action(s), specify sampling schedules and reflect the hydrologic conditions and management practices for the golf course.

- Use lysimeter sampling to monitor surface runoff and leachate in surface water, irrigation lakes, catch basins and other on site locations and to determine water quality within the golf course.

- Monitor adjacent surface water bodies to identify water quality impacts on a watershed basis.

- Monitor groundwater to determine the impact, or potential impact on the underlying aquifer.

- Have sampling locations and sampling parameters reviewed and approved by the Hawai'i State Department of Health, Safe Drinking Water Branch.

- Collect sufficient water quality monitoring data to identify and establish background levels and provide specific "trigger levels" for corrective action after background levels have been established.

- Undertake corrective action if sampling data is above approved background levels.

- Maintain all sampling locations and equipment in proper condition at all times.

- Perform all water quality sampling, documentation, handling and analysis in accordance with standard scientific methods recognized by the U.S. Environmental Protection Agency and approved by the Hawai'i State Department of Health.

- Use independent licensed laboratories to analyze all water quality samples. All laboratories should utilize detection limits that are lower than initial "trigger level," and background concentrations after they have been determined for any analyte.
- Submit quality assurance/quality control samples to the laboratory with each sample.

- Provide a copy of the analytical reports and testing laboratory's quality assurance/quality control data to the Hawai'i State Department of Health, Safe Drinking Water Branch.

2. DOH "10 Conditions" (2002)

STATE OF HAWAI'I
DEPARTMENT OF HEALTH
July 2002 (Version 6)

GUIDELINES APPLICABLE TO GOLF COURSES IN HAWAI'I

The State Department of Health recommends the following guidelines for all golf courses in Hawai'i to promote, protect, and enhance environmental quality and public health. These recommendations cover measures that could prevent groundwater and surface water pollution, soil contamination, chemical spills, noise and solid waste nuisances, and unsafe exposure to applied chemicals. Under certain situations, a state or county regulation may be necessarily applicable to a given activity, and such a regulation would require mandatory compliance. However, the intent of these guidelines is to voluntarily foster environmental protection and safety. Thank you for supporting these guidelines and caring about Hawai'i.

1. A groundwater or soil water monitoring plan for the purpose of preventing or minimizing groundwater contamination should be established with the following components:

   a. Baseline groundwater quality;

   b. Monitoring locations consisting of monitoring wells or lysimeters, or combination of both;

   c. Routine groundwater and/or soil water monitoring at frequencies such as quarterly, semiannually, or annually depending on the use of chemicals and the detection of contaminants;

   d. A list of chemicals and fertilizers that will be or have been used that may affect soil or groundwater adversely, and the analyses for such contaminants;

   e. Recordkeeping of monitoring results and a system of tracking trends in order to prevent, minimize, or mitigate occurrences of contamination;

   f. A procedure to notify all affected parties and the Department of Health of occurrences of contamination that pose, or may pose, a threat to public health or the environment.

   g. Availability of monitoring data to any interested person.

2. A surface water monitoring plan, if applicable, for the purpose of preventing or minimizing surface water contamination should be established using the principles of item No. 1.

3. If the golf course uses recycled water (treated wastewater) for irrigation, please refer to the Department of Health's Guidelines for the Treatment and Use of Recycled Water, May 15, 2002, for recycled water requirements. Information about this subject may be obtained from the Department's Wastewater Branch at 586-4294 (Honolulu).

4. The use of an above-ground storage tank with applicable safety considerations for petroleum products, used for fueling golf carts, maintenance vehicles, or emergency generators, should be preferred over an underground storage tank in order to easily detect leaks and minimize the risk of soil and groundwater contamination resulting from a leaking storage tank. Information about underground storage tanks may be obtained from the Department's Solid and Hazardous Waste Branch at 586-4226 (Honolulu).

5. Buildings used to store fertilizers, pesticides, algicides, fungicides, herbicides, and other chemicals especially in liquid form should be designed purposely for the containment and recovery of a catastrophic spill or leak of contents. An early warning system for spill or leak detection is advantageous.

6. Noise and dust from maintenance or construction activities should not disturb neighbors. Maintenance or construction activities should be scheduled and conducted accordingly.

7. Solid wastes should be managed without creating a nuisance. Furthermore, all green waste generated by the golf course should be reused on-site. Shredding and composting are activities that precede the reuse of green waste as a soil conditioner or a ground cover for weed control. Space and equipment should be provided to accomplish these activities. Additionally, where practicable, locally produced compost and soil amendments should be used whenever available.

8. Chemicals should be handled and applied according to instructions, and offsite drift during application should not occur. Methods of application and weather conditions should be chosen to optimize success.

9. A Best Management Practices (BMP) plan should be made for the golf course. The BMP plan functions as a hands-on environmental and worker safety maintenance manual that describes in plain English the elements and procedures for irrigation, chemical use, processing and reuse of green wastes, minimizing or preventing runoff, soil erosion and nuisance conditions, and sustaining worker safety. Use of the BMP should prevent the occurrence or recurrence of environmental or safety problems. The BMP should be available to any interested person.

10. Agencies or organizations such as the State Department of Agriculture, the Federal National Resource Conservation Service, and the Golf Course Superintendents Association of America may provide ideas or practices that would help to achieve the intent of these guidelines. Inquiries to these sources of information are advantageous.

The Department of Health appreciates your cooperation to preserve and protect environmental quality in Hawai'i. Questions about these guidelines may be directed to the Groundwater Pollution Control Section of the Safe Drinking Water Branch at 586-4258 (Honolulu). Direct toll free calls can be made from Kaua'i: 274-3141, ext. 64258; Maui: 984-2400, ext. 64258; Big Island: 974-4000, ext. 64258; Molokai and Lana'i: 1-800-468-4644, ext. 64258.

3. DOH "12 Conditions" (1992)

STATE OF HAWAII
DEPARTMENT OF HEALTH

January, 1992 (Version 4)

TWELVE (12) CONDITIONS APPLICABLE TO ALL NEW GOLF COURSE DEVELOPMENT

The following conditions are recommended for all new golf course development in Hawaii to assure that environmental quality is preserved and enhanced as it relates to human health and the protection of sensitive ecosystems. Additional conditions may be imposed based on site-specific considerations.

1. Baseline groundwater/vadose zone and/or, if appropriate, coastal water quality shall be established. Once the sampling plan has been determined and approved by the State Department of Health, the owner/developer shall establish the baseline groundwater/vadose zone water quality, and, if appropriate, nearshore water quality, and report the findings to the State Department of Health. Analyses shall be done by a laboratory approved by the Department of Health.

2. The owner/developer and all subsequent owners shall establish a groundwater monitoring plan and system which shall be presented to the State Department of Health for its approval. The groundwater monitoring plan and system shall minimally describe the following components:

   a. A monitoring system tailored to fit site conditions and circumstances. The system shall include, and not be limited to, the use of monitoring wells, lysimeters, and vadose zone monitoring technologies. If monitoring wells are used, the monitoring wells shall generally extend 10 to 15 feet below the water table.

   b. A routine groundwater monitoring schedule of at least once every six (6) months, or more frequently, if required by the State Department of Health in the event that the monitoring data indicates a need for more frequent monitoring.

   c. A list of compounds which shall be tested for as agreed to by the State Department of Health. This list shall include, but not be limited to the following: total dissolved solids; chlorides; PH; nitrogen; phosphorus; and other compounds associated with fertilizers, biocides, or effluent irrigation.

3. If the data from the monitoring system indicate increased levels of a contaminate that poses, or may pose, a threat to public health and the environment, the State Department of Health shall require the owner to take immediate action to stop the source of contamination. Subsequently, the owner shall mitigate any adverse effects caused by the contamination.

4. Owner/developer shall provide sewage disposal for the clubhouse and other facilities by connecting to the public sewer system or by means of a treatment individual wastewater system approved by the Department of Health in conformance with Administrative Rules, Title 11, Chapter 62, Wastewater Treatment Systems. The use of wastewater for irrigation will be generally encouraged, with appropriate controls (see Condition 5).

5. If a wastewater treatment works with effluent reuse becomes the choice of wastewater disposal, then the owner/developer, and all subsequent owners, shall develop and adhere to a Wastewater Reuse Plan which shall incorporate the provisions of the Department of Health's Guidelines for the Use of Reclaimed Water which includes:

   a. An Irrigation Plan encompassing buffer distances, pipe and appurtenance placement, and labeling.

   b. An Engineering Report encompassing treatment options and treatment levels.

   c. Hydro-geologic and hydrologic surveys to determine application rates, sizing and storage needs.

   d. A monitoring plan.

   e. A management plan.

   f. Public and employee education plans.

6. Underground storage tanks (USTs) used to store petroleum products for fueling golf carts, maintenance vehicles, and emergency power generators that pose potential risk to groundwater shall be discouraged. Use of electric golf carts and above-ground storage tanks for emergency power generators shall be encouraged.

   Should the owner/developer/operator plan to install USTs that contain petroleum or other regulated substances, the owner/developer/operator must comply with the federal UST technical and financial responsibility requirements setforth in Title 40 of the Code of Federal Regulations Part 280. These federal rules require, among other things, owners and operators of USTs to meet specific requirements in release detection and response, and subsequent corrective action. Also, the owner/developer/operator must comply with all State UST rules and regulations pursuant to the Hawaii Revised Statutes, Chapter 342-L, Underground Storage Tanks.

7. Buildings designed to house the fertilizer and biocides shall be bermed to a height sufficient to contain a catastrophic leak of all fluid containers. It is also recommended that the floor of this room be made waterproof so that all leaks can be contained within the structure for cleanup.

8. A golf course maintenance plan and program will be established based on "Best Management Practices (BMP)" in regards to utilization of fertilizers and biocides as well as the irrigation schedule. BMP's will be reviewed by the State Department of Health prior to implementation.

9. Every effort shall be made to minimize the amount of noise from golf course maintenance activities. Essential maintenance activities (e.g., mowing of greens and fairways) shall be conducted at times that do not disturb nearby residents.

10. Solid waste shall be managed in a manner that does not create a nuisance. Whenever possible, composting of green wastes for subsequent use as a soil conditioner or mulching material is encouraged. The composting and reuse should be confined to the golf course property to eliminate the necessity for offsite transport of the raw or processed material. In addition, during construction, the developer should utilize locally-produced compost and soil amendments whenever available.

11. Fugitive dust shall be controlled during construction in accordance with Hawaii Administrative Rules, Title 11, Chapter 60, Air Pollution Control. Pesticides and other agricultural chemicals should be applied in a manner that precludes the offsite drift of spray material. The State Department of Agriculture should be consulted in this regard.

12. To avoid soil runoff during construction, the developer should consult with the U.S. Department of Agriculture, Soil Conservation Service to assure that best management practices are utilized. If the total project area is five (5) acres or more and the development activities include clearing, grading, and excavation, a National Pollutant Discharge Elimination System (NPDES) stormwater permit application shall be submitted to the Department of Health in accordance with the Federal Clean Water Act requirements.

If there are any questions regarding the twelve (12) conditions mentioned here, please contact the Environmental Planning Office at 586-4337. We appreciate your cooperation in preserving and protecting environmental quality in Hawaii.

APPENDIX B. Facility Operations Manual and Emergency Procedures

Table of Contents

Facility Operations Manual and Emergency Procedures

This appendix satisfies multiple sections of the Maui County Zoning Condition 18; specifically, conditions 18 'e', 'f' (in part), 'g' (in part), and 'i' in part (also satisfies conditions 6, 7, 8, 11, and 12 of the DOH's '12 conditions'). The sections that are identified to be satisfied 'in part' are also partially satisfied in other sections of this document (e.g., 'f' is also satisfied [in part] in Part 3 of the main document and section F of this appendix). Condition 18 'g' will be satisfied by other documentation for the project (i.e., layout, master plan, or other submissions by Honula'ula Partners, LLC) to complete the Phase II development application process. Condition 9 of the DOH's '12 conditions' (relating to addressing noise from maintenance facilities through design and layout) will be satisfied as the project moves forward.

A. Overview

The maintenance facility will be located on approximately 1.1 acres. It will be a modern, carefully designed, fenced and secured, state-of-the-art complex containing offices, maintenance shop, employee lunch and locker room, equipment and material storage. It has been designed with the following goals in mind: operational efficiency (i.e., provide the equipment and layout required for the superintendent to do his or her job efficiently); worker health and safety protection; environmental protection (i.e., containment and management of possible spills so that the surrounding environment would not be impacted); and compliance with relevant federal, state, and local regulations.

B. Traffic Flow and Worker Access

Main access to the facility will be planned from the major entrance to the golf course complex. A secondary road will provide a direct route from the maintenance facility for maintenance vehicles (pickup trucks, golf carts, and tractors) to the golf course.

Adequate space will be designed in order to provide for a semi tractor-trailer to circle around the maintenance facility. The maintenance facility will be accessible from all sides. This will allow for emergency vehicle access as well as easy worker access. Adequate space will also be planned in front of the chemical storage buildings (TBD in site design) for emergency vehicles. Delivery of chemical products, equipment and equipment products, fuel, and bulk materials are not seen to be a problem.

C. Conceptual Stormwater Management

More detail will be provided, specifically including the actual drainage contours of the site, when the engineering report is completed by Wilson Okamoto Corporation, which will be included in the draft EIS (EISPN, 2009). This also satisfies Zoning Condition 18 'i' in part (condition 12 of the DOH's '12 conditions') relating to drainage.

The site will be graded, and curbs will be erected, so that parking lot drainage cannot flow directly into drainage features, but rather into a BMP such as a detention pond. There will

be catch basins on the east and west sides (one each) of the fuel island to capture contaminated stormwater runoff and significant spills. Minor spills will be contained within the scores (shallow grooves) around the fuel island. The two catch basins at the fuel island will contain petroleum absorbent 'pillows' (Passive Skimmers with Smart Sponges®, or equivalent) and Snout® vertical traps, or an equivalent. The latter will catch surface-floating contaminants and trash.

There will be catch basins throughout the complex, as indicated in the proposed maintenance facility site plan. One, immediately west and downslope of the storage bins, will include a special retention system to trap sand, soil, and mulch. All catch basins will be tied into a drainage system that terminates in a Vortechnics® treatment system (or equivalent) to remove sediments, floating debris, and petroleum contaminants.

The covered mixing/loading pad will have its own drainage control system. The drainage and contouring of the site will be designed by Wilson Okamoto Corporation. The stormwater management plan will be designed with consideration of the fact that runoff from the maintenance facility complex may include soil, sand, grass clippings, petroleum products (small amounts of oil and gasoline), fertilizers, and other typical hard surface runoff substances. There should be minimal to no presence of pesticides in runoff water due to the use of closed-loop recirculating systems and special containment pads (see sections D and G below).

D. Equipment Washbay

The golf course will install a recycling wash water system for the turfgrass equipment wash pad area. The recycling wash water system will be capable of capturing grass clippings, oil and grease, and trace organics. The system installed will be a closed-loop wash/recycle wash-down water system independent of the storm water drainage system. A back-up overflow system is normally installed to collect potential spills and divert the wash-down water onto the wash pad apron and/or collection system.

The wash bay will be designed so that equipment can be driven in one entrance and out the opposite entrance. The area will be approximately 500 sq ft. This system recycles the exterior equipment wash-down water for reuse as wash water. (Turf chemical spray solutions are addressed in section G below.)

Several companies provide closed-loop systems specifically designed for golf course use: RGF Inc., Chappell Supply, and Golf Structure Alternatives are examples. A list of suppliers is provided below. Filtration and treatment methods range from strictly physical (filters, separators and activated carbon) to those that incorporate environmentally friendly bacteria. All of these systems are designed for recycled wash water to eliminate the release of hydrocarbons and solid waste (grass clippings).

Closed Loop Wash System Suppliers
Carbtrol Inc. - carbtrol.com/advanced_washwater_recycle_system.html
Dultmeier - dultmeier.com
Hydroengineering Inc. - hydroblaster.com
RGF Inc. - rgf.com

Chappell Supply & Equipment - chappellsupply.com/bioandgolftreatment.htm (biological)
EPSI (Grass Grabber) - epsiusa.com/golfpage.htm
Pac Environmental GC Systems - pac-env.com/golfcoursesystems.htm
Cyclonator - megator.com/cyclonator.htm
Safety Storage Inc. - safetystorage.com
Golf Structure Alternatives - golfstructures.com

E. Fuel Storage, Pump/Fill Area, and Golf Carts

The maintenance compound will contain a fuel island of approximately 450 sq ft with a split, above-ground fuel tank. One tank will be used for gasoline, and one for diesel. Each tank should have the capacity to hold approximately 250 to 500 gallons of fuel. Both tanks will have double walls with vehicle barriers for accident prevention, and they will be covered with carport-type roofs.

The sump and concrete pad will be designed with a carport roof to protect the tanks from rainfall and evaporation. The tanks shall consist of a UL listed primary tank, a high-density polyethylene secondary compartment, and a six-inch reinforced concrete encasement. The concrete vault that provides thermal and corrosion protection can be poured on location or shipped precast. The tanks installed will conform to the Uniform Fire Code and NFPA.30 regulations for above-ground tanks. The tanks will be designed to meet the above-ground regulatory storage requirements in the State of Hawaii, and the State Fire Council (e.g., 6,000 gallons per tank up to 18,000 gallons per facility at private fleet fueling facilities, meeting the standards of UL 2085, Protected Aboveground Tanks for Flammable and Combustible Liquids, or Southwest Research Institute 93-01).

The appropriate signs indicating 'No Smoking' and 'Fuel Safety Warnings,' in addition to, an emergency cutoff switch will be installed in the fueling areas. A waste oil and solvent storage tank will be installed at the fuel storage area. Secondary containment will be able to handle twice the waste oil storage capacity. Non-hazardous waste, such as used oil which is comprised of crankcase oil, transmission fluid, gear oil, hydraulic fluid, and power steering fluid can be placed in a codified waste disposal system.

Golf carts used by golfers and other customer service vehicles (beverage carts, etc.) will be battery-powered electric vehicles requiring no fuel storage tanks. Emergency generators or any other internal combustion engine powered equipment on the property will use above ground storage tanks.

F. Pesticide and Fertilizer Storage

Pesticide storage will be in a pre-fabricated pesticide storage building specifically designed to be ventilated, fire resistant, vapor explosion resistant, vandalism protected, spill self-contained, and climate controlled. The pre-fab buildings like the ones produced by US Hazmat Storage Inc., or Hazvault Inc., can be customized for any hazardous material storage need. Often these buildings exceed code requirements for safe storage of hazardous materials. Building size

can be custom-made, and storage should be limited to a minimal amount of materials needed for one application. Typically a 400 sq ft building is sufficient for an 18-hole golf course. Several pre-fab chemical storage building vendors are listed below.

Pro-Tec Chemical Storage Buildings (cores.com/core_building.htm)
Affordable Pesticide Storage Inc.(pesticidebuildings.com)
Turfloc Inc. (chemicalbuildings.com)
US Hazmat Storage Inc. (ushazmatstorage.com)
Hazvault Inc. (hazvault.com
Safety Storage Inc. (safetystorage.com)
Golf Structure Alternatives (golfstructures.com)

The facility will be designated and posted as a pesticide storage area (as required by law), with a list of all chemicals contained in storage on file in the superintendent's office. One copy of this list will be provided to the local fire marshal. Additional copies will be located in the maintenance facility and/or clubhouse or in an appropriate file located away from the pesticide storage structure.

Pesticide Storage Facility Check List

The following operating procedures are proposed for the pesticide storage facility:

- The building will be secured and locked at all times.
- An additional key will be placed in the administrative office and in the office of the golf course superintendent in case of emergency; an equitable option is to provide a lock box at the entry to the building.
- Materials will be stored on shelves located high enough to permit cleaning of the floor. No material should be stored above 6 ft from the ground.
- All materials will have legible labels attached. Materials whose packaging has been damaged must be in containers clearly marked and labeled.
- Plastic secondary containers are used to store liquids shipped in quantities of 1 (one) gallon or more for protection against spillage.
- A fire extinguisher will be available.
- A plastic trash barrel with lid will be located inside the storage facility for cleanup.
- All golf course maintenance personnel will be trained in the operating procedures regarding this building.
- Appropriate protective clothing and equipment will be provided for use by those who handle pesticides.
- Absorbent materials designed to contain accidental spills will be available within the pesticide storage facility. An eyewash station will be available near the building.
- Disposal of pesticide containers shall comply with the instructions on the labeling and other state and federal regulations. Empty containers will not be allowed to accumulate or be stored within this building.
- The building will be inspected at least monthly by the golf course superintendent, and a record of each inspection recorded in the records for pesticide use.

Fertilizer and other dry bulk material typically contained in bag form should be stored in a separate, larger building. Size should be large enough to allow loaders or forklifts to handle materials on pallets, and be able to stack them up to three pallets high for maximum storage. This usually means a building with a large garage type overhead door with at least a 12' ceiling. Typically 800 sq ft of floor space is sufficient. A minimum amount of product should be stored in this building (i.e., enough for the next application and a little extra for spot applications). A ceiling fan that provides ventilation, with a switch by the door, should be sufficient ventilation in this building. Masonry construction for the walls of this building will prevent corrosion caused by fertilizer salts. Climate control for bulk materials is not necessary, as freezing is not a concern. When a spill occurs here, a broom and empty trash container are sufficient for clean up of dry materials. The appropriate fire extinguishers for the housed material should be placed by the entrance(s). A hazardous material placard marked for oxidizers should be displayed.

G. Mixing/Loading Area

A self-contained mixing/loading pad (concrete), that is enclosed on three sides and sloped to contain twice the capacity of the largest sprayer to be used, is recommended. The size is approximately 240 sq ft. On the low side of the pad a shallow sump hole will allow recovery (using a small electric pump) of product back to the sprayer. The purpose of this pad is to safely contain any spill, or emergency release of materials in the sprayer. In the event of a problem with a filled sprayer, the operator can release the material, repair the problem and recover the material to be sprayed.

Typically the largest sprayer used on the golf course for fairways and roughs is 300 gallons in capacity. This would require the mixing/loading pad to contain 600 gallons as a precaution. The height of the sidewalls can be calculated appropriately. This pad should also be covered to prevent rainwater filling the pad, and require pumping out after rain events. However, the main purpose is to prevent release of any chemicals or spray mix other than proper application to the turf.

H. Storage Bins

Four semi-enclosed bulk storage bins will be provided in the design. Two of them will be covered. The bins will hold various materials like topdressing sand, bunker sand, topsoil, or organic materials. The storage bins should be large enough to allow a dump truck direct access. The proposed bins will each be 16' x 16' or approximately 1024 sq ft. Proper storage of these materials maintains the integrity of the products. Sides and rear walls will be tall enough to contain the bulk materials and to prevent contamination with adjacent bins. Walls four to six feet high are adequate for this purpose.

Storage bins should have concrete floors for easy material loading. Walls will be composed of concrete block, formed concrete, or pressure-treated lumber.

I. Vehicle Maintenance and Storage

Golf course maintenance equipment and vehicles used onsite will be stored in a 5,000 ti 8,000 sq ft paved area of the maintenance facility. Drive-through overhead garage doors facilitate easy access in and out of the shop. Equipment used on a daily basis (mowers, utility vehicles) can be pulled in one side and be ready for exit the following day through the opposite doors. Equipment not used on a regular basis can be parked along the sides and accessed as needed (e.g., aerators, spreaders, topdressers).

The floor of the equipment storage area will be hard surfaced, allowing easy clean-up of oil leaks, spills, or other fluids that might come from the equipment. Proper absorbent materials should be easily accessed throughout the storage area for quick clean up of spills. No fluids should be allowed to escape this area. Floor drains are not allowed in this facility.

A modern equipment maintenance shop of approximately 3000 sq ft will be designed with considerable input from the mechanic. An equipment lift should be centrally located in the shop with adequate work benches lining the walls. Shop equipment such as air compressors, gas and arc welders, bench grinders, drill presses, and tire changers should be included in appropriate locations. A separate, well ventilated room should be constructed to house mower grinding and sharpening equipment. The entire shop area should be well ventilated, including exhaust fans to prevent the buildup of fuel vapors or exhaust fumes. Overhead exhaust hoses allow work to be done on running equipment, venting exhaust to the outside. Proper fire extinguishers will be placed by all doors and exits.

J. Worker Training, Personal Protection, and Eyewash Stations

It is important for the golf course superintendent to implement a worker-training program. Workers should be trained in safety procedures for operating equipment, handling fertilizers, fungicides, herbicides, and insecticides. Training should be done upon employee hiring and continued on a regular basis. Other areas of training include spill response, first aid, blood borne pathogens, proper golf course etiquette, maintenance techniques, employee benefits, turf management, fire safety procedures, and use of safety devices.

First aid kits and eye wash stations should be placed at various locations throughout the maintenance facility. Typically these items are placed near areas where accidents could occur. Examples are: mechanic's work space; reel or blade grinding area; pesticide or fertilizer storage areas; employee area (lunch room); and fuel station. All employees need to be trained in the location and use of first aid kits and eye wash stations.

Personal protective equipment (PPE) will be supplied to all appropriate employees (e.g., superintendent, applicators, etc.). PPE includes, but is not limited to, hard hats, eye protection, dust masks, proper gloves (e.g., chemical resistant) as needed, chaps, and ear protection. Some other specialty items may be required for individuals using specialized equipment or products (e.g., welder's face mask and fitted respirators for pesticide applicators).

The above mentioned safety and worker protection precautions are included but not limited to the HIOSH (Hawaii Occupational Safety and Health) regulations for Hawaii. OSHA (Occupational Safety and Health Administration) and HIOSH organizations' regulatory information and worker safety programs are to be maintained by the golf course's management team in place for the workers' protection and safety.

K. Emergency Management Plan

Two types of emergency spill plans could theoretically be required under EPA's 40 CFR Part 112 regulations, but the more comprehensive Spill Prevention Control and Countermeasure Plan is not required due to the facts that: the golf course will not be storing 1320 or more gallons of petroleum products above ground; no single fuel tank will have a capacity of 660 gallons or more; and there will be no underground storage tanks for fuel.

An emergency management plan will be written after the maintenance facility is built that will contain the following information.

ACCIDENTAL SPILL RESPONSE PROCEDURE

The following information and materials must be in place and an inventory of these items posted in the chemical storage area:

- Telephone numbers for emergency assistance, including Maui County law enforcement and fire departments;
- Sturdy gloves, footwear, and aprons that are chemical-resistant to most pesticides (e.g., foil-laminate gear), and protective eye wear;
- An appropriate respirator for any materials where one is required during handling activities or for spill cleanup (reference Material Safety Data Sheets on file for each product used);
- Containment 'snakes' or booms to confine the leak or spill to a small area;
- Absorbent materials, such as spill pillows, absorbent clay, dry peat moss or sawdust to soak up liquid spills;
- A water spray mist bottle to keep dry spills from becoming respirable dust during cleanup;
- A shovel, broom, and dustpan made from non-sparking and non-reactive materials;
- Heavy duty liquid detergent;
- A fire extinguisher rated for all types of fires;
- Any other spill clean-up items specified on the labels of any products used; and
- A sturdy plastic container with tightly closing lid that will hold the volume of material from the largest pesticide container being handled.

Reporting the Spill. The golf course superintendent or his/her assistant will be notified as soon as possible following a spill and have the responsibility of reporting all chemical spills to all responsible parties.

The following should be included when reporting a chemical spill:

1. Name and phone number of reporting party;
2. Time and location of spill;
3. Identity and quantity of material released; and
4. Status of containment and clean-up.

Controlling the Spill. Onsite responders should (a) protect themselves with appropriate protective clothing and eye-wear, (b) stop the source of the spill, (c) protect others by warning them of the spill, and (d) stay at the site until the spill is cleaned up.

Containing the Spill. Onsite responders should (a) confine the spill as quickly as possible, (b) protect water sources and water resources, (c) use absorbent material for liquid spills, and (d) cover dry materials to prevent them from becoming airborne or solubilized.

L. Personnel Areas

The typical golf course maintenance facility requires approximately1500 to 2500 sq. ft. that is dedicated to offices, restrooms, and an employee lunch and break room. This area needs to have separate ventilation and plumbing from pesticide and fertilizer storage areas. Offices are usually part of the main maintenance building. Office and staff areas should be equipped with appropriate climate control units, plumbing, telephone, and communications. Multiple phone lines for the superintendent, assistant superintendent, and mechanics will be needed. Additionally, fax machines, office computers, and a dedicated irrigation computer (discussed in Part 2: section B) and a weather station will be needed. All office equipment and individual phone needs will be considered in the design of this area. This area is where the superintendent, assistant, mechanics, and staff give and get their daily assignments, take breaks, and eat lunch. Therefore it should be an environment where all employees feel comfortable.

Generally, the superintendent and assistants have separate offices totaling 300 to 500 sq ft. These offices house the irrigation computer, office computers, fax, and other office machinery. The superintendent will conduct meetings with vendors, members, and staff here. Privacy and a professional appearance should be considered.

The mechanic should have dedicated office space that can also double as a parts storage area. Approximately 300 to 500 sq ft should be planned to this, either as part of the 1500-2000 sq ft offices/lunchroom space or the 1500-3000 sq ft repair shop space. Shelving and desk space will provide the mechanic with sufficient space to maintain records and provide storage for routine items such as filters, hoses, bedknives, and other parts used on a regular basis. A dedicated telephone line will provide the mechanic with the ability to contact his vendors, while keeping dirt and grease out of other office areas.

The remaining space (1000 sq ft or more) can be dedicated for employee-shared space. Restrooms should meet all current code requirements. Shower facilities and locker space can be located in the restroom area. Male and female accommodations should be separate and equal, and ADA accessible. The lunch area should be large enough to hold the entire staff for lunch/breaks, meetings, training, and other group activities. Typically a refrigerator/freezer, sink, and microwave oven are provided in the lunch area.

The maintenance facility is a direct reflection of the golf course. A neat, well-organized, clean work space in the shop usually translates to the same in the field. All of the top golf courses have excellent maintenance facilities. Table B-1 provides a summary of dimensions for the proposed maintenance facility.

Table B-1. Summary of Proposed Dimensions for the Maintenance Facility

	Square Feet	**Comments**
1. Main Structure		
Offices/Lunchroom	1500-2000	
Repair Shop	1500-3000	Includes part storage
Subtotal	***3000-5000***	
2. Storage Areas		
Equipment Parking	5000-8000	Large, small equipment
Fertilizer & Seed Storage	800	
Pesticide Storage	400	Self contained structure
Subtotal	***6200-9200***	
3. Exterior Areas		
Storage Bins	1024 total	4 bins
Equipment Washing	500	
Chemical Mixing/Loading	240	
Fuel Island	450	
Subtotal	***2214***	
TOTALS	**11,414-16,414**	

APPENDIX C. Relevant SLUC Findings of Fact (1994)

BEFORE THE LAND USE COMMISSION

STATE OF HAWAII

In the Matter of the Petition of PALAUEA BAY PARTNERS To Amend the Agricultural Land Use District Boundary into the Urban Land Use District for approximately 669.387 acres at Paeahu, Palauea and Keauhou, Makawao District, Maui, Hawaii, TMK Nos.: 2-1-08: 43, 56 (por.), 71	DOCKET NO. A93-689 FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER

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

SEP 20 1994 by [signature]
Date Executive Officer

LAND USE COMMISSION
STATE OF HAWAII
SEP 20 7 47 AM '94

FINDINGS OF FACT,

CONCLUSIONS OF LAW, AND DECISION AND ORDER

EXHIBIT "A"

BEFORE THE LAND USE COMMISSION

STATE OF HAWAII

In the Matter of the Petition of PALAUEA BAY PARTNERS To Amend the Agricultural Land Use District Boundary into the Urban Land Use District for approximately 669.387 acres at Paeahu, Palauea and Keauhou, Makawao District, Maui, Hawaii, TMK Nos.: 2-1-08: 43, 56 (por.), 71	DOCKET NO. A93-689 FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER

FINDINGS OF FACT,

CONCLUSIONS OF LAW, AND DECISION AND ORDER

PALAUEA BAY PARTNERS, a Hawaii limited partnership, ("Petitioner"), filed a Petition for District Boundary Amendment on August 6, 1993, and a First Amendment to the Petition on June 29, 1994, (cumulatively "Petition"), pursuant to chapter 205, Hawaii Revised Statutes, ("HRS"), and chapter 15-15 Hawaii Administrative Rules ("HAR"), to amend the Land Use District Boundary to reclassify approximately 669.387 acres of land at Paeahu, Palauea and Keauhou, Makawao District, Island and County of Maui, State of Hawaii, specifically identified as Tax Map Key Nos. 2-1-08: parcels 43, portion of 56 and parcel 71, ("Property" or "Petition Area") from the Agricultural District to the Urban District, to develop a planned residential community, commercial area, two (2) golf courses, parks, open space, roadways and an electrical substation ("Project"). The Land Use Commission ("Commission") having examined the testimony and evidence

FERTILIZER AND PESTICIDE USE

66. Through compliance with the approved Integrated Golf Course Management Plan ("IGCMP") and the practices of responsible turf management, the Project is not expected to have any significant adverse impact on the basal aquifer, nearshore organisms or residents.

67. In July 1993, the Department of Health gave final approval to the IGCMP for the Project, which specifically addresses how golf courses should be developed and managed in a manner to minimize any potential impacts related to fertilizers or pesticides.

Done at Honolulu, Hawaii, this 20th day of September 1994, per motion on September 8, 1994.

LAND USE COMMISSION
STATE OF HAWAII

By ______
JOANN N. MATTSON
Chairperson and Commissioner

By ______
TRUDY K. SENDA
Vice Chairperson and Commissioner

By ______
ALLEN K. HOE
Commissioner

By (abstain)
M. CASEY JARMAN
Commissioner

By (abstain)
ALLEN Y. KAJIOKA
Commissioner

By ______
LLOYD F. KAWAKAMI
Commissioner

By ______
EUSEBIO LAPENIA, JR.
Commissioner

By ______
RENTON L. K. NIP
Commissioner

By ______
ELTON WADA
Commissioner

Filed and effective on
September 20, 1994

Certified by:

______
Executive Officer

APPENDIX D. USGA Greens Construction Methods

USGA Greens Construction Methods

A. Shaping Procedures

The putting surface should be graded with the green cavity excavated to a depth of 18" (12 inches if top soil is to be added later); such grade to be approved by the designer. Once such approval is made, the Contractor is then responsible for installing the putting surface according to the specifications. The finished grade will identically replace the originally approved sub-grade.

B. Sub-Grade and Compaction

The contours of the sub-grade should conform to the proposed finish grade with a tolerance of plus or minus one inch. The sub-grade should be compacted to approximately a 90% ASTM modified proctor, as specified, to prevent future settling that might create water-holding depressions in the sub-grade surface and corresponding depressions in the putting surface. It will be noted that layers of materials above the sub-grade consist of 4" of gravel, 2" of coarse sand, and 12" of topsoil mixture. Thus, the total depth will be eighteen inches.

It is important to note that the collar of the green is included in these specifications with the only difference being an eventual higher height of cut.

C. Drainage

Drainage is the most important feature of greens built to USGA specifications. All materials must be tested and approved by a USGA recommended laboratory. Clean workmanship and adherence to the designer's methods and specifications is essential to building the highest quality putting greens.

A pattern of the drainlines will be laid out on the sub-grade with marking paint by the designer or the designer's designee. Drainlines will be installed no more than twenty feet apart, in a typical herringbone pattern, in straight lines with 45 degree fittings. Whenever possible, the mainline drain on each green shall run along the line of maximum fall. A semicircular 'smile' drain should be installed at the lowest point of the green cavity at the mainline exit point. The location of suitable outfalls and sumps will be designated by the designer. Frequently, green drains are directed to larger storm water drains around the green or approach area. The outfall or end of the drainline must be protected from crushing and screened from burrowing animals.

Trenches eight inches in diameter and twelve inches deep should be excavated along the lines in the sub-grade by trenchers or mini-excavators. All soil excavated from the trenches will be removed from the green cavity. All drainlines will have a minimum of 0.5 % slope. Trenches should then be lined with washed pea gravel of 1/4 to 3/8 inch diameter (as approved by a USGA recommended laboratory). All pipe shall be four inches in diameter corrugated plastic ADS N-12 with smooth interior walls. Only those fittings and connectors recommended by the pipe manufacturer will be used. At the upper end (or highest point) of each green, the mainline shall exit the green cavity 2 to 3 feet and directed to the surface with a 90 degree elbow and capped at grade with a 4-inch grate. This allows air to enter the system, improving drainage and providing a 'clean out' for flushing drainlines in the future. A 14-gauge insulated copper wire (sprinkler system wire) should be installed alongside the mainline drainpipe from the clean-out grate to the outfall so the pipe can be located with tracking devices. With the pipe in place, the trenches should be filled with gravel with care taken to keep the pipe in the middle of the trench. When the drainlines are covered, a grid of 36-inch survey stakes should laid out and clearly marked at 4 inches for the gravel layer and at 16 inches for the rootzone mix (an additional 2 inches is needed if a choker layer is required) with the top of the stakes spray painted with a bright color for visibility.

D. Plastic Interface

To prevent capillary water movement between the greensmix and surrounding site soils, a plastic interface shall be installed to ring the putting green and collar. The plastic will be one millimeter in thickness and two feet in width. The plastic will be placed vertically around the cored sub-grade so that the top coincides with the height of the finished grade. The sheet shall be staked at five foot intervals to ensure that it remains in a vertical position. A 14-gauge tracer wire should be installed alongside the plastic to allow future tracking and location of original edges.

E. Gravel Base

The entire sub-grade should be covered with a layer of clean, washed pea-gravel or crushed stone to a uniform thickness of four inches. The preferred material for this purpose is washed pea gravel (with less than 3% combined silt and clay) of 1/4" to 3/8" diameter (as approved by a USGA recommended testing lab). Particles of any other size will be screened out. This is important to the proper functioning of the perched water table (see sub-section f below).

F. Intermediate Sand Layer

Creation of a perched water table is essential in USGA putting green construction. It is imperative to work closely with a USGA-approved soil testing laboratory in the selection of all materials. Depending on the particle sizes of gravel and rootzone mix, an intermediate sand layer may be required. If the gravel is relatively large in particle size and the rootzone mix is relatively small in particle size, an intermediate sand layer is required to prevent the migration of rootzone particles into the gravel layer and also to create the perched water table effect. However, engineering principles can be used in material selection to create bridging between the smallest 15% of the gravel particles and the largest 15% of the rootzone particles thereby eliminating the need for the intermediate sand layer. Eliminating the intermediate sand or choker layer is desirable - - not only in the cost of the material but in the hand labor required to spread a thin 2-4" layer of sand. This has been an over-abused and confusing part of the USGA specifications for years.

G. Rootzone Mixture

Selection of the rootzone mix is one of the most important decisions made during construction. Sand is the primary component of rootzone mixes, but sands vary widely in physical characteristics and are frequently blended with organic matter to increase moisture and nutrient retention. Thorough testing by a USGA recommended laboratory is required, and a quality control program during construction is strongly recommended. It is entirely possible for a sand to meet USGA specifications without organic amendments. However, these straight sand greens frequently have poor nutrient and moisture retention and will require more fertilizer and irrigation. While there are many straight sand greens on Maui, a small fraction of organic matter, even 10% will reduce the need for fertilizer and irrigation. Peat moss is normally used for this organic fraction. However, due to the lush environment of Maui, there are many high quality composts available that may be a possible substitute. Laboratory testing will determine the suitability of compost for rootzone mix. Inorganic soil amendments such as Zeolite™ and porous ceramic products such as Profile™ should be avoided. These products are designed to hold moisture without increasing the soil's cation exchange capacity. Problems arise if water quality deteriorates. These water holding amendments will then be retaining water with contaminants and make the greens difficult to

flush. Suitable sands are somewhat limited on Maui and may need to be imported. There are sand and peat suppliers on Maui capable of supplying putting green rootzone mixes however. This convenience satisfies the very important requirement of off-site mixing. Under no circumstances should any amendment be mixed on-site by tilling, etc. The use of local materials is highly desirable as freight costs frequently surpass the cost of the materials themselves.

The final rootzone mixture will be decided by laboratory analysis. The basis of that decision is determined primarily by particle size and distribution as summarized in Table 1 below.

Table 1. Particle Size Distribution of USGA Rootzone Mix

Particle Type	Particle Diameter	Recommendation (by weight)
Fine Gravel	0 - 3.4 mm	Not more than 10% of the total particles in this range, maximum of 3% fine gravel
Very Coarse Sand	1.0 – 2.0 mm	Minimum of 60% of the particles must fall in this range
Coarse Sand	0.5 – 1.0 mm	
Medium Sand	0.25- 0.50mm	Not more than 20% of the particles may fall in this range
Fine Sand	0.15-0.25mm	
Very Fine Sand	0.05-0.15mm	Not more than 5 % total particles
Silt	0.002-0.05mm	Not more than 5% in this range not to exceed 10%
Clay	Less than 0.002	Not more than 5%

Other considerations in sand selection are particle shape and chemical properties. Particle shape has some influence on the physical properties of the rootzone mix. Sand particles that are too round in shape may cause a lack of surface stability resulting in scalping and wheel tracking problems during grow-in. Sands that are too angular may cause root shearing. These are usually short term problems. Once turf is established, particle size has little bearing on performance, but it is important to avoid extremes in particle shape. However, particle shape is extremely important in bunker sand selection. The mineral content of sand affects it's chemical properties. Quartz sands are preferred because they are chemically inert and resistant to future weathering. Calcareous and feldspar sands will weather faster than quartz but it is thought this process will take decades.

H. Organic Matter

If organic matter is included in the rootzone mix the amount is generally 10-20% by volume or 2-4% by weight. Laboratory analysis will determine the exact amount and type of organic matter to be used. As with sands, there are wide variations in peat materials and it is quite possible that composts, sawdust, rice hulls, and other organic materials can be used. Factors considered in organic matter selection are: source, pH, ash content, degree of decomposition, moisture, and fiber size and content.

Special precautions should be used with the organic matter during the mixing process. It is important not to overshred the peat which can happen to very dry material, literally turning into dust and not mixing properly. Conversely, these organic materials frequently appear clumpy and proper screening is needed so balls of material do not appear in the mix.

Table 2 below provides the recommended range for the rootzone mix after the addition of organic matter.

Table 2. Physical Properties of the Rootzone Mix

Physical Property	Recommended Range
Total Porosity	35%-55%
Air Filled Porosity (at 40 cm tension)	15%-30%
Capillary Porosity (at 40 cm tension)	15%-25%
Saturated Hydraulic Conductivity: Normal Range: Accelerated Range:	 6-12 inches/hr 12-24 inches/hr
Organic Matter Content (by weight)	1%-5% (ideally 2%-4%)

The final rootzone mix for this project should have a saturated hydraulic conductivity in the accelerated range of 12-24 inches/hr. While water quality does not appear to be an issue now, well water tends to increase in salinity with time and it will be necessary to periodically flush the greens to remove salts.

Sand is generally low in fertility. Thus it is desirable to blend fertilizer and/or lime into the rootzone mix whenever possible to accelerate the establishment of turf. This can reduce the number of fertilizer applications needed in the first few weeks after planting when traffic on the surface is detrimental to young plants. Blending also mixes nutrients uniformly throughout the profile. Soil testing will identify any nutrient deficiencies. Generally, one pound of starter fertilizer per cubic yard of mix is sufficient. A rapid grow-in will reduce weed pressure and reduce herbicide treatments.

I. Delivery, Soil Covering, Placement, Smoothing, Firming and Sterilization

Advanced planning is needed between the contractor and the supplier of the rootzone mix to schedule delivery. Most suppliers will have minimum order requirements for custom mixes, and storage of the material can pose problems for both parties. It is generally desirable to mix large quantities of material with fewer production runs, and samples should be taken of each load for quality control reasons.

A suitable storage area near the access road should be developed to stockpile material as it is delivered. Large over the road trucks generally are not able to traverse golf course construction sites. Material should be dumped and stored on a hard surface or synthetic liner to reduce contamination. Care should be taken when loading and transporting any rootzone mix to avoid contamination, and when possible, equipment should be dedicated solely for that purpose.

The rootzone should be transported to the green site with small, maneuverable tip carts, dump trailers, or small trucks, and dumped directly into the cavity around the perimeter. Small crawler type loaders should be used to spread the mix, keeping their weight on previously spread material, never on the

gravel base. The material should be compacted and watered if extremely dry. Repeated raking and firming is needed until uniform firmness is obtained.

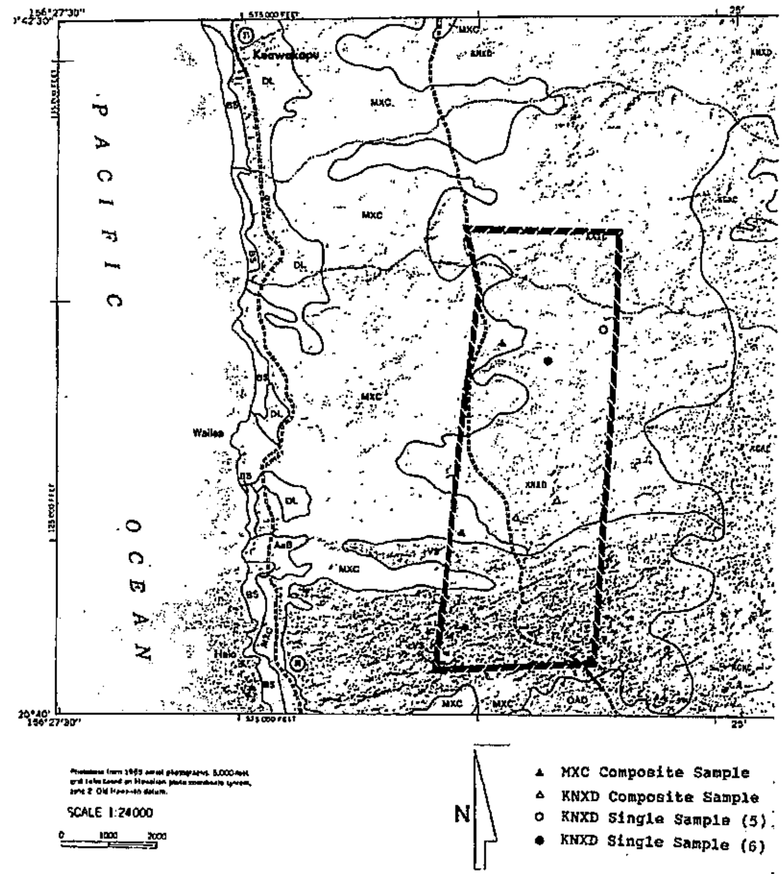
Once the rootzone mix is in place, fumigation can be considered if there is a concern for weed or nematode contamination. At this writing the use of methyl bromide is still allowed but rumored to soon be suspended and golf course superintendents on Maui report that it is already unavailable in Hawaii. There are few substitutes. Basamid, a granular product, could possibly be used as a substitute. Some soil blenders have the ability to sterilize soils with heat treatments. It is a complex problem. The seashore paspalum turf that will be used has a high level of tolerance to weeds and nematodes if fumigation proves to be impossible.

J. Fine Grading

The entire green area shall be fine graded and floated so all contours blend into fairways, bunkers, and mounds as shown on the greens plans or as directed by the designer. No water-holding pockets shall remain and slopes should not exceed the designer's specifications.

[Note: If the designer's final specifications for construction differ from the text above, the designer's specifications must be considered as alternatives from those provided.]

APPENDIX E. Soil Sampling Results



TURF DIAGNOSTICS & DESIGN

"Managing the Elements Through Science"

Environmental & Turf Services
Tom Durborow
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PHONE:301-933-4700
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Account No. 79130100
Date 3/13/92
Facility Wailea 670

		Textural Analysis					Chemical Evaluation		
		Sand	Silt	Clay	USDA Textural Class	Mean Diameter (mm)	pH	Organic Matter %	Electrical Conductivity umhos/cm
	USDA (mm)	.05 to 2.00	.002 to .05	<.002					
	U.S. Sieve (mesh)	270 to 18							
LAB ID NO.	SAMPLE NAME								
92010018-7	6-12" KNXD One location	18.3	17.1	64.5			7.2	2.5	
	Duplicates								
92010018-3D	0-6" KNXD Composite								
92010018-7D	6-12" KNXD One location							2.5	
92010018-2D	6-12" MXC Composite						6.8		

		Gravel Content			Sand Distribution				
		Gravel > 4.0mm	Gravel	Total Gravel	Very Coarse	Coarse	Medium	Fine	Very Fine
	USDA (mm)	> 4.0	2.0	> 2.0	1.0	0.5	0.25	0.10	0.05
	U.S. Sieve (mesh)	> 5	10	> 10	18	35	60	140	270
LAB ID NO.	SAMPLE NAME	% Material Retained on Sieve							
92010018-7	6-12" KNXD One location	0.0	0.1	0.1	0.6	1.9	2.7	5.3	7.9
92010018-3	Duplicate								

Reviewed by: [signature]
VP Technical Operations

A Kansas Corporation

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Account No. 79130100
Date 2/29/92
Facility Wailea 670

		Textural Analysis					Chemical Evaluation		
		Sand	Silt	Clay	USDA Textural Class	Mean Diameter (mm)	pH	Organic Matter %	Electrical Conductivity umhos/cm
	USDA (mm)	.05 to 2.00	.002 to .05	<.002					
	U.S. Sieve (mesh)	270 to 18							
LAB ID NO.	SAMPLE NAME								
-1	0-6" MXC Composite	17.8	27.2	54.6	Clay		6.8	3.3	
-2	6-12" MXC Composite	16.9	24.1	58.9	Clay		6.8	1.8	
-3	0-6" KNXD Composite	21.9	27.2	50.9	Clay		7.1	3.3	
-4	6-12" KNXD Composite	18.4	22.2	59.4	Clay		6.9	2.7	
-5	0-6" KNXD One Location	23.7	27.5	47.8	Clay		7.0	3.6	
-6	0-6" KNXD One Location	22.0	24.3	52.1	Clay		7.2	4.2	

		Gravel Content			Sand Distribution				
		Gravel > 4.0mm	Gravel	Total Gravel	Very Coarse	Coarse	Medium	Fine	Very Fine
	USDA (mm)	> 4.0	2.0	> 2.0	1.0	0.5	0.25	0.10	0.05
	U.S. Sieve (mesh)	> 5	10	> 10	18	35	60	140	270
LAB ID NO.	SAMPLE NAME	% Material Retained on Sieve							
-1	0-6" MXC Composite	0.0	0.3	0.3	0.9	1.3	2.1	6.0	8.0
-2	6-12" MXC Composite	0.0	0.1	0.1	0.5	1.0	1.6	5.9	8.5
-3	0-6" KNXD Composite	0.0	0.0	0.0	0.4	1.5	3.3	7.2	9.5
-4	6-12" KNXD Composite	0.0	0.0	0.0	0.9	1.8	2.9	5.9	7.1
-5	0-6" KNXD One Location	0.0	1.0	1.0	2.9	5.1	5.8	5.4	4.6
-6	0-6" KNXD One Location	0.0	1.6	1.6	1.5	2.9	5.0	6.3	6.4

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VP Technical Operations

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ENVIRONMENTAL & TURF SERVICES, INC. 11141 Georgia Ave. Suite 208, Wheaton, MD 20902, (301) 933-4700

Sample Chain of Custody Record

Project: WAILEA 670 Site:
Client: ENVIRONMENTAL + TURF SERVICES, INC
Address: 11141 GEORGIA AVE, STE 208 WHEATON, MD 20902
Phone: (301) 933-4700
Sampler's Name/Firm: T. DURBOROW / L. BARNES
Phone: same Sampler's Signature: L. Jon Barnes

Preservative Used / Analyses Required: pH, [illegible], TEXTURE, [illegible]

Sample Number	Date	Time	Matrix	No. of Containers	pH	[illegible]	TEXTURE	[illegible]					Remarks or Sample Location
SS#1/0-6"	1-13-92		Soil	1									MXC Composite
SS#1/6-12"	1-13-92		Soil	1									MXC Composite
SS#2/0-6"	1-14-92		Soil	1									KNXD Composite
SS#2/6-12	1-14-92		Soil	1									KNXD Composite
SS#3/0-6	1-14-92		Soil	1									KNXD One location
SS#4/0-6	1-14-92		Soil	1									KNXD One location
SS#4/6-12	1-14-92		Soil	1									KNXD One location

will call Tuesday 1/21/92 [illegible]

Samples in 2 containers shipped together

Relinquished by: (Signature) 1	Date/Time	Received by: (Signature)	Relinquished by: (Signature) 4	Date/Time	Shipping Carrier:
[signature]	1/16/92				
Relinquished by: (Signature) 2	**Date/Time**	**Received by: (Signature)**	**Received for Laboratory by: (Signature)**	**Date/Time**	**Shipping Ticket Number:** Fed-X
			[signature]	1/24/92 1500	3055101464
Relinquished by: (Signature) 3	**Date/Time**	**Received by: (Signature)**	**Sampler Remarks**	**Lab Remarks**	
[signature]	1/24/92 17:10	[signature]		9123TDD56650	

White-Return to Client Yellow-Retain by Lab (Project File) Pink-Retain by Lab (Client Services) Gold-Retain by Sampler

TURF DIAGNOSTICS & DESIGN

"Managing the Elements Through Science"

Samples Submitted By

Environmental & Turf Services
Tom Durborow
11141 Georgia Ave., Suite 208
Wheaton, MD 20902
PHONE:301-933-4700
FAX:301-933-4701

Account No. 79130100
Date 2-Mar-92
Facility Wailea 670

LAB ID NO.	SAMPLE NAME	Infiltration Rate in/hr	-1/3 Bar Water Holding % Moisture	Bulk Density g/cc	Porosity Total %	Porosity Capillary %	Porosity Non Capillary %
92010018-1	0-6" MXC Composite	0.2	26.5	1.2	53.6		
92010018-2	6-12" MXC Composite	0.9	27.0	1.1	58.8		
92010018-3	0-6" KNXD Composite	0.4	29.6	1.1	57.0		
92010018-4	6-12" KNXD Composite	0.8	27.8	1.1	57.0		
92010018-5	6-12" KNXD Composite	0.9	25.5	1.0	60.7		
92010018-6	0-6" KNXD One Location	0.8	25.7	1.1	56.8		
92010018-7	6-12" KNXD One Location	1.5	23.7	1.2	54.7		

Reviewed by: [signature]
Title: Vice President Technical Operations

A Kansas Corporation

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APPENDIX F. Pest Infestation Tables and Threshold Guidelines

Pest Problems Associated With Turf at Honua'ula

Table 1 represents the pest problems that might be encountered at Honua'ula. They are listed in the order of insects, weeds, and disease. Each of the pests listed in 6 have been given a Pest Index code that determines the probability of impact. A corresponding Frequency Index to determine the degree of likelihood that this pest should be monitored is also provided. The location of probable impact is also provided.

Preliminary Threshold Guidelines

Lists of Preliminary Threshold Guidelines have been established for each of the anticipated pests and are presented on the following pages in Tables 2-5. These thresholds set a period of time for the golf course superintendent to analyze turf pest occupancy and establish baseline density for implementing cultivation and mechanical control methods. They also have been established for the golf course superintendent to determine when a potential pesticide may be needed for control.

Development of economic thresholds in field crops attempts to relate pest populations with the amount of damage caused. This relationship can then be used to decide if the cost of applying a control will actually result in more money being made from the crop. Obviously, turfgrass is mainly used for its ornamental value and is not harvested like a field crop. This ornamental value varies according the turf use and in some cases can not even be determined. Therefore, the traditional use of 'economic' threshold should probably be changed to aesthetic threshold. Again, this is a value judgement because each person would value turf in a different way. Some people would not mind a few dandelions or brown spots in their lawn while others demand flawless turf.

Turf specialists have attempted to study the relationship of turf insects to damage observed and, unfortunately, don't seem to be able to come to any set rules. In the past, controls were recommended for annual grubs when populations reached 6-10 per square foot. We now know that skunks or raccoons may consider this number good enough reason to rip up the turf. On the other hand, with good irrigation and fertilizer over 20 grubs per square foot may not be noticeable.

TABLE 1. Location and Extent of Pest Infestation

Pest Infestation Index			
INSECTS			
Insect	**Pest Index**	**Location**	**Frequency Index**
Bagworm	P	F	1
Bermudagrass mite	P	T F	3
Bermudagrass scale	P	T F G	3
Black cutworm	O	T G	3
Fiery Skipper	P	F	1
Frit Fly	O	F R	2
Grass webworm	K	T F G R	4
Hunting billbug	O	F R	2
Lawn armyworm	O	T G	2
Rhodesgrass mealybug	O	T F	2
Southern chinch bug	O	T F R	2
WEEDS (Monocotyledons)			
Weed - Monocotyledon	**Pest Index**	**Location**	**Frequency Index**
Annual bluegrass	O	T G	3
Bahiagrass	O	T F R	2
Cyperus sedge	P	T F R	3
Dallisgrass	O	F R	3
Goosegrass	***K***	***T F G R***	***5***
Green kyllinga	P	T F R	3
Henry's crabgrass	P	T F G R	4
Hilograss	O	T F R	3
Kikuyugrass	O	T F R	3
Lovegrass	O	T F R	2
Molasses grass	O	F R	2
Purple Nutsedge	K	T F R	3
Sandbur	P	F R	1
Smutgrass	O	T F R	4
Stargrass	O	T F R	2
Swollen finger grass	O	T F R	2
Vaseygrass	O	T F R	2
Wainaku grass	P	T F G R	3
White kyllinga	O	T F R	1
Yellow Nutsedge	O	T F R	3

Frequency of Severe Outbreaks: 1-Low.....5-High
Location Index: T=Tees F=Fairways G=Greens R=Roughs
Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

TABLE 1. (cont'd)

Pest Infestation Index			
WEEDS (Dicotyledons)			
Weeds - Dicotyledons	**Pest Index**	**Location**	**Frequency Index**
Ageratum	K	T F R	4
Alternanthra	O	F R	2
Asiatic pennywort	P	T F R	4
Broad-leaved plantain	O	F R	2
Buttonweed	O	F R	2
Creeping indigo	O	F R	2
Dandelion	P	T F R	3
Drymaria	O	F R	2
Garden spurge	O	F R	2
Kaimi clover	O	T F R	3
Marsh pennywort	O	T F R	2
Milkwort	O	F R	2
Pigweed prostrate	O	T F R	3
Pigweed spiny	O	T F R	3
Pink wood sorrel	P	R	1
Prostrate spurge	O	F R	4
Purslane	O	F R	2
Sensitive plant	P	F R	3
Sow thistle	O	F R	2
Spurge spotted	O	T F R	2
Synedrella	O	F R	2
Yellow wood sorrel	O	F R	2
DISEASE			
Disease	**Pest Index**	**Location**	**Frequency Index**
Algae	K	T F G	4
Anthracnose	O	T G	3
Brown patch	K	T F G	4
Dollar spot	O	T G	2
Dreschlera leaf spot	P	T F	2
Fairy ring	O	T F G R	2
Fusarium blight	O	T G	2
Pythium blight	O	T G	4
Leaf rust	O	F	3
Melting out	K	T F	4
Nematodes	0	T F G R	1
Take all patch	P	T G	1

Frequency of Severe Outbreaks: 1-Low.....5-High
Location Index: T=Tees F=Fairways G=Greens R=Roughs
Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

TABLE 2. Preliminary Threshold Guidelines - Turfgrass Insects

INSECT DENSITY			
Area	Pest	Cultivation Controls	Curative Controls
Greens/Tees	Baqworm	3-5/sq ft	6/sq ft
Fairways		5-8/sq ft	8/sq ft
Roughs		5-8/sq ft	8/sq ft
Greens/Tees	Bermudagrass mite	1-2/sq ft	4/sq ft
Fairways		3-4/sq ft	6/sq ft
Roughs		4-8/sq ft	10/sq ft
Greens/Tees	Bermudagrass scale	1-2/sq ft	4/sq ft
Fairways		3-4/sq ft	6/sq ft
Roughs		4-8/sq ft	10/sq ft
Greens/Tees	Black Cutworm	1-2/sq ft	3/sq ft
Fairways		2-3/sq ft	4/sq ft
Roughs		3-4/sq ft	5/sq ft
Greens/Tees	Fiery Skipper	1-2/sq ft	3/sq ft
Fairways		2-3/sq ft	4/sq ft
Roughs		3-4/sq ft	7/sq ft
Greens/Tees	Grass webworm	1-3/sq ft	4/sq ft
Fairways		3-5/sq ft	6/sq ft
Roughs		5-8/sq ft	8/sq ft
Greens/Tees	Hunting billbug	3-4/sq ft	4/sq ft
Fairways		4-5/sq ft	6/sq ft
Roughs		5-8/sq ft	8/sq ft
Greens/Tees	Lawn armyworm	1-3/sq ft	4/sq ft
Fairways		3-5/sq ft	6/sq ft
Roughs		6-8/sq ft	8/sq ft
Greens/Tees	Rhodesgrass	3-5/sq ft	4/sq ft
Fairways	mealybug	5-8/sq ft	6/sq ft
Roughs		6-8/sq ft	8/sq ft
Greens/Tees	Southern chinch bug	10-15/sq ft	12-16/sq ft
Fairways		16-25/sq ft	25-30/sq ft
Roughs		26-30/sq ft	30-35/sq ft

*Currently there are no established industry standards for pest threshold guidelines. The following thresholds for insects, weeds and disease are established as a preliminary guide to assist the golf course superintendent in deciding when to choose the appropriate form of control. We fully expect that local experience will result in the refinement of these threshold guidelines.

TABLE 3. Preliminary Threshold Guidelines - Turfgrass Weeds

TURFGRASS WEEDS (Monocotyledons)			
Pest Control	Area	Cultivation Management	Curative Management
Purple Nutsedge	Tees/Greens	spot treat	post emergence
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Sandbur	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Smutgrass	Tees/Greens	preventative	spot treat
	Fairways	preventative	spot treat
	Roughs	preventative	spot treat
Stargrass	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	spot treat
	Roughs	spot treat	spot treat
Swollen finger	Tees/Greens	preventative	spot treat
grass	Fairways	preventative	spot treat
	Roughs	preventative	spot treat
Vaseygrass	Tees/Greens	mechanical removal	spot treat post emergence
	Fairways	spot treat	post emergence
	Roughs	spot treat	
Wainaku grass	Tees/Greens	spot treat	post emergence
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Yellow nutsedge	Tees/Greens	spot treat	post emergence
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence

* Control of annual turfgrass weeds on Bermudagrass greens and tees are best obtained with the use of a pre-emergent herbicide. The use of spot treatment will serve as a guide to those compounds modeled for use under the maximum number of acres treated per year.

TABLE 4. Preliminary Threshold Guidelines - Turfgrass Weeds

Turfgrass Weeds – Dicotyledons			
Pest	**Area**	**Cultivational Management**	**Chemical Control**
Ageratum	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Alternanthra	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Asiatic pennywort	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Broad-leaved plantain	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Buttonweed	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Creeping indigo	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Dandelion	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Drymaria	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Garden spurge	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Kaimi clover	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Marsh pennywort	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Milkwort	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Pigweed prostrate	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence

Turfgrass Weeds – Dicotyledons			
Pest	**Area**	**Cultivational Management**	**Chemical Control**
Pigweed spiny	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Pink wood sorrel	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	spot treat
	Roughs	spot treat	spot treat
Prostrate spurge	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Purslane	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Sensitive plant	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Sow thistle	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Spurge spotted	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Synedrella	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence
Yellow wood sorrel	Tees/Greens	mechanical removal	spot treat
	Fairways	spot treat	post emergence
	Roughs	spot treat	post emergence

* Dicot weeds may be controlled with consistent cutting heights on Greens and Tees. The use of clean treated topsoil or topsoil blended with cinder, organic matter, and ash should result in lower counts of weed infestation. Consistent monitoring and proper timing of spot treatment will result in less need for post emergent applications.

TABLE 5. **Preliminary Threshold Guidelines - Turfgrass Disease**

Turfgrass Disease			
Pest	**Area**	**Cultivation Management Threshold**	**Chemical Control Guidelines**
Algae	Tees/Greens Fairways Roughs	upon detection 24-48 hours 48-72 hours	spot treat 72 hours 120 hours
Anthracnose	Tees/Greens Fairways Roughs	upon detection 48-72 hours 48-72 hours	spot treat 96 hours 96 hours
Bacterial stripe	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	72 hours 96 hours 120 hours
Brown Patch	Tees/Greens Fairways Roughs	upon detection 24-48 hours 48-72 hours	spot treat 72 hours 96 hours
Dollar spot	Tees/Greens Fairways Roughs	upon detection 24-48 hours 48-72 hours	spot treat 72 hours 96 hours
Dreschlera leaf spot	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat 96 hours
Fading out	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat 96 hours
Fairy ring	Tees/Greens Fairways Roughs	24-48 hours 48-72 hours 96 hours	72 hours 96 hours 120 hours
Fusarium blight	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat 96 hours
Grease spot	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 24-48 hours	48 hours 48 hours 48 hours
Leaf rust	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat 96 hours
Melting out	Tees/Greens Fairways Roughs	24-48 hours 24-48 hours 48-72 hours	spot treat spot treat spot treat
Moss	Tees/Greens Fairways Roughs	upon detection 96 hours 120 hours	spot treat spot treat spot treat
Nematodes	Tees/Greens Fairways Roughs	sample counts sample counts sample counts	spot treat spot treat spot treat
Take all patch	Tees/Greens Fairways Roughs	upon detection upon detection upon detection	spot treat spot treat spot treat

*Currently there are no established industry standards for pest threshold guidelines. The following thresholds for insects, weeds and disease are established as a preliminary guide to assist the golf course superintendent in deciding when to choose the appropriate form of control. We fully expect that local experience will result in the refinement of these threshold guidelines.

APPENDIX G. Monitoring and Scouting Summary Report Example

Monitoring and Scouting Summary Report

NAME OF SCOUT OR IPM SPECIALIST____________________________
DATE____________ TIME IN_______ TIME OUT_______
Disease_________ Weed_________ Insect_______ Other______

Host Site: Tee____ Fairway____ Green____ Rough____ Ornamental____ Other________
Hole Number:_________________

Observations (Comments):

____
____
____

IDENTIFY AND CATEGORIZE PEST POPULATION

MACRO ENVIRONMENT	MICRO ENVIRONMENT
Key Pests	Potential Pests
Occasional Pests	Non Pests
Migrant Pests	

DRAW MAP

Qualitative Assessment
Low ___ Medium ___ High ___ Pest/_______Sq. Yd.
Ranking-1(low)-5(high) _______ Action Limit/_______Sq. Yd.
Turfgrass Quality ________________
Color ________________
Quantity ______________
Presence or Absence of Beneficial Organisms YES NO

Weather Information

____
____
____

Computer Weather Station Information Attached YES_____ NO_____
Disease Immunoassay Kit Used____________ Positive Identification: YES_____ NO_____
Mechanical Damage Observed or Noted (EXPLAIN CAUSE)
Form of Control Method Used
Biological
Cultivation
Follow Up:
Mechanical
Chemical
None

Signature of Golf Superintendent: ______________________________________

APPENDIX H. Updated Pesticide Risk Evaluation

UPDATED PESTICIDE RISK EVALUATION FOR THE HONUA'ULA GOLF COURSE

I. Context, Purpose, and Approach

The project previously planned for this site was called Maui Wailea 670. An EIS was prepared for the overall project ca. 1989. In March, 1992 a comprehensive package that included our golf course risk assessment, water quality monitoring program, and management plan (Durborow et al., 1992) was submitted, "Application Submittal for Change in Zoning and Project District Development Approval Phase I Kihei-Makena Community Plan Project District 9." (Our report was Exhibit F in Volume II of that submittal.) The DOH reviewed and gave final approved of that original risk assessment and management plan in 1993 (see Appendix C) and stated that "...the Project is not expected to have any significant adverse impact on the basal aquifer, nearshore organisms or residents."

Our 1992 report thoroughly evaluated potential ground water and surface water contamination risks of 16 pesticides/metabolites using hundreds of site-specific and chemical-specific input parameters. The complex USDA model SWRRBWQ (subsequently renamed SWAT) was used for the stormwater runoff evaluation, and the US EPA's linked PRZM-VADOFT model was used to estimate potential ground water contamination impacts. This work required hundreds of person-hours of work.

This project has evolved, and it has been necessary to amend the pesticide list for two reasons: the pesticides registered for use nationally and in Hawaii have changed since 1992, and the turfgrass planned for this golf course has changed. Previously, the widely used turf species bermudagrass was planned for this golf course. Since that time, a more environmentally desirable species has become available in Hawaii: seashore paspalum (Part 3(B) of this BMP plan discusses this issue in more detail.) Insect, weed, and disease pest pressures can be different for seashore paspalum compared with bermudagrass. Therefore the pesticide requirements are expected to be different, which affects the list of proposed pesticides.

Accordingly, this BMP plan lists 16 conventional pesticide active ingredients proposed for this golf course, plus other products that are 'organic'/'biorational' and/or "Reduced Risk" (EPA). Our 1992 report recommended 14 conventional pesticides. The two lists are combined in Table H-1. The proposed pesticide active ingredients listed in **bold** and in ***bold and italics*** are our 2009 recommendations, the remaining pesticides were recommended in 1992 and are not recommended now. These currently recommended pesticides (in **bold** and in ***bold and italics***) might be needed at some point during the first five years of course operation.

As noted above, the original water quality risk assessment process was site-specific, highly detailed, and resource intensive. Although it is necessary to conduct a risk evaluation of the newly proposed pesticides, it is preferable not to repeat the intensive evaluation conducted 1991-1992. Therefore the following approach was been taken.

1. Maximum pesticide application rates are provided for all pesticides: original (1992) and new (2009).
2. Environmental fate data - - pesticide mobility and persistence - - have been obtained for all pesticides and updated for the original pesticides.
3. Human and aquatic toxicity data have been obtained and used to determine the toxicity reference points.
4. The US EPA's highly conservative GENEEC pond model for surface water (http://www.epa.gov/oppefed1/models/water/geneec2_description.htm) was applied to all pesticides to estimate their environmental concentrations. The GENEEC-predicted concentrations are irrelevant to nearshore coastal waters (these predicted concentrations are much higher, more conservative), but these predicted concentrations provide a common reference point for internal comparisons.
5. Similarly, the US EPA's conservative, Tier I SCI-GROW model for ground water (http://www.epa.gov/oppefed1/models/water/#scigrow) was also applied to the updated pesticide list. These results provide an extreme upper limit on potential pesticide concentrations in Maui ground water.
6. Pesticide concentrations predicted using GENEEC and SCI-GROW were divided by the MACs (maximum allowable concentrations for aquatic organisms) and HALs (lifetime drinking water Health Advisory Levels), respectively, to produce risk ratios. Concentrations predicted by GENEEC were further diluted by onsite and upstream site runoff to refine the surface water risk ratios.
7. The risk ratios for the original and the revised pesticide lists were compared to each other in order to qualitatively evaluate their potential environmental risks.

Sections II-IV below summarizes this process and provides the results.

II. Environmental Fate, Human Health Criteria, and Aquatic Criteria

Table H-1 provides a list of all pesticides, with the currently recommended pesticides being in bold and bold italic fonts. This table also includes pesticides that were recommended in our 1992 risk assessment and golf course management plan (Durborow et al., 1992) for comparison. Expected application rates, key environmental fate parameters, aquatic maximum allowable concentrations (MACs), and lifetime drinking water Health Advisory Levels (HALs) are presented.

A. Pesticide Chemistry and Environmental Fate Properties

A risk assessment is a process that either measures or estimates the probability of harm. This is done by quantifying both exposure to particular substances and their toxicity to humans and/or other organisms. (When using EPA-based standards, a risk assessment is actually an evaluation of the probability of exceeding an action level, defined as a level just below the concentration that may cause harm, allowing for uncertainty.) Thus it can be said that the dose makes the poison, i.e., neither toxicity alone nor exposure alone determines whether a pesticide would cause harm to humans or the environment. Rather, the two must be combined.

The technical terms listed and defined below are used frequently in the risk assessment using EPA tier-I models (GENEEC and SCIGROW):

Half-life (t½) - The time required for half (50%) of the original pesticide to transform to chemicals that are nontoxic or have significantly lower toxicity. For example, the herbicide 2,4-D is degraded rapidly, with a 6-day half life in soils, depending on the climate. Modeling requires the use of rate constants, k, which are related to other terms as follows for first-order decay:

$$k = 0.693/t_{½},$$
$$k = \text{decay rate}/[P],$$

where [P] = concentration of the parent pesticide.

K_d - soil/water distribution coefficient. The higher the K_d, the more tightly bound the chemical is to the soil. This varies for each pesticide from soil to soil. Pesticides with K_d values less than 1 are very mobile in soils and can leach to ground water if they are persistent. K_d or Koc (see below) is needed for running GENEEC and SCIGROW models.

K_{oc} - the K_d divided by the organic carbon fraction of the soil. This is supposed to be constant among different soils for each pesticide that is neutral. The K_{oc} can be calculated from the water solubility if experimental data are not available.

ADI - Acceptable Daily Intake for humans in milligrams/kilogram body weight/day. Usually referred to as the reference dose (RfD) when it represents an EPA-wide consensus. This term is generally not used by the EPA anymore, but it is used by the World Health Organization.

cPAD - Chronic Population Adjusted Dose. See section B below.

RfD - See ADI.

HAL - the Health Advisory Level is an acceptable concentration level in drinking water based on the RfD. An HAL is the maximum concentration of a substance that can be consumed for a lifetime from drinking water without causing ill effects. The HALs were obtained directly from EPA when available. Otherwise, they were calculated based on cPAD, as described in section B below.

B. Human Health Risk Assessment for Drinking Water Impacts

Tier I ground water modeling results were compared with chronic (lifetime) drinking water standards or guidelines. EPA's legally enforceable Maximum Contaminant Levels (MCLs) were only available for two of the pesticides, and EPA's non-enforceable lifetime drinking water HALs were available for an additional three pesticides (www.epa.gov/waterscience/health). The remainder of the lifetime HALs was calculated as follows, generally following the approach used by the EPA's Office of Ground Water and Drinking Water. Chronic reference doses (cRfDs) adjusted with the Food Quality Protection Act (FQPA) uncertainty factors (the maximum unit dose in mg chemical/kg body weight/day calculated that one could consume without suffering any adverse effects) were generally obtained from the EPA's Office of Pesticide Programs Registration Eligibility Decision documents (www.epa.gov/oppsrrd1/reregistration/status.htm) or food tolerance notices published in the Federal Register. A secondary source was the EPA's Integrated Risk Information System (IRIS). (The first two sources are preferred because IRIS information can be less up-to-date.) The lifetime HAL was calculated using this formula for non-neurotoxic endpoints:

(1) lifetime HAL = cPAD X 70 kg body wt/2 L/day X food factor

where cPAD = cRfD divided by the FQPA uncertainty factor (usually 1, 3, or 10), and the food factor = 0.2 if there are tolerances registered for the subject pesticide on any foods other than a limited number of minor crops. Eqn. 1 is modified for neurotoxic agents by substituting 10 kg body wt/1 L/day as the consumption rate multiplier appropriate for toddlers.

Most pesticides are not considered probable or possible human carcinogens by the US EPA. (None are considered to be human carcinogens.) Theoretically, the cancer slope factor, in units of $(mg/kg/day)^{-1}$, should be used to provide an estimate of a pesticide concentration that generates a $1x10^{-6}$ (one chance in a million) risk at the upper 90% confidence level. However, this is rarely done because EPA scientists usually recommend that the RfD or cPAD (see above) be used due to the relative lack of carcinogenic potency and/or the weak confidence that the pesticide is likely to be carcinogenic in humans.

C. Risk Criteria for Fish and Aquatic Invertebrates

In general, any water quality risk assessment for a site next to a key surface water resource must consider potential impacts on aquatic vertebrates (fish) and invertebrates. Hawaii ambient fresh water quality standards were only available for one of the 31 pesticides (including 3 metabolites): chlorpyrifos. Likewise, there was only one saltwater criterion available: chlorpyrifos. The following procedure was used for the other pesticides.

The USEPA, Office of Pesticide Programs, Environmental Fate and Effect Division established a database called the Aquatic Life Benchmarks for use in ecological risk assessments. The aquatic life benchmarks are based on toxicity information presented in the data that support the registration of the selected pesticides. These benchmarks are estimates of concentrations below which the pesticide(s) are "not expected to have adverse effects" (USEPA, 2007). We obtained the lowest acute LC_{50} concentrations for the most sensitive fish species and invertebrates from the EPA's ECOTOX database (http://cfpub.epa.gov/ecotox) and calculated the MAC for those pesticides lacking federal criteria. This was done by dividing the lowest LC_{50} for the chemical by 10; i.e., multiplied the low LC_{50} values by 0.1 to obtain an estimate of the No Observable Effect Level (NOEL). This may be a conservative estimate of the exposure to fish species. In some cases, the algae EC_{50} values were lower than the 0.1 x LC_{50} values for fish and insects. When this occurred, the plant EC_{50} was used as the MAC.

D. Availability and Significance of Aquatic Toxicity Data

The US EPA and other government agencies have reported extensive databases on acute and chronic toxicity of chemicals to aquatic organisms. As extensive as these databases are, many organisms and chemicals have not been evaluated. It would be an enormous and very expensive task to evaluate each chemical for each organism. The available data are generally provided for certain indicator species, as recommended by the EPA Office of Pesticide Programs guidance document, "Hazard Evaluation Division Standard Evaluation Procedure, Ecological Risk Assessment." These indicator species are selected based on criteria such as demonstrated sensitivities to toxic chemicals and ecological significance in widespread habitats (EPA-OPP/HED, 1986). These data allow for assumptions and extrapolations to be made in assessing the risk of chemicals to other organisms (Mayer et al., 1987).

Mayer and Ellersieck (1986) and Mayer et al. (1987) conducted statistical analyses of acute toxicity data and found that correlations for toxicity exist among aquatic organisms. These correlations are best within the same families of fishes and are generally better between fish than between fish and invertebrates. Correlations are also good among invertebrates of the same families (Mayer et al., 1987). While good correlations do not imply that each species will be equally sensitive to a particular chemical, sensitivity ranges can be predicted for species with little or no data using known sensitivity data of other species. The estimated environmental concentrations (EEC) can then be compared with the low end of the sensitivities for species more taxonomically distant from the test species and compared more closely to the test values for species within the same family.

At least some aquatic toxicity data were available for all pesticides

III. Screening-Level Tier I Modeling

A. GENEEC model

The environmental fate and human and aquatic toxicity for the proposed pesticides, including three toxic degradates, described in Table H-1 were evaluated using EPA's GENEEC model (http://www.epa.gov/oppefed1/models/water/geneec2_description.htm), as noted above. The principles

for evaluation of environmental fate have been described in part by Cohen et al. (1984). The principles for human and aquatic toxicity evaluations were described in sections II(B) and (C) above.

The GENeric Estimated Environmental Concentration (GENEEC) model is a surface water screening level tier I model that was designed to mimic the results of a tier II model (i.e., PRZM-EXAMS). The model conservatively assumes a pesticide is applied to a 10-hectare field and runs off into a 1-hectare pond with no renewable source of water.

Key chemical properties (K_{oc}, soil aerobic metabolic half life, water solubility, and others) are used to evaluate the chemicals in the model. It would be impractical to cite in the table all the references that were used. However, whenever available, the US EPA and the USDA recommendations for environmental fate parameters were used. The model is also able to account for multiple applications, if applicable, and pond degradation (if aerobic aquatic metabolic half-life, hydrolysis, and/or photolysis are available). It should also be noted that GENEEC was created for agricultural scenarios, not for turfgrass scenarios, and therefore results for this risk screening assessment are overly conservative (i.e., it produces higher concentrations than expected). Further, it does not allow for the significant dilution that occurs at the shoreline. The model output consists of peak, 4-day, 21-day, and 56-day estimated environmental concentrations (EECs).

A risk ratio was computed to evaluate the potential risk of a pesticide to aquatic life. The risk ratio for each chemical was calculated by dividing the 4-day EEC from GENEEC model by its MAC. Values greater than or equal to 1 indicate a highly conservative presumption of risk with the use of the pesticide. A value less than 1 suggests that the use of the pesticide would not present a risk to aquatic life.

B. SCIGROW model

The tier I SCIGROW (Screening Concentration In Ground Water) model (v. 2.3.0.0; EPA, 2005) is a screening level model that the EPA Office of Pesticide Programs uses to calculate pesticide concentrations in vulnerable ground water. These concentrations are approximately the upper 99th percentile of actual monitoring results. The model provides an exposure value that is used to determine the potential risk to the environment and to human health from drinking water contaminated with the pesticide(s) modeled. The SCIGROW estimate is based on environmental fate properties of the pesticide(s) (aerobic soil degradation half-life and linear sorption coefficient normalized for soil organic carbon content), the maximum application rate, and existing data from small-scale prospective ground water monitoring studies at sites with sandy soils and shallow ground water. Pesticide concentrations estimated by SCIGROW represent conservative or high-end exposure values.

The SCIGROW results were used conservatively to determine a presumption of risk for humans using the HALs based on the assumptions of the assessment. This was done by computing the risk ratios (i.e., the ratio of the SCIGROW estimated concentration to the level of concern). This is used for ground water risk assessment. Values greater than or equal to 1 indicate a conservative presumption of risk with the use of the pesticide as defined in the calculations. A value less than 1 suggests that the use of the pesticide would not present a risk to human health.

C. Tier I Modeling Results

Table H-2 provides the results for the GENEEC and SCIGROW models (both model output files are available upon request) and pesticide risk ratios. Risk ratios greater than or equal to 1 (bold) indicate a presumption of risk. Two sets of risk ratios were calculated (Table H-2) for surface water based on the GENEEC results. One set was based on the GENEEC 4-day EECs in the pond; and the other set was refined and based on the same EECs; but, after additional dilution. The additional dilution accounts for surface water runoff from onsite and upstream of the site. Runoff volumes for 1-year return storm event from both onsite (8.9E7 L) and upstream of the site (2.07E8 L) were generated by the SWRRWQ model (Durborow et al., 1992). Risk ratios from the refined calculations are still conservative since there will be additional dilution and filtration before the onsite runoff reaches the ocean.

There are two new proposed pesticides (bifenthrin and chlorothalonil) with risk ratios greater than 1. The risk ratio for bifenthrin is 3.3 and that for chlorothalonil is 2.4. Both risk ratios were less than 5. We think the potential risks imposed by both pesticides will be insignificant given further dilution and filtration after initial dilution in the ocean. [Chlorpyrifos and trichlorfon risk ratios were greater than 1; however, neither of these products are proposed for use on the golf course (see discussion below).]

All risk ratios calculated from SCIGROW results for ground water are below 1, indicating the use of the pesticides would not present a risk to human health.

IV. Discussion

There are 16 pesticides that were proposed in our 1992 report (Durborow et al., 1992). Seashore paspalum will replace the previous turfgrass selection. Therefore, the new pesticide list was updated accordingly. The pesticides currently proposed include eight herbicides, three fungicides (including one reduced-risk fungicide), six insecticides (including two organic insecticides and one reduced-risk insecticide), and one plant growth regulator (see Table 2, Part 4(E) in the main body of this BMP report).

Surface water and ground water risk assessments were conducted for all pesticides using tier I screening model, GENEEC and SCIGROW, respectively. Both models are very conservative. Thus, the risk ratios calculated based on these model results tend to significantly overestimate pesticide risk potential.

Only bifenthrin and chlorothalonil show potential risks to aquatic lives of the 19 new pesticides proposed for the golf course,. However, considering the extremely conservative nature of GENEEC model

and further dilution before they reach the ocean, the chances of these two pesticides to impact water quality and aquatic lives are minimal. The risk ratios calculated from the SCIGROW results for ground water are all below 1, indicating that the use of the pesticides would not present a risk to human health.

We also calculated the risk ratios for pesticides evaluated in 1992 (Durborow et al., 1992) for risk comparison purpose and include them in Tables H-1 and H-2. The risk ratios from the SCIGROW results for ground water are all below 1. Two of the original pesticides, chlorpyrifos and trichlorfon have risk ratios greater than 1 based on the conservative GENEEC surface water assessment. The risk ratios for chlorpyrifos are approximately 10 and 92 for freshwater and saltwater, respectively (Table H-2). The risk ratio for trichlorfon is 1.5 (Table H-2). It appears that the currently proposed pesticides pose no higher risks than those proposed in 1992.

Table H-1. Pesticide Chemistry and Toxicity for the Honua'ula Golf Course: 2009 and 1992 Products

Active Ingredient*	Max. lbs a.i./yr	H_2O solubility (ppm)	Koc‡	Half life (days)		Health Advisory Levels (HALs) or MCL (ppb)	Aquatic Toxicity**
				Aerobic soil[1]	Turf field[2]		MAC (ppb)
Herbicides							
Glyphosate - new	4	12,000	2,100	2		700	21,500
Glyphosate	0.62	12,000	2,100	2		700	21,500
Foramsulfuron	0.026	3,290	89	40		>10,000‡‡	9,360
Imazaquin	1.02	60	460	60		8,750	10
Metribuzin	1.5	1,200	95	24		70	2,100
MSMA	6	57,000	300,000	90		700	234
2,4-D	2.46	900	20	5	16.2	70	12,500
MCPP-new	0.24	620	130	12	3	35	9,200
MCPP	1.3	620	130	12	3	35	9,200
Dicamba-new	1.3	4,500	8	9	8.7	4,000	14,000
Dicamba	0.24	4,500	8	9	8.7	4,000	14,000
Halosulfuron	0.124	1,650	100	18		700	2,100
Quinclorac	1.5	64	36	280		2,800	316
Oxadiazon	8	0.7	3,345	180		40	53
Potassium salts of fatty acids[3] (RR)	4.05	NA	NA	NA		NA	NA
Insecticides							
Bacillus thuringiensis[3] (RR)	0.75	NA	NA	NA		NA	NA
Spinosad (RR)	0.84	NA	NA	NA		NA	NA
Trichlorfon	16	15,400	45	5	3.1	20	18
Dichlorvos[4]	8	10,000	150	7		1	55
Chlorpyrifos	2	2	9,000	36	19.3	2	0.05, 0.011[5]
Fipronil	0.05	3.78	427	225		1.4	19
Indoxacarb (RR)	0.15	0.2	5,200	23.6		40	60
Bifenthrin	0.1	0.1	237,000	26		105	0.00225
Imidacloprid	0.54	510	530	306		399	35
Fungicides							
Fenarimol	5.44	14	716	357		42	90
Iprodione	5.44	13	500	26		280	120
Mancozeb	52.2	7.2	1,000	28		21	230
ETU[4]	14.1	2,000	3.7	2.1		0.2	134,500
Metalaxyl	2.72	7,100	35	32		420	6,250
Thiophanate methyl	5.44	3.5	1,000	1		560	167.5
MBC[4]	2.72	8	1,390	35 (est.)		90 (est)	123 (est)
Chlorothalonil	16.4	0.8	2,680	13	4.2	2	1.8
Propiconazole	0.88	100	682	60	13.5	9.2	425
Boscalid (RR)	0.47	6	1,622	337		153	82
Growth Regulator							
Flurprimidol	1	130	300	364		700	118

*Pesticides in bold are currently recommended for use on the golf course. Pesticides in bold and italics are currently recommended and were also recommended in our original report (Durborow et al., 1992) for use on the golf course. The remaining pesticides were recommended in our original report (Durborow et al., 1992) but are no longer recommended. RR = pesticides that are natural products and/or are classified by the US EPA as reduced risk pesticides.

‡ organic carbon absorption coefficient

[1] These soil metabolism half lives are derived from lab experiments in dark chambers at constant temperature. Actual field dissipation half lives will tend to be much shorter for turf in general, as shown in the table; e.g., 19 day field half life for turf vs. 36 day aerobic soil metabolism half life for chlorpyrifos, respectively. See footnote 2.

[2] Turf field dissipation half life (Magri and Haith, 2009).

**These MAC values are for freshwater, except for chlorpyrifos, for which the water quality standard for saltwater is available from the Hawaii Administrative Rules, Title 11, § 11-5-4, Department of health, September 22, 2004.

‡‡ The foramsulfuron HAL is an estimate due to its extremely low toxicity. No toxic effects were noted in the six chronic and delayed toxic studies at the highest doses tested, 500 – 1,115 mg/kg/day (US EPA Pesticide Fact Sheet [for foramsulfuron], 3/27/02).

New = new application rates are recommended.

[3] Environmental fate and toxicity parameters for these "biorational" pesticides are not listed here due to their inherent safety.

NA = not applicable

[4] ETU, MBC and dichlorvos, are metabolites of mancozeb, thiophanate methyl and trichlorfon, respectively. For modeling purposes, 27% of mancozeb was applied as ETU, 50% of thiophanate methyl was applied as MBC, and 50% of trichlorfon was applied as dichlorvos.

[5] Hawaii water quality standard for saltwater.

Table H-2. Tier I Modeling Results and Risk Ratios*

Active Ingredient[‡]	GENEEC Result[§] (ppb)	GENEEC Risk Ratio**	Refined GENEEC Risk Ratio***	SCI-GROW Results (ppb)	SCI-GROW Risk Ratio
Herbicides					
Glyphosate - new	10.23	4.8E-5	3.2E-5	2.48E-3	3.5E-6
Glyphosate	1.59	7.4E-5	5.0E-6	3.84E-4	5.5E-7
Foramsulfuron	1.20	1.3E-4	8.7E-6	1.21E-2	<1E-6
Imazaquin	28.87	2.9	0.2	1.52E-1	9.1E-6
Metribuzin	47.67	2.3E-2	1.5E-3	3.13E-1	4.5E-3
MSMA	7.73	3.3E-2	2.2E-3	3.6E-2	5.1E-5
2,4-D	48.47	3.9E-3	2.6E-4	1.21E-2	1.7E-4
MCPP - new	5.6	6.1E-4	4.1E-5	1.27E-2	3.6E-4
MCPP	30.35	3.3E-3	2.2E-4	6.87E-2	1.9E-3
Dicamba - new	32.81	2.3E-3	1.6E-4	8.57E-2	2.1E-5
Dicamba	6.06	4.3E-4	2.9E-5	1.58E-2	3.9E-6
Halosulfuron	3.54	1.7E-3	1.1E-4	1.57E-2	2.2E-5
Quinclorac	75.58	0.2	1.6E-2	3.07E+1	1.1E-2
Oxadiazon	55.91	1.1	7.1E-2	2.05E-1	5.1E-3
Potassium salts of fatty acids[‡‡] (RR)	NA	NA	NA	NA	NA
Insecticides					
Bacillus thuringiensis[‡‡] (RR)	NA	NA	NA	NA	NA
Spinosad[‡‡] (RR)	NA	NA	NA	NA	NA
Chlorpyrifos	7.44	**149(fw), 676 (sw)[1]**	**10.1 (fw), 91.9 (sw)[1]**	1.96E-2	9.8E-3
Trichlorfon	410.34	22.8	1.5	1.47	7.4E-2
Dichlorvos[2]	209.53	3.8	0.3	9.87E-2	9.87E-2
Fipronil	1.55	8.2E-2	5.5E-3	2.56E-2	1.8E-2
Indoxacarb (RR)	0.68	1.1E-2	7.7E-4	1.43E-3	3.6E-5
Bifenthrin	0.11	49.3	3.3	6E-4	5.7E-8
Imidacloprid	11.85	0.3	2.3E-2	1.92E-1	4.8E-4
Fungicides					
Fenarimol	136.76	1.5	0.1	5.48E-1	1.3E-3
Iprodione	78.66	0.7	4.4E-2	3.16E-1	1.1E-3
Mancozeb	589.14	2.6	0.2	5.27E-1	2.5E-2
ETU[2]	118.74	8.8E-5	5.9E-5	6.77E-2	0.3
Metalaxyl	122.75	1.9E-2	1.3E-3	1.21	2.9E-3
Thiophanate methyl	11.18	6.7E-2	4.5E-3	8.82E-2	1.6E-4
MBC[2]	32.06	0.3	1.8E-2	9.21E-2	1.0E-3
Chlorothalonil	64.91	36.1	2.4	1.94E-1	9.7E-2
Propiconazole	19.42	4.6E-2	3.1E-3	8.67E-2	9.4E-3
Boscalid (RR)	4.89	5.9E-2	4.0E-3	3.28E-2	2.1E-5
Growth Regulators					
Flurprimidol	31.11	0.3	1.8E-2	1.32	1.9E-3

* Key input parameters are provided in Table H-1. All surface water risk ratios were calculated based on freshwater MACs except for chlorpyrifos for which both freshwater and saltwater risk ratios were calculated.

‡ Pesticides in bold are currently recommended for use on the golf course. Pesticides in bold and italics are currently recommended and were also recommended in our original report (Durborow et al., 1992) for use on the golf course. The remaining pesticides were recommended in our original report (Durborow et al., 1992) but are no longer recommended. RR = pesticides that are natural products and/or are classified by the US EPA as reduced risk pesticides.

§GENEEC maximum 4-day average concentrations

**It appears that there is no consistent trend in aquatic toxicities between freshwater and saltwater. Thus, the risk ratios are mainly used for internal comparison.

***The refined risk ratios were calculated by accounting for further dilution from onsite and upstream site runoff. See section C above for details.

New = new application rates are recommended.

‡‡ Environmental risk analyses were not done for these "biorational" pesticides due to their inherent safety.

[1]The freshwater (fw) risk ratio was calculated based on freshwater MAC and the saltwater (sw) risk ratio was calculated based on saltwater MAC.

NA = not applicable

[2] ETU, MBC, and dichlorvos are metabolites of mancozeb, thiophanate methyl and trichlorfon, respectively.

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APPENDIX I. Proposed Honua'ula Ground Water Quality Monitoring Protocol

PROPOSED GROUND WATER MONITORING PROTOCOL FOR THE HONUA'ULA GOLF COURSE

For:

Honua'ula Partners, LLC

By:

N. LaJan Barnes, M.S., P.G.
Senior Hydrogeologist
Field Study Director

Stuart Z. Cohen, Ph.D., CGWP
Study Director

Environmental Scientist
Environmental & Turf Services, Inc.
Maryland

Originial
August 21, 1992

Revised
December 1, 1992
October 2, 2006
March 30, 2007
October 9, 2009
January 19, 2010

PROPOSED GROUND WATER MONITORING PROTOCOL FOR THE HONUA'ULA GOLF COURSE

SPONSOR:	Honua'ula Partners, LLC 381 Hukulii Place, Suite 202 Kihei, Maui, Hawaii 96753
TEST SUBSTANCES:	Pesticides, fertilizers and related substances as noted herein
STUDY SPONSOR:	Charlie Jencks Honua'ula Partners, LLC s
STUDY DIRECTOR:	Dr. Stuart Z. Cohen, President Environmental & Turf Services, Inc. Wheaton, Maryland
FIELD STUDY DIRECTOR:	N. LaJan Barnes, M.S., P.G. Environmental & Turf Services, Inc. Wheaton, Maryland
ETS JOB NUMBER	6-138-G
FIELD COOPERATOR:	To be determined
PROPOSED START DATES:	2010 - well installation 2010 - baseline sampling Routine semiannual (following golf course completion)
PROPOSED TERMINATION DATE:	Sunset determined by Hawaii Department of Health
TEST LOCATION:	Wailea, Maui, Hawaii
ANALYTICAL TESTING FACILITY:	Underwriters Laboratory (pesticides) or Hawai'i certified lab, and State of Hawaii Certified Lab (nutrients)

PROTOCOL APPROVAL
SIGNATURE PAGE

Charlie Jencks Honua'ula Partners, LLC Kihei, Hawaii	Date
Stuart Z. Cohen, Ph.D. Study Director Environmental & Turf Services, Inc. Wheaton, Maryland	Date
N. LaJan Barnes, M.S., P.G. Field Study Director Environmental & Turf Services, Inc. Wheaton, Maryland	Date
To Be Determined Field Cooperator Honolulu, Hawaii	Date
Chauncey Hew Geologist Hawaii Department of Health Honolulu, Hawaii	Date

EXECUTIVE SUMMARY

Honua'ula Partners, LLC is proposing to develop an 18-hole golf course and related facilities in the Kihei-Wailea-Makena region of the leeward side of eastern Maui. The 670 acre project site is located on the lower slopes of Haleakala. The 18-hole golf course would parallel the coastline within the project site boundaries. The site is approximately one mile east (mauka) of the Wailea community and the southern portion of the proposed golf course is immediately adjacent to Wailea's Gold golf course. Site elevations range from approximately 320 to 710 ft.

The project site overlies a brackish aquifer system, most of which is below the Underground Injection Control (UIC) no-pass line. Ground water discharges to the ocean at the coast, and may flow within the influence of five irrigation wells of the Wailea resort complex. Therefore the purpose of this study is to determine the extent to which turf chemicals may migrate from the Honua'ula golf course to ground water and to the coastline. Baseline monitoring of ground water discharge in the ocean began in 2005.

The objective of this protocol is to present and implement a ground water monitoring study design that can produce reliable, quality data.

Two monitor wells are proposed for installation on site. In addition, an existing irrigation well will also be used for monitoring ground water quality. The irrigation well will be used as a background well and the remaining two wells will monitor ground water downgradient of managed turf.

Two to four rounds of samples will be collected after well installation and prior to construction to obtain baseline water quality data. One round will include a comprehensive pesticide list, inorganics, and field parameters. The remaining two to three rounds will include inorganic and field parameters only. Wells would be sampled semi-annually during the routine monitoring phase during golf course operation. The first routine monitoring samples will be collected six months after golf course operation begins and continue until such time that the Hawaii Department of Health certifies that no further monitoring is necessary.

The pesticide and nutrient analytes specified are based on the turf management program and the on-going marine monitoring program. Standard field parameters such as pH, temperature, etc. will be included.

A contingency plan is proposed that would trigger pesticide use restrictions or bans if pesticides are detected at predetermined concentrations.

Monitoring will stop when the Hawaii Department of Health certifies that no further monitoring is required based on a review of the monitoring data following no less than five years of routine monitoring.

Amendment(s) to this protocol will be written and submitted following acceptance of this protocol if it has been determined that additional provisions have not provided in this basic protocol. In addition, an amendment will be written for any major changes to the monitoring procedures following approval of this basic protocol.

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TABLES AND FIGURES

I. INTRODUCTION, PURPOSE AND OBJECTIVE

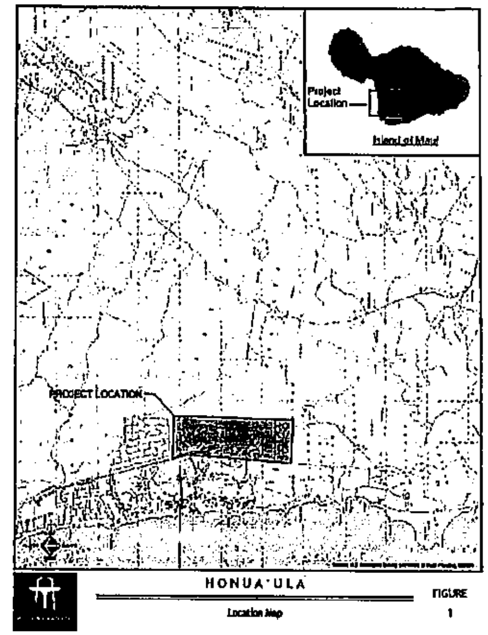
Honua'ula Partners, LLC is proposing to develop an 18-hole golf course and associated facilities in the Kihei-Wailea-Makena region of the leeward side of south eastern Maui. The 670 acre project site is located on the lower slopes of Haleakala, immediately south of the Maui Meadows community. The location of the site is shown on Figure 1.

The site overlies a brackish aquifer system, most of which is below the Underground Injection Control (UIC) no-pass line. Ground water discharges to the ocean, and may flow within the influence of five irrigation supply wells of the Wailea resort complex. Therefore the purpose of this study is to determine the extent to which turf chemicals may migrate from the Honua'ula golf course to ground water and to the coastline. The objective of this protocol is to present and implement a ground water monitoring study design that can produce reliable, quality data.

Specifically, the protocol will establish the following:

- a characterization of the Honua'ula project site including soils, climate, and the hydrologic and hydrogeologic setting;
- a monitoring study design, including detailed descriptions of monitor well installation, placement, turf chemical applications, sample collection, scheduling and analyses;
- a quality control program that addresses recordkeeping, sample custody, and quality assurance procedures; and
- a plan that defines response strategies if contaminants are detected above response triggers.

Figure 1. Site Location Map



II. SITE LOCATION AND CHARACTERIZATION

A. Site Location

The Honua'ula project site comprises approximately 670 acres of gentle to steeply sloping terrain on the lower, leeward slopes of Haleakala near Wailea on east Maui. The project site is east (mauka) of the existing Wailea resort area and directly adjacent to Wailea's Gold golf course on the southern boundary. In addition, the Ulupalakua ranch is mauka of the property and the Maui Meadows community is to the north. Elevations range from about 320 ft to 710 ft. The west (makai) boundary of the property is about 1 mile from the coastline.

B. Site Characterization

1. Soils

There are four soil types that comprise the project area. These are indicated on the figure in Appendix A. The dominant soil types are the Keawakapu extremely stony silty clay loam (KNXD), the Makena loam, stony complex (MXC), and very stony land (rVS). A small portion of the site in the southeast corner includes the Oanapuka very stony silt loam (OAD). These soils are described in some detail in Okamoto (2009) and USDA, SCS, (1972). The most significant characteristic of these soils is that they have severe limitations with regard to cultivation and are generally unsuited for agricultural purposes. The SCS has assigned a capability classification range of VIs to VIIs for these soils. These limitations are related to extreme stoniness, and unfavorable texture.

Four soil samples were collected in January, 1992 from the project site by Environmental & Turf Services (ETS) and analyzed for physical characteristics. The sampling locations are indicated on the figure in Appendix A. Two samples from two different locations for each of the two major soil types (Keawakapu and Makena) were collected and composited into one sample to represent each of those two soil types. In addition, two individual samples were taken from two locations in the northeast portion of the site comprising the Keawakapu soil type. These samples were not composited, because the samples were noticeably different. Based on the consistency of the results, the difference in those two samples was most likely due to the variability in the stoniness.

The results of the soil analyses are presented in Appendix A. Additional soil samples in 2006 were not collected because the soil is not expected to be different from 1992.

The southern quarter of the property is comprised of very stony land (rVS). Due to the nature of the rVS, it could not be sampled. 'A'a lava covers most of the rVS surface and there was not enough soil to collect samples for the physical characteristics analysis. There is a potential that the 'a'a lava surface that comprises a significant portion of the southern part of the site may be worked into a "cinder soil" by mechanical means to provide a growing medium for turf in these areas.

2. Climate

The climate at the project site is semi-arid and receives an average rainfall of about 12 inches/year (EIS, 1988). The majority of the rainfall occurs during the months of November to March. Temperatures fluctuate very little throughout the year.

Morrow (1988) analyzed wind conditions for a location near the project site in the Air Quality Impact Report of the Maui Wailea 670 EIS (PBR Hawaii, 1988). The report indicated that northwesterly winds with a strong westerly component are dominant. Afternoon winds on the average tend to be less than 17 knots (~15 mph) about 75% of the time and less than 11 knots (~10 mph) about 50% of the time. We do not expect that this would have changed significantly.

3. Surface Hydrology

The site is characterized by a moderate to dense cover of Kiawe trees, and, to a lesser extent, Wiliwili trees. The land surface is densely covered with pastureland grass and low shrubs. The project site exhibits relatively simple hydrology. No perennial streams exist on the site, because there is neither adequate rainfall nor shallow depth to ground water to support a continuous base flow. Surface runoff does occur at times of heavy rainfall on-site or mauka on the slopes of Haleakala. There are many channels and gulleys that route surface runoff across the site. There are no plans to significantly alter the drainage characteristics of the site. The major channels will be left in their natural condition or improved to facilitate off-site drainage and erosion control.

The drainage report (Okamoto, 2009) describes the drainage patterns at the site. The study reported that 12 distinct drainage areas exit (comprising about 4,687 acres) that contribute to runoff that may course the site. Only five of these drainage areas constitute major drainage basins and the study goes only as far as the Piilani Highway. The project site occupies a small percent (~ 14%) of the total acreage of these contributory drainage areas extending from western (maiki) property boundary to the upper slopes of Haleakala.

ETS staff witnessed a 1.75 inch storm event during the January, 1992 soil sampling site visit. No runoff was observed leaving the project site; however, flow was observed in the large channels coursing the Wailea resort area into the ocean. Very little surface runoff was observed on the Wailea golf course areas. Runoff from within the Wailea resort apparently occurred primarily from the impervious areas such as roads, buildings, and parking areas.

4. Regional and Site Specific Geology

The proposed project is located on the west side of Haleakala Volcano, which forms east Maui. The proposed site parallels the coastline approximately 1.8 miles and is mauka of the Wailea community less than one mile within the Makawao District.

Approximately three fourths of the northern portion of the project site is overlain with Keawakapu and Makena soils (discussed above) while the remaining area is covered with very stony land of the Kaula and Hana volcanic series. Underlying the soils in the northern portion of the site is mostly the Kula volcanic series composed of andesitic 'a'a lava flows, which contain many interstratified, thin ash-soil layers (Stearns, 1966). The interstratified ash-soil layers described by Stearns seems to be supported by one of the two borings which is described as soft cinder. Those borings are located at approximately the 520 ft elevation on the northern end of the site drilling to depths of 550 ft and 559 ft.

5. Site Hydrogeology

The site has elevations that range from approximately 320 ft on the makai side to

approximately 710 ft on the mauka side. The basal ground water lens is approximately 3 to 4 ft above sea level under the site and has a chloride content which has a range of 500 to 1000 mg/L (Mink, 1986). A chloride content of this nature is considered brackish (one criteria for potable water is a chloride content of less than 250 mg/L). Water quality results from the two wells located on the northern end of the site show chloride concentrations that range from 140 mg/L (2001) to 211 mg/L (2006).

There are five wells located downgradient of the project site that are used to irrigate the Wailea golf course. These wells are part of an ongoing water quality monitoring program. The aquifer system under the site is the Kamaole [60304], within the Central Aquifer Sector. The Kamaole Aquifer system extends from Kihei to south of Makena and up to the center of Haleakala where most of the recharge takes place. The Kula volcanics is the dominant rock with the Hana series covering the southern portion of the system (Yuen, 1990).

Ground water under the site flows toward and discharges into the ocean and it is not considered a drinking water source; but should be protected.

III. STUDY DESIGN

A. Monitor Well Locations

Two monitoring wells will be constructed on the project site. There are two exiting wells located on the northern end of the property designated as irrigation wells. At least one of these wells will be included in the water quality monitoring program and serve as the background well since ground water at that location will not be impacted by golf course management.

Two downgradient wells are proposed to be installed. These wells will be dedicated for water quality monitoring and will be located downgradient of managed turf. The exact location of these two wells will be determined in the field; but, will be dependent on rig accessibility. Figure 2 (at the end of this section) shows example locations where downgradient monitoring wells could be in stalled. Both wells will be located in out of golf course play areas.

B. Well Construction Procedures

Constructing the wells in a pattern to determine ground water flow will not be necessary, since the general direction of flow is not a question. The total depth of the wells will be determined by depth to ground water, but could be as deep as 400 ft depending on the exact location. All wells will be surveyed at ground surface and the top of casing. The top of the casing will be marked by a notch at the time of the survey so that water level measurements can be measured in the same place at each sampling event.

The drilling technique used will be the technique that is the most appropriate considering the lava rock at the site. Generally, the diameter of the boreholes for monitoring wells is 8-10"; however, considering the potential depth (~400 ft) of the downgradient wells, the diameter will be dependent on the collection system selected for obtaining ground water samples. Standard installation procedures for Hawaii geology will be used to construct the downgradient wells so that ground water samples can be retrieved and used for water quality monitoring. Details of the final installation procedures will be provided in the well completion report following installation.

The monitoring wells will be protected by at least three 4 to 6 ft tall, heavy duty steel posts forming a triangle installed around the well stick-up to protect the well(s) from heavy

equipment movement during golf course construction. The steel posts will be seated in cement at least 2 ft below the surface and extend at least 4 ft above ground surface.

Standard well development will be conducted long enough to remove silt and fines from the well bore by pumping and/or surging. The wells will be allowed to stabilize for approximately one week after development so that accurate water level measurements can be taken and to allow stabilization of the ground water. All boreholes will be logged by a geologist/hydrogeologist. Photographs of well installation and completion activities will be taken using a digital camera. The diagram will contain the following information:

- Date/time of construction
- Well location
- Borehole diameter
- Well depth
- Depths and description of lithologies encountered
- Casing material/diameter
- Screen material
- Screen slot size/length
- Sand pack (depths from ___ to___)
- Bentonite seal (depths from ___ to___)
- Cement/grout (depths from ___ to___)
- Ground surface elevation
- Elevation at top of casing
- Depth to static water

C. Sampling Procedures

All activities and measurements will be recorded in water-resistant ink in a bound log book with water resistant pages. Ground water sampling will not be collected during heavy rains to prevent cross contamination. At no time should roller ball-type pens be used in the field log book. A pump dedicated for this project will be used to purge and sample the wells. The pump will be of such capacity that it will lift ground water from at least 400 ft depths.

The following sampling procedures are general guidelines use to collect ground water samples; however, some of these procedures may be adjusted for the sampling technique implemented at this site.

- The wells will be uncapped and allowed to stabilize to ambient air pressure prior to taking water level measurements.
- Weather conditions and the time that the well cap is removed will be noted in the log book(s).
- Measurements from the top of the casing to static water level will be measured from the same point (i.e., notched casing) and recorded prior to each sampling event. Depth of ground water will be recorded to the nearest 0.01 ft. The volume of water in each well will be calculated using the appropriate equation for the well diameter (e.g., for a 4" well – length of water column (ft) * 0.653 gal/ft of water = total volume of water in well (gal)).
- The top of the casing will be marked by a notch at the time of the survey so that water level measurement can be measured in the same place for each sampling event. Ground water level measurements will be taken from the top of the well casing at the notch, not the protective steel well casing.
- The field parameters will be taken and recorded after each well volume is purged. The purged water and the sampled water shall be analyzed in the field for the following three field parameters: pH, temperature (°C), and specific conductance (µS/cm). All field parameters units will be recorded.
- If submersible pumps are used in the wells to purge and sample the ground water the pump must be decontaminated between each well. Standard decontamination procedures recommended by the pump manufacturer should be followed.
- Disposable latex-type protective gloves will be worn on both hands and changed at each well during sampling and decontamination procedures (and as necessary) to prevent cross contamination during sampling events.
- Low-flow dedicated pumps may be used in two downgradient wells in which case removal of 3-8 well volumes prior to sampling will not apply. However, the stabilization of field parameters will be used to collect representative ground water samples. The wells will be purged until two of the following three parameters stabilize: pH, temperature and specific conductance (typically 3 to 8 well volumes). This procedure ensures that the ground water sample is representative of the aquifer. Purging will be performed by the dedicated pump and tubing from ground water to the surface. The wells will be pumped at a rate that will be within the specifications of the pump selected. A portion of the pumped water will be collected into a glass cylinder each time a well volume has been evacuated; then the temperature, pH, and specific conductance will be measured and recorded. Evacuation will continue until two of the three parameters have stabilized for three consecutive well volumes or until 8 well volumes have been purged, whichever comes first. Stability in this context is defined as temperature readings differing by no more than 0.3°C, pH varying no more than 0.1 pH unit, and specific conductance varying by no more than 3 umhos/cm, in three successive well volumes.
- Appropriate aliquots of ground water will be placed into properly labeled sample containers as provided by the approved laboratory immediately after stabilization of the previously described parameters. The time of collection, sample ID, and

description of water will be recorded in the log book(s) and samples will be placed in a cooler to maintain a temperature of approximately 0-4°C.

D. Sampling Schedule and Chemical Analysis

This section discusses the number and timing of sample collection during the baseline and operational phases of monitoring, and the chemical analyses for each phase (Table 1).

1. Baseline Sampling

Water samples will be collected from the designated monitoring wells before construction begins to establish baseline conditions. Attempts will be made to collect two to four rounds of samples to be analyzed for inorganics. One of the rounds will include samples that will be analyzed for pesticides and/or metabolites.

Ground water monitoring will begin no less than one week after the wells have been installed and developed, to allow the aquifer around the well bore to stabilize. Pesticides and inorganics will be sampled according to the schedule below.

The baseline analysis is based on product use within the same watershed and upgradient of the site, pesticides proposed for use on the golf course, the Hawaii Department of Health (HDOH) requirements, and previous monitoring by Steve Dollar (2009). All pesticides proposed for use on the golf course will be included in baseline monitoring if a method exists (Table 2 at the end of this section). Baseline monitoring will also include inorganics (i.e., nutrients, anions, cations as appropriate).

2. Routine Sampling

Samples will be collected semi-annually at designated monitoring wells during the operational phase of the Honua'ula golf course. The first routine monitoring samples will be collected six months after golf course operation begins and continue until such time that the HDOH certifies that no further monitoring is necessary. Monitoring for all inorganic parameters is required during each sampling event. Pesticides selected for ground water monitoring will be based on those chemicals that are more likely to leach and have been applied to the golf course.

Table 1. Monitoring Matrix

Stations	Baseline Monitoring			Biannual Routine Monitoring		
	Pesticides	Inorganics	Field Parameters	Pesticides	Inorganics	Field Parameters
Wells	1	2-4	2-4	2*	2	2

* selected pesticides only

E. Quality Control Samples

1. Field QA/QC

Field quality control samples are analyzed to check contamination and to detect any systematic or random error from the time of sampling to the time of analysis. Three types of field QA/QC samples may be used to assess field quality control: field duplicates, field blanks, and decontamination samples. Quality control samples will be analyzed for any and all relevant parameters required by this protocol.

a. Field Duplicates

One set of duplicate samples will be collected during each sampling event. The location of the duplicate sample will be chosen randomly, and will be rotated between the downgradient wells from one event to the next. This set of samples will be "blind" coded, i.e., the station identification and time of collection will not be written on the sample containers nor the chain-of-custody (COC). Instead, only "field duplicate" or "GW DUP" will be written on the COC. However, it is imperative that a note be made in the field notebook as to the location of the field duplicate (e.g., field duplicate taken from well MW-1). The laboratory will provide an extra set of bottles for the collection of the duplicate sample. The purpose of the field duplicate is to look for sampling contamination during the time of sampling, and to verify the accuracy of the laboratory analysis.

b. Decontamination Samples

The purpose of the decon rinsate sample is to look for sources of contamination associated with decontamination of equipment washing

procedures. Proper decontamination between stations reduce the likelihood of cross-contamination. If dedicated sampling equipment is used (e.g., low-flow dedicated micro-purge pumps in each well), this sample is not required. This sample is also not required for the pH meter nor the container used for measuring field parameters.

If a well does not contain a dedicated pump, then a decontamination sample ("decon rinsate") will be collected. The decon sample will be collected from the final rinsate water (i.e., the water that passes through the pump) using standard decontamination procedures recommended by the pump manufacturer. This sample should be collected between sampling of the two downgradient monitoring wells. The sampler will obtain distilled water for decontaminating field equipment. This sample will be poured in lab-supplied bottles. The bottle will be labeled "decon rinsate," and will be shipped and analyzed with all the other samples. If detergent is used for the decon procedures, it should be phosphate free.

2. Laboratory QA/QC

A laboratory that is certified for drinking water and/or wastewater analyses in Hawaii or that participates in a reciprocating program will be contracted to conduct the analyses for this monitoring program. It is possible that two labs will be contracted for this monitoring program - a local lab for inorganics and microbiologicals and an out-of-state lab for pesticides. The laboratory will follow related standard procedures where standard methods are not available for a constituent of interest. In addition, the laboratory will demonstrate accuracy and precision of the adopted methods with at least five-point standard curve, sample spikes, and duplicate analyses.

The results from each sampling event will also include the following laboratory quality control results: trip blanks, matrix spikes (MS), MS duplicates (MSD), method blanks, quality control samples, and surrogate recoveries where appropriate. The laboratory will note any analytical QC problems.

a. Trip Blanks

The trip blank (TB) sample is designed to assess any potential source of contamination associated with the lab, e.g., bottle washing or lab contamination. A complete set of sample containers for all water quality parameters required for the sampling event will be filled with inorganic-free reagent/distilled water in the laboratory, preserved in the same fashion as other field samples, and labeled as the "trip blank." This sample set will be included with the bottle shipment sent from the lab to the field sampling cooperator and taken into the field during a sampling event. The TB bottles are not to be opened by the field personnel at any time. When the sampling event is completed, the TB samples shall be processed as any other sample, listed on the COC, and shipped back to the laboratory for analyses. One set of TB samples/day of sampling will be submitted during each sampling event.

b. Matrix Spike/Matrix Spike Duplicates

The purpose of the MS/MSD samples are to test laboratory equipment accuracy. One set of MS and MSD samples will be collected during every event. The lab will provide appropriately labeled bottles for these samples. Field personnel will collect water samples from a randomly selected station. This sample will be collected from the well other than where the duplicate samples are collected. The location of the MS/MSD sample will rotate from one event to the next. The MS and MSD samples will be designated as such on the COC and processed accordingly. In addition, the location of collection will be recorded in the field notebook.

F. Sample Recording

A unique identification number will be assigned to each sample. Ground water samples will be labeled with an ID that is a function of the well number and collection date (e.g., MW-2-013107 = monitor well #2, January 31, 2007). The duplicate sample identification will be labeled "GW DUP" or given a bogus well number not associated with any of the monitoring wells. The MS/MSD samples will be identified on the COC with the appropriate well (e.g.,

MW-2 013107 (MS). All labels and COCs will be written using waterproof ink or ball point pen ink. Roller-ball or jel-type pens are not allowed to be used on any monitoring documents for this project to prevent smudging.

G. Monitoring Sunset Provision

Monitoring will stop when the HDOH certifies that no further monitoring is required based on a review of the monitoring data following no less than five years of routine monitoring.

H. Protocol Amendments

Amendment(s) to this protocol will be written and submitted following acceptance of this protocol if it has been determined that additional provisions have not provided in this basic protocol. In addition, an amendment will be written for any major changes to the monitoring procedures following approval of this basic protocol.

Table 2. Baseline Monitoring List and Possible Methods

Parameters	Analytical Method	Container Volume	Preservative	T (°C)	Holding Time
		INORGANICS			
TKN	351.4	500 mL	H_2SO_4	1-4	28 d
Nitrate-Nitrogen	353.2	120 ml	None	1-4	48 h
Nitrite-Nitrogen	353.2	120 ml	None	1-4	48 h
Ammonia-Nitrogen	350.3	250 ml	H_2SO_4	1-4	28 d
Total Phosphorus	4500-PB	120 ml	HCl	1-4	28 d
Ortho-Phosphorus	4500-PB	120 ml	None	1-4	48 h
Chlorophyll a					
Silica	200.7	500 ml	HNO_3	ambient	6 mos
Turbidity	180.1	120 ml	None	1-4	48 hr
		ORGANICS (PESTICIDES)			
Bifenthrin	S150	1 L	Trizma mixture	1-4	14 d
Chlorothalonil					
Fipronil					
Flurprimidol					
Indoxacarb					
Propiconazole (a&b)					
Imidacloprid	L300	1 L	Trizma mixture	1-4	14 d
Oxadiazon					
Boscalid	L302	1 L	HCl	1-4	14 d
Halosulfuron					
Quinclorac					
Foramsulfuron					
2,4-D	515.3	1 L	$Na_2S_2O_3$ + H_2SO_4	1-4	14 d
MCPP					
Dicamba					
Glyphosate	547	2 x 44.7 ml	$Na_2S_2O_3$	1-4	14 d

TBD = to be determined

Table 2. (cont'd)

Field Parameters	Analytical Method	Units	Hold Time
pH	EPA 150.1	standard buffer index	at time of sampling
Temperature	SM 2550B	°C	at time of sampling
Dissolved Oxygen	ASTM D 5543-94	% saturation (or O2 ppm)	at time of sampling
Salinity		ppt	at time of sampling

IV. QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

Establishing a sound quality assurance/quality control (QA/QC) program is an essential part to any water quality monitoring study. QA/QC programs help ensure the quality of the data collected by setting in place a series of quality control "checks" that help identify sources of sample contamination, human error, and lab equipment inaccuracies, and it establishes a chain of custody so that the locations of the water samples are known at all times. The QA/QC program established for this monitoring study is in the spirit of EPA's Good Laboratory Practice Standards (GLPs) (40 CFR Part 160). GLPs were developed to create uniformity from study to study to help ensure the quality of data collected. Listed below are the most important parts of the QA/QC program that field and lab personnel must follow.

A. Sample Preservation and Shipment

Possible sample volumes and preservatives are listed in Table 2. However these may change as dictated by the analyzing lab. Prior to each sampling event, all bottles for analytical purposes will be sent directly from the lab to the field personnel. The field personnel should be careful not to overfill the bottles provided by the lab during sample collection. This is because some of the bottles contain preservatives to prevent the chemicals from spilling out during collection.

Coolers will be packed with sufficient frozen blue packs and supplemented with bagged ice to insure that the samples remain cool as possible during sample collection and shipment to the lab (4° C is sufficiently low to eliminate degradation of sample). If packages are lost or delayed by the shipping carrier such that the samples exceed analytical holding time(s) or are received at the lab at greater than ambient temperatures as collected at the time of sampling, the Study Director will determine if samples are to be recollected (at the expense of the golf course). If a distant lab is used, samples will be shipped via overnight carrier, not by the U.S. Postal Service, to that lab.

NOTE: If samples are received at the lab significantly above ambient temperatures as measured at sample collection, they will be recollected at the expense of the field personnel, if it is found that insufficient ice and/or cold packs were used in the shipping containers.

B. Field Safety

Field personnel should always remember basic field safety while collecting samples. Dress attire should be appropriate for weather conditions on the day of sampling and/or inspection of equipment. Field personnel should drink plenty of fluids (e.g., water) frequently throughout the day.

It is recommended that all field personnel be certified by the American Red Cross, or other organization, in basic first aid and adult CPR. In addition, field personnel should have a basic first aid kit that is easily accessible during sample collection. In addition, field personnel will contact the Study Director prior to collecting samples.

C. Field Quality Control

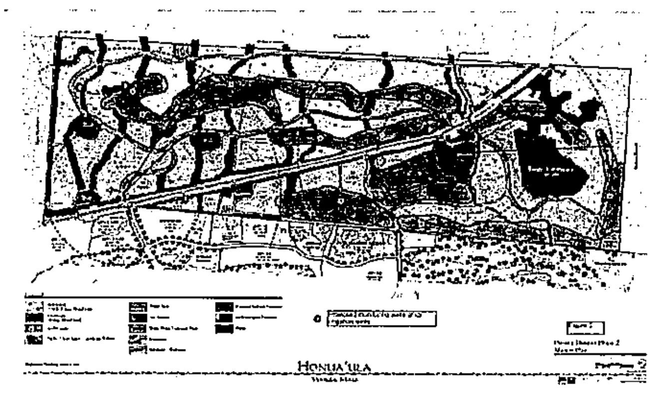
All collection of water quality samples will be conducted by qualified personnel trained in water collection and familiar with the QA/QC program established herein. Field personnel should never hesitate to contact ETS in the event of any questions.

1. Field Personnel General Procedures

A field logbook (see below) will be maintained exclusively for this water quality monitoring program. In addition, a copy of this protocol will be prepared on water-resistant paper and given to the field contractor. This water-resistant copy will be kept with the field logbook and will be taken to the field for all sampling events should sampling procedure questions arise. If there are any questions regarding sampling procedures, this protocol should be consulted first and then, if necessary, the current Study or Field Director (301-933-4700, eastern time zone) shall be consulted. It is especially important for the field cooperator to contact ETS prior to any sampling event at this project, due to the 6 hour time difference so that an alternative telephone number can be provided for after hours contact. The following procedures should be followed at all times.

- Standardized and approved methodologies are to be used by the field personnel.
- Records should be kept and maintained for calibration of all field instruments.

Figure 2. Proposed Monitoring Well Locations
(Map taken from 092409 Concept Plan)



- Records should be kept of all irregular incidents or experiences that may affect the measurement taken.
- All field equipment and instruments should be kept clean and in good working condition.
- Records should be kept of all repairs to the field instruments and apparatuses.
- Each chain-of-custody sheet shall be signed and dated by at least the lead member of the sampling team.
- Samples should be iced immediately after collection. Adequate methods shall be used to ensure sample temperatures are maintained at 0-4°C. Where applicable, samples received at the lab significantly above ambient temperatures, as measured at the time of sample collection, will be considered for recollection as described above in section A.

2. **Prevention of Sample Contamination**

The quality of data generated in the laboratory depends on the integrity of samples received by the laboratory. The field personnel should take appropriate measures to protect samples from cross-contamination and deterioration.

- The sample collector should keep his/her hands clean and avoid smoking and eating while working with water samples.
- Sample containers (bottles) must be kept in a clean environment, away from dirt and dust. Vehicle cleanliness is important for transporting sampling equipment.
- All metal objects should be kept out of contact with acids and water samples.
- Petroleum products and exhaust fumes should be kept away from samples.
- Only the lab-approved or provided sample container for each water quality sample submitted for analysis shall be used.
- If the field measurement equipment (e.g., pH, temp., etc.) does not provide a sample holding device to record the data, the field measurement sample shall be taken in a glass or plastic container (provided by the field personnel). All sample holding devices used for field measurement collection shall be decontaminated by the field personnel between sampling sites using standard decontamination procedures.
- All field measurements will be taken from separate sub-samples and should never be taken from the water sample that is collected in the

sample bottle(s) for analysis. Once the field measurements have been taken and recorded, the sample shall be discarded.

- Measurements for specific conductance should never be made in the sample water that was used for a pH measurement. Potassium chloride diffusing from the pH probe may affect the conductivity of the sample.
- All field parameters measurements should be taken immediately after the water sample is retrieved from the well.
- All field personnel involved in handling the water samples will wear disposable latex-type gloves to prevent direct contamination of the sample and to protect the sampler. Gloves shall be changed at each new location or as needed.
- The inner portions of sample containers and container caps should never be touched with bare hands, gloves, or placed on the ground.
- Once collected, the sample shall be stored in the lab provided container/ice chest. Samples must be kept at 0-4°C using bagged ice and frozen blue packs and packed to eliminate bottle breakage.
- Samples must be shipped overnight or hand delivered to the laboratory the same day of collection via UPS, FedEx, or other over-night carrier. Two-day or U.S. Postal Service delivery to the lab is unacceptable. Friday shipment may be possible, but acceptance by the lab must be verified in advance.

3. **Field Log Forms/Book**

A field sampling log/notebook containing water resistant pages will be maintained. Only water-resistant ink pens will be used to make notations. Roller ball pens, erasures, and scratch-outs are not allowed. If mistakes are made in recording, corrections will be made using a one line strike-through, initialed, dated, and rewritten. The field log will include site conditions, observations, weather conditions (e.g., temperature, precipitation, etc.), time of sample collection, field measurements (e.g., pH, water temperature, and specific conductance), sample location, and sample station condition (e.g., brush overgrowth, DTW, and total depth of well). Specific observations such as discoloration of the water, presence of sediment, or any other unusual circumstances will also be noted. Any deviations from this protocol must be approved by the Study Director and/or Field Director at the time of or immediately following the deviation(s). The deviation must follow generally accepted sampling practices and must be noted in the field notebook.

Copies of original field notes, completed chain of custodies (COCs), and airbill tracking numbers (e.g., FedEx, UPS) will be faxed to the Study Director within 24 hrs of each sampling event. In addition, hard copies of the field notes and COCs will be sent to the Field Director within one week of each sampling event. Alternatively, pdf files can be made of field notes, COCs, and shipping labels and emailed to the current Study Director at ETS@ETS-MD.COM.

D. Chain-of-Custody and Shipment

A chain-of-custody (COC) program will be followed to ensure that proper transportation and storage practices are documented. Information that will be included on the COC form are: project identification (e.g., Honua'ula golf course); date; time; sample identification (except and noted above in section III(F); preservatives, if any; requested lab analysis; overnight courier and package tracking number; special instructions for the lab, if any; names and signatures of field personnel; and time of sample relinquishment to the overnight courier. ETS or the analyzing lab will provide blank or pre-printed COC forms. Should there be any questions regarding how to properly fill out the COC form, field personnel should call ETS for clarification.

The COC will be a triplicate (i.e., carbonless pages) form used to record and document sample shipment to the lab. Each sample box sent to the lab will contain the completed original (1st page) and the 2nd page of the triplicate COC form and will be placed in a plastic, airtight bag (e.g., baggie) and placed inside the shipping container. The bottom copy (3rd page) will be torn off and retained by field personnel for record keeping and making copies to send and to fax to ETS.

The field personnel shall fax a copy of the COC along with the field notes to ETS as soon as possible (preferably the same day or day following sampling).

At no time should samples collected for analyses be sent to the lab via the U.S. Postal Service or without a completed COC form.

E. Protocol Deviations

All protocol deviations will be documented in the log books/forms; ETS must be notified of all protocol deviations. Whenever possible, approval for protocol deviations will be requested

in advance from the Study Director and/or Field Director. The annual report (see "Reporting" below) containing the analytical results for the monitoring event should include a summary of the deviation(s) and the significance of the deviation(s) on the reliability of the results. Finally, the lab will be notified only if the deviation(s) may impact analytical analysis (e.g., a preservative was lost in a bottle due to overfilling the bottle).

F. Field Audit

The Study Director, or his designee, will conduct an audit of field collection techniques during one monitoring event no less than bi-annually. All aspects of sample collection will be observed including, but not limited to: bottle preparation, water collection and transfer into bottles with preservatives, collection of field data (pH, specific conductivity, and temperature), preparation of chain-of-custody sheets, and equipment decontamination. The field personnel will be informed of any QA/QC violations and recommendations will be given to reduce the likelihood of future violations. Results will be included in the annual report in which the audit took place.

G. Reporting

1. Baseline Report

A comprehensive report will be issued after all baseline sampling results have been analyzed. It will include the following topics: background, sampling stations, well construction/logs, field results, lab results, conclusions, and protocol amendments, if any.

Data obtained during the baseline monitoring will be analyzed using appropriate statistical procedures and will be presented in graphical form to study water quality trends. Descriptive statistics such as mean and standard deviation, and statistical procedures such as t-tests and regression analysis will be used to interpret the data as necessary. Multiline charts, bar charts, pie charts, and scatter plots are examples of graphical presentations that may be useful to help visualize the trends of the water quality variables at the site. The statistical analyses will be used to revise the final protocol for the operational phase monitoring. In addition, historical monitoring data will be incorporated where applicable.

2. Annual Report

The Study Director will submit comprehensive, interpretive, annual reports to the HDOH within two to three months after receipt of the lab results from the last sampling event of the monitoring year. The annual report will include a review of all pertinent golf course management data and water quality results. Significant water quality trends between sampling events and from year to year will also be discussed in the annual report. Comparison of the results of the Wailea resort wells and the ocean sample results will be included in as much as the data are available to ETS.

Data obtained during field sampling and laboratory results will be analyzed using appropriate statistical procedures and will be presented in graphical form to study spatial and temporal trends of water quality parameters. Descriptive statistics such as mean and standard deviation, and statistical procedures such as t-tests and regression analysis will be used to interpret the data as necessary. Multiline charts, bar charts, pie charts, and scatter plots are examples of graphical presentations that may be useful to help visualize the spatial and temporal trends of the water quality variables at the site. Recommendations regarding changing management practices, and using alternative pesticides and fertilizers may also be made based on the monitoring results.

After five years of operational phase monitoring has been completed, the Study Director will review monitoring results to determine the need for additional monitoring. Any recommendations to the monitoring program will be included in the annual reports.

V. CRITERIA FOR MANAGEMENT RESPONSE

This section will be revised after all baseline data have been evaluated.

The following chapter describes the methodology used for establishing the response thresholds (RTs), at the Honua'ula golf course and the required management response to a parameter that exceeds its RT. Briefly, the RTs for inorganic parameters are based on baseline monitoring data. Details follow.

Repeated exceedances of pesticide and/or nutrient limits will, at a minimum, trigger a review of the particular BMPs designed to prevent such exceedances.

A. Inorganic Parameters

Baseline concentrations of nitrate-nitrogen (N) and total phosphorus (TP) will be established prior to construction following a review of all baseline data. Operational phase RTs will be the upper 95% confidence limits (CL) of each of the baseline phase for N and TP. Natural fluctuations as observed during baseline monitoring in the hydrologic system will be considered when establishing these triggers.

Exceedances of the thresholds will trigger a proportionate reduction in N or TP use for the affected subbasin until the residues stabilize. For example, a 20% exceedance of the N threshold will trigger a 20% decrease in N use in the affected subbasin.

The references points contained in Table 3 will also be considered.

To be determined after all baseline samples have been collected, analyzed, and reviewed.

1. Actions for Inorganic RT Exceedances

The following action will be required if nutrient (nitrogen and phosphorus) concentrations are detected above a station's respective RT (as defined by baseline results) not including the background station:

- The offending station(s), plus the background, will be resampled within two weeks following the receipt of results.
- A review of chemical application records, site conditions, and weather records will be conducted to identify possible causes for the increased nutrient concentration(s).
- Fertilizer applications will be reduced proportionately to the percentage of excess that the nitrogen or phosphorus concentrations exceed the RT (e.g., If a concentration of 3 mg/L represents a level of 50% above a 2 mg/L RT, a 50% reduction in fertilizer application to the turf upgradient of the offending ground water station will be required).
- An evaluation will be conducted of the extent to which the superintendent is complying with the soil and plant tissue testing program outlined in the BMP.
- Additional use of slow-release fertilizers and alternative fertilizer sources will be considered, as will more 'spoon feeding' (frequent applications of small amounts).

Fertilizer restrictions will be limited to the subbasin(s) contributing to the offending ground water station(s). Restrictions will remain in place until the review of management practices, weather, and site conditions is conducted, and nutrient concentrations at the offending station(s) return to concentrations below the respective RT, or the Study Director determines the elevated concentrations are not the result of golf course management practices. If a significant increasing trend as determined from statistical analyses is detected at any monitoring station, fertilizer application rates and/or types will be adjusted accordingly.

B. Pesticides

Any pesticide detections above the minimum reporting limit (MRL) will trigger a response. Detections exceeding 20% of the reference concentrations – the lower of the Health Advisory Levels (HALs) or Maximum Concentration Levels (MCLs), and/or the HDOH water quality standards as appropriate – will trigger a restriction of use for the particular pesticide in the affected subbasin (Table 3). These 20% values will be called response thresholds (RTs).

Two levels of management response have been established to respond to pesticide detections in ground water: alert level and response level.

1. Alert Level

The alert level is triggered when a pesticide or pesticide metabolite concentration is detected above the MRL (i.e., method reporting limit) but below the RT. The following management responses will be triggered if a pesticide used on the golf course is detected at a concentration corresponding to the alert level.

- A review of management practices, weather, and site conditions will be conducted to identify possible reasons for detections.
- Alternative pest control measures will be considered and a recommendation regarding the continued use of the problem pesticide will be made.

2. Response Level

If a pesticide or pesticide metabolite used on the golf course is detected at or above the RT (Table 3), the following management responses will be triggered. These actions assume detections resulted from normal pesticide use. In the event contamination resulted from a point source activity, e.g., a spill or well breach, the Study Director may recommend alternative responses.

- The use of the pesticide will be immediately stopped and routine monitoring for the pesticide will continue until it is not detected in the on-site down gradient wells.
- A review of management practices, weather, and site conditions will be conducted to identify possible reasons for the detection.
- Alternative pesticides for replacement of the problem pesticide(s) will be evaluated.

The evaluation should discuss circumstances which led to the elevated detection of the pesticide, reasons why the superintendent needs the specific pesticide compared with alternatives, and a presentation of management practices that will be implemented to prevent further detections of the offending pesticide. The chemical will continue to be monitored as long as it is used on the golf course. If the chemical continues to be detected above its RT for two consecutive rounds, the pesticide will be permanently removed from the management program.

Table 3. Preliminary Pesticide List and Water Quality Standards

Parameters	HAL/MCL (ppb)	Response Thresholds[1]
Bifenthrin	105	
Boscalid	153	
Chlorothalonil	2	
Dicamba	200	
Fipronil	1.4	
Flurprimidol	700	
Foramsulfuron		
Glyphosate	700	
Halosulfuron	700	
Imidacloprid	399	
Indoxacarb	40	
MCPP	35	
Quinclorac	2,800	
Oxadiazon	40	
Propiconazole (isomer a&b)	9.2	
2,4-D	70	
Nitrate-Nitrogen	10 ppm	
Nitrite-Nitrogen	2 ppm	

[1] TBD = to be determined after baseline data has been collected and evaluated

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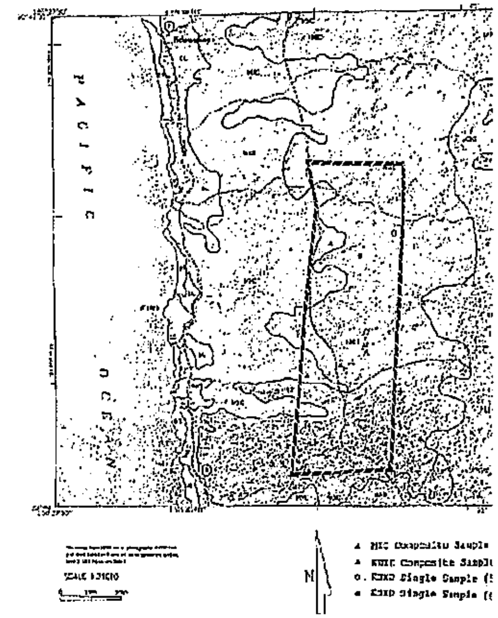
APPENDIX A. Soil Sampling Results (1992)



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Account No. 7312D100
Date 2/27/92
Facility Walter 670

		Textural Analysis					Chemical Evaluation		
		Sand	Silt	Clay	USDA Textural Class	Mean Diameter (mm)	pH	Organic Matter %	Electrical Conductivity mmhos/cm
	USDA (mm)	.05 to 2.00	.002 to .05	<.002					
	U.S. Sieve (mesh)	270 to 10							
LAB ID NO.	SAMPLE NAME								
920:001-7	6-12" KNXD One Location	18.3	13.1	68.5			7.2	7.5	
	Duplicates								
920:001-3D	0-6" KNXD Composite								
920:001-7D	6-12" KNXD One Location							2.5	
920:001-2D	6-12" MXC Composite						5.4		

		Gravel Content			Sand Distribution				
		Gravel > 4.0mm	Gravel	Total Gravel	Very Coarse	Coarse	Medium	Fine	Very Fine
	USDA (mm)	>4.0	2.0	>2.0	1.0	0.5	0.25	0.10	0.05
	U.S. Sieve (mesh)	>5	10	>10	18	35	60	140	270
LAB ID NO.	SAMPLE NAME	% Material Retained on Sieve							
920:001-7	6-12" KNXD One Location	0.0	0.1	0.1	0.6	1.9	2.7	5.2	7.9
920:001-3	Duplicate								

Reviewed by [signature]
VP Technical Operations

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Date 2/27/92
Facility Walter 670

		Textural Analysis					Chemical Evaluation		
		Sand	Silt	Clay	USDA Textural Class	Mean Diameter (mm)	pH	Organic Matter %	Electrical Conductivity mmhos/cm
	USDA (mm)	.05 to 2.00	.002 to .05	<.002					
	U.S. Sieve (mesh)	270 to 10							
LAB ID NO.	SAMPLE NAME								
-1	0-6" MXC Composite	37.8	27.2	34.6	Clay		6.8	3.3	
-2	6-12" MXC Composite	36.5	24.1	38.9	Clay		5.8	1.6	
-3	0-6" KNXD Composite	21.9	27.2	50.5	Clay		7.1	3.4	
-4	6-12" KNXD Composite	18.1	22.2	59.4	Clay		6.9	2.3	
-5	0-6" KNXD One Location	23.7	27.3	47.8	Clay		7.0	5.4	
-6	0-6" KNXD One Location	23.0	34.3	35.1	Clay		7.2	4.2	

		Gravel Content			Sand Distribution				
		Gravel > 4.0mm	Gravel	Total Gravel	Very Coarse	Coarse	Medium	Fine	Very Fine
	USDA (mm)	>4.0	2.0	>2.0	1.0	0.5	0.25	0.15	0.05
	U.S. Sieve (mesh)	>5	10	>10	18	35	60	140	270
LAB ID NO.	SAMPLE NAME	% Material Retained on Sieve							
-1	0-6" MXC Composite	0.0	0.5	0.5	0.9	1.5	2.1	6.0	8.0
-2	6-12" MXC Composite	0.0	0.1	0.1	0.5	1.0	1.6	5.9	8.5
-3	0-6" KNXD Composite	0.0	0.1	0.0	0.4	1.5	3.3	7.2	9.5
-4	6-12" KNXD Composite	0.0	0.0	0.0	0.9	1.3	2.5	5.4	7.1
-5	0-4" KNXD One Location	0.0	1.0	1.0	2.5	5.1	5.5	5.4	4.6
-6	0-6" KNXD One Location	0.0	1.6	1.6	1.5	2.5	5.6	6.5	6.4

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APPENDIX J. Nearshore Monitoring (2010)
Marine Research Consultants, Inc. (Steve Dollar)

(Please refer to Appendix D of this EIS for the full report)

Appendix D

Marine Water Quality/
Marine Environmental Assessments

Marine Water Quality Assessment

ASSESSMENT OF MARINE WATER CHEMISTRY FOR THE HONUA'ULA PROJECT

WAILEA, MAUI

Prepared for:

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By:

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Submitted
February 2010

I. PURPOSE

The Honua'ula project is situated on the slopes of Haleakala directly mauka of the Wailea Resort in South Maui, Hawaii. The project area is comprised of two parcels totaling 670 acres and is designated Project District 9 in the Kihei/Makena Community Plan (Figure 1). The project area is also zoned Project District 9 in the Maui County code. Current zoning includes provisions for up to 1,400 homes (including affordable workforce homes in conformance with the County's Residential Workforce Housing Policy (Chapter 2.96, MCC), village mixed uses, a homeowner's golf course, and other recreational amenities as well as acreage for parks, and open space that will be utilized for landscape buffers and drainage ways. The project is immediately above three 18-hole golf courses (Blue, Gold and Emerald) within the southern area of Wailea Resort. The composite Wailea Resort/Honua'ula encompasses approximately 1.9 miles of coastline. No aspect of the project involves direct alteration of the shoreline or nearshore marine environment. At the time of submission of this report, development of the project EIS and Phase II submittal is in progress. No construction activities associated with the project have commenced.

There is no *a priori* reason to indicate that responsible construction and operation of Honua'ula will cause any detrimental changes to the marine environment. Current project planning includes detention of surface drainage on the golf course and other areas, and a private wastewater system will treat effluent to the R-1 level which is suitable for irrigation re-use. Yet, there is always potential concern that construction and operation could cause environmental effects to the ocean off the project site. Of particular importance is the potential for cumulative effects from the combined Wailea Resort and Honua'ula projects. As the properties are oriented above one another with respect to the ocean, subsurface groundwater will flow under both project sites prior to discharge at the coastline. Hence, groundwater leachate from fertilizers and other materials that reach the ocean will be a mix from both projects.

While all planning and construction activities will place a high priority on maintaining the existing nature of the marine environment, it is nevertheless important to address any potential impacts that may be associated with the planned community. The potential exists, however, for the project to affect the composition and volume of groundwater that flows beneath the property, as well as surface runoff. As all groundwater and runoff that could be affected by the project could potentially reach the ocean, it is recognized that there is potential for effects to the marine environment. As the shoreline downslope from the planned project is a recreational area and is utilized for surfing, swimming, and fishing, evaluating the potential for alterations to water quality and marine life from material input from the community constitutes an important factor in the planning process.

In the interest of addressing these concerns and assuring maintenance of environmental quality, a marine water quality assessment and potential impact analysis of the nearshore areas downslope from Honua'ula has been conducted. The foundation of this assessment was based on a monitoring program that was stipulated as a condition of zoning (County of Maui Ordinance No. 3554 Condition 20) which states:

> *Marine monitoring programs shall be conducted which include monitoring and assessment of coastal water resources (groundwater and surface water) that receive surface water or groundwater discharges from the hydrologic unit where the project is located. Monitoring programs shall include both water quality and ecological monitoring.*
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> *Water Quality Monitoring shall provide water quality data adequate to assess compliance with applicable State water quality standards at Hawaii Administrative Rules Chapter 11-54. Assessment procedures shall be in accordance with the current Hawaii Department of Health ("HIDOH") methodology for Clean Water Act Section 305(b) water quality assessment, including use of approved analytical methods and quality control/quality assurance measures. The water quality data shall be submitted annually to HIDOH for use in the State's Integrated Report of Assessed Waters prepared under Clean Water Act Sections 303(d) and 305(b). If this report lists the receiving waters as impaired and requiring a Total Maximum Daily Load ("TMDL") study, then the monitoring program shall be amended to evaluate land-based pollutants, including: (1) monitoring of surface water and groundwater quality for the pollutants identified as the source of the impairment; and (2) providing estimates of total mass discharge of those pollutants on a daily and annual basis from all sources, including infiltration, injection, and runoff. The results of the land-based pollution water quality monitoring and loading estimate shall be submitted to the HIDOH Environmental Planning Office, TMDL Program.*
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> *The ecological monitoring shall include ecological assessment in accordance with the Coral Reef Assessment and Monitoring Program protocols used by the Department of Land and Natural Resources. The initial assessment shall use the full protocol. Subsequent annual assessments can use the Rapid Assessment Techniques. Results shall be reported annually to the Aquatic Resources Division, Department of Land and Natural Resources.*

This marine water quality assessment report is prepared in compliance with the above condition. Compliance with the ecological monitoring requirement of this condition will be provided in a separate report. It should be noted that to date, HIDOH, which is the agency responsible for developing TMDL's has not developed any TMDL criteria for any marine areas off the coast of Maui.

At the time of this writing three increments of monitoring have taken place since the establishment of conditions of Zoning (Condition 20), with the most recent survey conducted in September 2009. However, prior to approval of the conditions several increments of monitoring to establish baseline conditions for Honua'ula were conducted in 2005, 2006 and 2008. Data used in the following evaluation of water quality include the overall six phases of the monitoring program for the Honua'ula project, with particular emphasis on the most recent survey in September 2009.

The monitoring program to meet this condition utilizes established scientific methods that are capable of determining the contribution of groundwater to the marine environments offshore of Honua'ula, and to evaluate the effects that this input has on water quality at the present time. As no construction activities for Honua'ula have yet commenced, results of the monitoring program characterize existing conditions, particularly with respect to effects of the existing Wailea Resort. Combining this information with estimates of changes in groundwater and surface water flow rates and chemical composition that could result from the proposed Honua'ula project provides a basis to evaluate the potential future effects to the marine environment. Predicted changes in groundwater composition and flow rates have been supplied by Tom Nance Water Resource Engineering (TNWRE 2010). Results of the combined evaluation will indicate the potential degree of change to the marine environment that could occur as a result of Honua'ula.

II. ANALYTICAL METHODS

Figure 1 is an aerial photograph showing the shoreline and topographical features of the Wailea area, and the location of the three existing Wailea golf courses. Also shown are the boundaries of the proposed Honua'ula project. Ocean survey site locations are depicted as transects perpendicular to the shoreline extending from the highest wash of waves out to what is considered open coastal ocean (approximately the 20 m depth contour). Site 1 is located near the southern boundary of the Wailea Gold Course inside Nahuna Point offshore of an area locally known as "Five Graves"; Site 2 bisects the area off the center of the Wailea Emerald Course at the southern end of Palauea Beach (downslope from the southern boundary of the Honua'ula project site); Site 3 is located off the southern end of Wailea Beach off the approximate boundary of the Emerald and Blue Courses (downslope from approximate center of the Honua'ula project site), and Site 4 is off the northern end of the Blue Course at the northern end of Ulua Beach (downslope from the northern boundary of the Honua'ula project site). Survey Site 5 is located near the northern boundary of the 'Ahihi-kina'u natural area reserve, and just north of the 1790 lava flow. The site is approximately four kilometers (km) south of the Honua'ula project site. Land uses of the coastal area landward of Site 5 include several private residences and pasture for cattle grazing. Site 5 serves as the best available "control" survey site, as it is located offshore of an area with minimal land-based development, and no golf course operations, residential or commercial "development". In order to maximize the similarity of the control and test sites, the location of Site 5 was in an area of similar geologic and oceanographic structure as the sites off of the Wailea Resort and

Honua'ula. Farther to the south of Site 5, land development is less, but geologic structure consists of the 1790 lava flow, which is dissimilar with respect to hydrologic characteristics from the other survey sites off of Wailea.

All field work for the most recent survey was conducted on September 4, 2009 using a small boat and swimmers working from shore. Environmental conditions during sample collection consisted of calm seas, light winds and sunny skies.

Water samples were collected at five stations along transects that extend from the highest wash of waves to approximately 150 meters (m) offshore at each site. Such a sampling scheme is designed to span the greatest range of salinity with respect to groundwater/surface water efflux at the shoreline. Sampling is more concentrated in the nearshore zone because this area is most likely to show the effects of shoreline modification. With the exception of the two stations closest to the shoreline, samples were collected at two depths; a surface sample was collected within approximately 10 centimeters (cm) of the sea surface, and a bottom sample was collected within 1 m of the sea floor. The intermittent stream located at the base of Wailea Point (Site 3) was not flowing during this survey.

Samples from within 10 m of the shoreline were collected by swimmers working from the shoreline. Samples were collected by filling triple-rinsed 1 liter polyethylene bottles at the estimated distance from the shoreline. Samples beyond 10 m of the shoreline were collected using a small boat. Water samples were collected at stations locations determined by GPS using a 1.8-liter Niskin-type oceanographic sampling bottle. The bottle is lowered to the desired depth where spring-loaded endcaps are triggered to close by a messenger released from the surface. Upon recovery, each sample was transferred into a 1-liter polyethylene bottle until further processing.

Following collection, subsamples for nutrient analyses were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice until returned to Honolulu. Water for other analyses was kept in the 1-liter polyethylene bottles and kept chilled until analysis.

Water samples were collected from Wailea golf course irrigation wells on February 11, 2009. Samples were collected from well #'s 2, 5, 6, 7, 8, 9 and 10) located on the Gold and Emerald courses and one reservoir located on the Gold course.

Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the Water Quality Standards, Department of Health, State of Hawaii. These criteria include: total nitrogen (TN) which is defined as inorganic nitrogen plus dissolved organic nitrogen, nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium (NH_4^+), total phosphorus (TP) which is defined as inorganic phosphorus plus dissolved organic phosphorus, chlorophyll *a* (Chl *a*), turbidity, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) were reported because these

constituents are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Analyses for NH_4^+, PO_4^{3-}, and NO_3^- + NO_2^- (hereafter termed NO_3^-) were performed using a Technicon autoanalyzer according to standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion following digestion. Dissolved organic nitrogen (TON) and dissolved organic phosphorus (TOP) were calculated as the difference between TN and inorganic N, and TP and inorganic P, respectively. Limits of detection for the dissolved nutrients are 0.01 µM (0.14 µg/L) for NO_3^- and NH_4^+, 0.01 µM (0.31 µg/L) for PO_4^{3-}, 0.1 µM (1.4 µg/L) for TN and 0.1 µM (3.1 µg/L) for TP.

Chl *a* was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted in 90% acetone in the dark at -5°C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer (level of detection 0.01 µg/L). Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.0003‰.

In situ field measurements included water temperature, pH, dissolved oxygen and salinity which are acquired using an RBR Model XR-620 CTD calibrated to factory specifications. The CTD has a readability of 0.001°C, 0.001pH units, 0.001% oxygen saturation, and 0.001 parts per thousand (‰) salinity.

Analyses of nutrients, turbidity, pH, Chl *a* and salinity were conducted by Marine Analytical Specialists located in Honolulu, Hawaii. This laboratory possesses acceptable ratings from EPA-compliant proficiency and quality control testing.

III. RESULTS

A. Horizontal Stratification

Table 1 shows results of all marine and well water chemical analyses for samples collected off Wailea on September 4, 2009 reported in micromolar units (µM). Table 2 shows similar results presented in units of micrograms per liter (µg/L). Tables 3 and 4 show geometric means of ocean samples collected at the same sampling stations during surveys conducted since June 2005. Table 5 shows water chemistry measurements (in units of µM and µg/L) for samples collected from seven irrigation wells and a reservoir located on the Wailea Golf Courses. Concentrations of twelve chemical constituents in surface and deep water samples are plotted as functions of distance from the shoreline in Figures 2 and 3. Mean concentrations (±standard error) of twelve chemical constituents in surface and deep water samples from previous increments of sampling, as well as data from the most recent sampling, are plotted as functions of distance from the shoreline in Figures 4-18.

Evaluation of transect data reveals that at all five sites there was distinct horizontal stratification in the surface concentrations of dissolved Si, NO_3^-, and TN over the entire length of the transects. In addition, nutrient concentrations in surface waters are generally elevated compared to the concentration of the corresponding sample of bottom water (Figure 2, Tables 1 and 2).

For all nutrients with distinct horizontal gradients, slopes of concentrations were steepest within 5 m of the shoreline at all five transect sites. Beyond 5 m from the shoreline concentrations of nutrients decreased progressively with distance from shore but at a substantially reduced gradient compared with the zone within 5 m of the shoreline. Salinity showed the opposite trend, with distinctly lower values within the nearshore zone, and progressive increases with distance from shore (Figure 3). The pattern of decreasing nutrient concentration and increasing salinity with distance from shore is most evident at Sites 1 and 2 (Five Graves, Palauea Beach) , where surface concentrations of NO_3^- near the shoreline were two orders of magnitude higher than samples collected at the seaward ends of the transects. Salinity was correspondingly lower near the shoreline compared to offshore samples, with values differing by 22.3‰ and 14.7‰ between the shoreline and offshore terminus of transects at Sites 1 and 2, respectively (Tables 1 and 2). Transects at Sites 3-5 had elevated nutrient concentrations and correspondingly lower salinities near the shoreline, but the horizontal gradients were far less pronounced compared to the patterns at Transects 1 and 2.

The pattern of elevated Si, NO_3^-, and TN with corresponding low salinity is indicative of groundwater entering the ocean near the shoreline. Low salinity groundwater, which contains high concentrations of Si, and NO_3^-, (see values for well waters in Table 5), percolates to the ocean near the shoreline, resulting in a distinct zone of mixing in the nearshore region. The magnitude of the zone of mixing, in terms of both horizontal extent and range in nutrient concentration, depends on the magnitude of the flux of groundwater entering the ocean from land, and the magnitude of physical mixing processes (primarily wind and wave stirring) at the sampling location.

Surface concentrations of PO_4^{3-} and TP did not show the same horizontal patterns with distance offshore as was evident with the other dissolved nutrients (Figure 2, Tables 1 and 2). A few distinctly higher measurements were recorded at different locations along the transects at various sites, but no obvious gradient is visible.

Dissolved nutrient constituents that are not associated with groundwater input (NH_4^+, TON, TOP) show varying patterns of distribution with respect to distance from the shoreline (Figure 2). With the exception of the shoreline sample at Site 3, the surface concentrations of NH_4^+ were relatively constant along the length of each transect, with values ranging from 0.01 – 0.42 µM (Figure 2, Tables 1 and 2). Similar to NH_4^+, surface concentrations of TOP and TON were relatively constant at all sampling locations on all transect sites during the September 2009 survey (Figure 2).

At Transect site 3 (Wailea Beach), surface concentrations of turbidity were nearly an order of magnitude greater near the shoreline compared to offshore measurements. At Sites 4 (Ulua Beach) and 5 ('Ahihi-kina'u) turbidity was also elevated at the shoreline and decreased with distance from shore, but to a lesser extent than at site 3 (Figure 3

and Tables 1 and 2). At Sites 1 (Five Graves) and 2 (Palauea), turbidity did not exhibit elevated levels near the shoreline, and were nearly constant along the length of each transect. Beyond the nearshore area within 10 m of the shoreline, turbidity was similar on all five transects. At all five sites, concentrations of Chl *a* were elevated within the nearshore zone (within 10 m of the shoreline) compared to farther offshore (Figure 3, Tables 1 and 2). With the exception of the high value of Chl *a* in the shoreline sample at Site 4 (2.76 µg/L), concentrations were of the same magnitude among the five sites during September 2009. Surface temperature was distinctly lower at Site 5 compared to the other four sites during September 2009 (Figure 3, Tables 1 and 2). At all sites, temperature decreased from the shoreline to a distance of 50 m from the shoreline, beyond which temperature was relatively constant (Figure 3, Tables 1 and 2). During the September 2009 survey, the highest measurements were at Site 4 (28.4°C) and the lowest measurement was at Site 5 (26.1°C).

B. Vertical Stratification

In many areas of the Hawaiian Islands, input of low salinity groundwater to the nearshore ocean creates a distinct buoyant surface lens that can persist for some distance from shore. Buoyant surface layers are generally found in areas with both conspicuous input of groundwater, and turbulent processes (primarily wave action) insufficient to completely mix the water column. During the September 2009 survey, vertical stratification was apparent in that concentrations of nutrients that occur in relatively high concentrations in groundwater (Si, NO_3^-, PO_4^{3-}, TN) were elevated in surface samples relative to bottom samples at all sites, while salinity showed a reverse trend with high values in bottom samples compared to surface values. Such gradients suggest that the groundwater was not completely mixed within the water column in the nearshore zone throughout the region of study.

Contrary to the nutrients listed above, there were no consistent patterns in vertical stratification in the concentrations of NH_4^+, TP, TOP, TON and Chl *a* during the September 2009 survey (Figures 2 and 3). In many instances, concentrations were higher in deep water compared to the surface water and in other cases, the opposite was evident. The lack of consistent trends in the stratification indicate that the variation is not likely a result of groundwater input, or any other factors associated with freshwater input from land. Temperature values did show stratification with the deep water samples colder than the surface water. These results were most likely due to solar warming.

C. Temporal Comparison of Monitoring Results

Figures 4-18 show mean concentrations (and the standard error) of water chemistry constituents from surface and deep samples at all five sites over the course of the Honua'ula monitoring program. Also plotted separately are data from the most recent survey in September 2009.

Examination of the plots in Figures 4-18 reveal some indications of changes in water chemistry between the most recent survey and the average survey results, as well as between the different survey sites over the course of monitoring. With respect to groundwater efflux, similar patterns of decreasing concentrations of Si, NO_3^-, PO_4^{3-} and increasing salinity with distance from shore are evident in the mean values at all five sampling sites, and have been consistently highest at Site 1 (Five Graves), Site 2 (Palauea), and Control Site 5 (Figures 4-18). In the most recent survey (September 2009) the concentrations of Si, NO_3^-, and TN were slightly higher than the mean values at Sites 1 and 3 while salinity was distinctly lower at Sites 1 and 2. In contrast, at Site 5, concentrations of Si, NO_3^-, and PO_4^{3-} were lower and salinity higher than the mean values (Figures 16 and 18). Excursions from the mean values have been observed in past surveys, most notable in the December 2007 survey which was conducted three days after a major storm front moved through the area (rainfall to the area was recorded at 2.95 inches in a 24 hour period).

These comparisons suggest that while there are some differences between surveys, water chemistry of the nearshore zone at Sites 1 and 2 was influenced by greater groundwater efflux during the September 2009 survey compared to the average values of surveys conducted in past years. In addition, the concentrations and gradients in nutrients that occur at Site 5, located beyond the influence of the Wailea Resort and other development in Wailea, were similar to the patterns on the transects located offshore of two of the sites off the Wailea Golf Courses (Sites 3 and 4. Therefore, it is apparent that the golf course operations are not solely responsible for changes that might be depicted in water quality.

D. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land involves a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity. Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question (Officer 1979, Dollar and Atkinson 1992, Smith and Atkinson 1993). Figure 19 shows plots of concentrations of four chemical constituents (Si, NO_3^-, PO_4^{3-} and NH_4^+) as functions of salinity for the samples collected at each site in September 2009. Figures 20 and 21 show similar plots with historical data compared with the most recent survey.

Each graph also shows conservative mixing lines that are constructed by connecting the end-member concentrations of open ocean water and groundwater from irrigation wells upslope of the sampling area. The conservative mixing line for Figure 19 was constructed using water from Wailea Well No. 5 located to the northwest of the project area, and ocean water collected from near the bottom at the most offshore sampling locations.

If the parameter in question displays purely conservative behavior (no input or removal from any process other than physical mixing), data points should fall on, or very near, the conservative mixing line. If, however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as uptake by biotic metabolic processes, data points will fall below the mixing line.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 19 that all but two data points from Sites 1-5 fall in a linear array on, or very close to the conservative mixing line for Si, indicating that groundwater entering the ocean at these sites is a nearly pure mix of groundwater similar to that from Wailea Well No. 5, and open coastal water. The anomalous data points collected from the shoreline at Sites 1 and 2 fell off the linear array below the conservative mixing line. The deviation of these nearshore points suggest that groundwater entering the ocean at the shoreline at Sites 1 and 2 may have a contribution from another groundwater source lower in Si concentration (possibly rainwater) that is contributing to input to the ocean. It can be seen in Figure 20 that similar deviations in concentrations of silica as functions of salinity have occurred in previous surveys. In addition, it is also evident in Figure 20 that there have been deviations above the mixing line in previous surveys, indicating input of other sources of groundwater enriched in Si relative to groundwater from Wailea Well No. 5.

The plots of NO_3^- versus salinity reveal a generally similar pattern as Si, with most of the data points from all five sites falling on, or very close to the mixing line (Figure 19). Similar to Si, the plots of NO_3^- vs. salinity of the shoreline samples at Sites 1 and 2 also fall below the mixing line.

The linear relationship of the concentrations of NO_3^- as functions of salinity indicates little or no detectable uptake of this material in the marine environment (e.g., no upward concave curvature of the data lines). Lack of uptake indicates that NO_3^- is not being removed from the water column by metabolic reactions that could change the composition of the marine environment. Rather, the nutrients entering the ocean through groundwater efflux are dispersed by physical mixing processes. In addition, the distinct vertical stratification that is usually evident to a distance of at least 100 m from the shoreline suggests that water with increased concentrations of NO_3^- as a result of groundwater input are limited to a buoyant surface plume that does not mix through the entire water column. As a result, these analyses provide valid evidence to indicate that the increased nutrients fluxes from land have little potential to cause alteration in biological community composition or function.

It has been documented in other locales in the Hawaiian Islands (e.g., Keauhou Bay on the Big Island) where similar nutrient subsidies from golf course leaching occur that excess NO_3^- does not cause changes in biotic community structure (Dollar and

Atkinson 1992). It was shown at Keauhou that owing to the distinct vertical stratification in the nearshore zone, the excess nutrients do not normally come into contact with benthic communities, thereby limiting the potential for increased uptake by benthic algae. In addition, the residence time of the high nutrient water was short enough within the embayment to preclude phytoplankton blooms. As a result, while NO_3^- concentrations doubled in Keauhou Bay as a result of golf course leaching for a period of at least several years, there is no detectable negative effect to the marine environment. Owing to the unrestricted nature of circulation and mixing off the Wailea site with no confined embayments it is reasonable to assume that the excess NO_3^- subsidies that are apparent in the ongoing monitoring will not result in alteration to biological communities. Inspection of the region during the monitoring surveys indicates that indeed, there are no areas where excessive algal growth is presently occurring, or has occurred in the past.

The other form of dissolved inorganic nitrogen, NH_4^+, does not show a linear pattern of distribution with respect to salinity (Figure 19). Several of the samples with high (34-35‰) salinity also displayed the highest concentrations of NH_4^+, particularly at Transect Sites 1 and 3. The lack of a correlation between salinity and concentration of NH_4^+ suggests that this form of nitrogen is not present in the marine environment as a result of mixing from groundwater sources. Rather, NH_4^+ appears to be generated by natural biological activity in the ocean waters off of Wailea.

PO_4^{3-} is also a major component of fertilizer, but is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in soils. It can be seen in Figure 19 that there is a weak correlation between PO_4^{3-} and salinity, when compared to the linearity for Si and NO_3^- (Figure 19). In the cumulative data, most of the data points at salinities below 32‰ from all the sites fall on or below the conservative mixing line (Figure 21). These results suggest that the operation of the golf course is not resulting in increased concentrations of PO_4^{3-} in the nearshore zone.

E. Time Course Mixing Analyses

While it is possible to evaluate temporal changes from repetitive surveys conducted over time in terms of concentrations of water chemistry constituents (See Section D), a more informative and accurate method of evaluating changes over time is to utilize the results of scaling nutrient concentrations to salinity. As discussed above, the simple hydrographic mixing model consisting of plotting concentrations of nutrient constituents versus salinity eliminates the ambiguity associated with comparing nutrient concentrations of samples collected at different stages of tide and sea conditions. Tables 6-8 show the numerical values of the Y-intercepts, slopes, and respective upper and lower 95% confidence limits of linear regressions fitted through the data points for Si, NO_3^-, and PO_4^{3-} as functions of salinity for each year of monitoring at Transect Sites 1-5.

The magnitude of the contribution of nutrients to groundwater originating from land-based activities will be reflected in both the steepness of the slope and the magnitude of the Y-intercept of the regression line fitted through the concentrations scaled to salinity (the Y-intercept can be interpreted as the nutrient concentration that would occur at a salinity of zero if the distribution of data points is linear). This relationship is valid because with increasing contributions from land, nutrient concentrations in any given parcel of water will increase with no corresponding change in salinity. Hence, if the contribution from land to groundwater nutrient composition is increasing over time, there would be progressive increases in the absolute value of the slopes, as well as the Y-intercepts of the regression lines fitted through each set of nutrient concentrations plotted as functions of salinity. Conversely, if the contributions to groundwater from land are decreasing, there will be decreases in the absolute values of the slopes and Y-intercepts.

Plots of the values of the slopes (Figure 22) and Y-intercepts (Figure 23) of regression lines fitted though concentrations of Si, NO_3^- and PO_4^{3-} scaled to salinity during each survey year provide an indication of the changes that have been occurring over time in the nearshore ocean off Wailea. As stated above, Si provides the best case for evaluating the effectiveness of the method, as Si is present in high concentration in groundwater but is not a component of fertilizers. NO_3^- and PO_4^{-3} are the forms of nitrogen and phosphorus, respectively, found in high concentrations in groundwater relative to ocean water, and are the major nutrient constituents found in fertilizers.

Examination of Figures 22 and 23, as well as Tables 6-8 reveal that none of the slopes or Y-intercepts of Si or NO_3^- from 2005 to 2009 at any of the transect sites exhibit any indication of progressively increasing or decreasing values over the course of monitoring. The term "REGSLOPE" in Tables 6-8 denotes the values of the slopes and 95% confidence limits of linear regressions of the values of the yearly slopes and Y-intercepts as a function of time. In most cases, the upper and lower 95% confidence limits of the REGSLOPE coefficients are not significantly different than zero, indicating that there is no statistically significant increase or decrease in the salinity-scaled concentrations of Si, NO_3^- and PO_4^{3-} over the course of the monitoring program (Tables 6-8). Notable excursions from zero in the confidence limits for Sites 2 and 4 occurred during 2005 and 2008 (Tables 6 and 7) and at Site 5 in 2009 (Table 7). The weak linear relationship between Si, NO_3^- and salinity in these instances were possibly a result of extreme physical mixing of the water column during those surveys.

Patterns in the time course mixing analysis for PO_4^{3-} are not as definitive as for Si and NO_3^-. The inconsistent linearity between PO_4^{3-} and salinity between sites and surveys result in a wide variation in the confidence limits. Overall, the lack of any significant slope from zero indicates that there have been no increases or decreases in nutrient input to the ocean from the project site over the course of monitoring (2005-2009).

F. Compliance with DOH Standards

Tables 1 and 2 also show samples that exceed DOH water quality standards for open coastal waters under "wet" and "dry" conditions. The distinction between application of wet and dry criteria is based on whether the survey area is likely to receive less than ("dry") or greater than ("wet") 3 million gallons of freshwater input per mile per day. DOH standards include specific criteria for three situations; criteria that are not to be exceeded during either 10% or 2% of the time, and criteria that are not to be exceeded by the geometric mean of samples. Comparison of the 10% or 2% of the time criteria for the small data set presently acquired is not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Boxed values in Tables 1 and 2 indicate measurements which exceed the DOH 10% standards under "dry" conditions, while boxed and shaded values show measurements which exceed DOH 10% standards under "wet" conditions. All but sixteen of the sixty samples collected were above the 10% criteria for NO_3^- under "dry" or "wet" conditions in the September 2009 survey (Table 1). Most of the previous surveys have also had a high percentage of the samples exceeding the 10% limit for NO_3^-. In addition to NO_3^-, two measurements of NH_4^+, eight measurements of TN, two measurements of turbidity and nine measurements of Chl *a* exceeded the 10% DOH criteria under "dry" conditions in September 2009. If "wet" criteria are applied, four measurements of NH_4^+, twenty-three measurements of TN, two measurements of turbidity and fourteen measurement of Chl *a* exceeded the DOH water quality standards. During the September 2009 survey, no measurements of TP exceeded either the "dry" or "wet" DOH standards.

Tables 4 and 5 show geometric means of samples collected at the same locations during the six increments of the monitoring program. Also shown in these tables are the samples that exceed the DOH geometric mean limits for open coastal waters under "dry" (boxed) and "wet" (boxed and shaded) conditions. All measurements of NO_3^- in surface waters, and nearly all measurements of NH_4^+, TN and Chl *a* exceeded the DOH geometric mean standards for dry conditions. Conversely, only a few of the geometric means of TP and turbidity were exceeded under dry conditions. It is important to note that a similar pattern of exceedance of geometric means occurred at Site 5 compared to the other four sites. As described above, Site 5 is considered a control that is located beyond the influence of the golf courses or other major land uses. The large number of water chemistry values that exceed the DOH criteria at Site 5, and the similarity in the pattern of these exceedances relative to the four Sites located directly off the existing Wailea Golf Courses and the Honua'ula site indicate that other factors, including natural components of groundwater efflux, are responsible for water chemistry characteristics to exceed stated limits. Thus, the elevated concentrations of water chemistry constituents at sampling stations offshore of the developed Wailea area cannot be attributed completely to anthropogenic factors associated with land use development. As naturally occurring groundwater contains elevated nutrient concentrations relative to open coastal water, input of naturally occurring groundwater is likely a factor in the exceedances of DOH standards which do not include consideration of such natural factors.

IV. DISCUSSION and CONCLUSIONS

The purpose of this assessment is to assemble the information to make valid evaluations of the potential for impact to the marine environments from the proposed Honua'ula project. The information collected in this study provides the basis to understand the processes that are operating in the nearshore ocean, so as to be able to address any concerns that might be raised in the planning process.

The proposed Honua'ula project does not include any plans for any direct alteration of the shoreline or offshore areas. In fact, the shoreline area downslope from Honua'ula is separated by the existing Wailea Resort. Therefore, potential impacts to the marine environment can only be considered from activities on land that may result in delivery of materials (primarily fresh water and nutrients) to the ocean through infiltration to groundwater on land with subsequent discharge to the ocean, and surface runoff. To evaluate the possible magnitude of these processes, a report has been prepared by Tom Nance Water Resource Engineering entitled "*Assessment of the Potential Impact on Water Resources of the Honua'ula Project in Wailea, Maui*" (TNWRE 2010).

For the purposes of analyses of impact on water resources on the property, potable and irrigation water would be provided by six brackish wells; four wells have already been developed (two onsite and two to the north of the project site), with two new wells planned as needed. Onsite reverse osmosis (RO) of brackish well water will provide potable water. Recovery rate of the RO process is on the order of 65% of the feedwater supply, with the remaining 35% being a concentrate that would be mixed with brackish and R-1 water and reused for golf course irrigation. Domestic wastewater would be treated to R-1 quality, either at the Makena Resort treatment plant, or a new onsite treatment plant, and also used for golf course irrigation. Landscape irrigation in areas outside of the golf course would be supplied by brackish well water. Numerous detention basins are also planned so that there will be no increase in the peak rate of storm water runoff leaving the Property compared to existing conditions.

With respect to the potential impacts these proposed scenarios TNWRE (2010) provides the following assumptions and potential impacts to groundwater downgradient of the Honua'ula project site:

1) 70% of the average annual runoff from the project will percolate to groundwater through detention basins. The remainder will be lost to evaporation or overtop the detention basins in severe storm events, and flow through the Wailea Resort to the shoreline.

2) For all the sources of supply used to irrigate the golf course and landscaped areas, the portion percolating through the root zone will have a salinity increase of 10% and a reduction of 50% in the concentration of nitrogen (N) and phosphorus (P) as a result

of nutrient uptake by processes occurring within the soil (e.g., plant uptake and adsorption).

3) R-1 effluent from the Wastewater Treatment Plant that will be reused for golf course irrigation will have an N concentration of 775 µM (10.85 mg/L) and a P concentration of 165 µM (2.00 mg/L)

4) On a long-term basis, it is assumed that the salinity of the combined brackish well water supply is 0.95‰. With 65% RO product recovery rate, the salinity of the remaining 35% of the brackish water used for golf course irrigation will rise to 2.41‰. Essentially all of the N and P in the brackish water run through the RO process will be contained in the 35% feedwater concentrate that will be used for golf course irrigation.

5) Fertilizer applications in landscaped areas will be approximately 3 lbs. N per 1,000 ft^2 per year, and 0.5 lbs. P per 1,000 ft^2 per year. Of these applications, 10% of the N, and 2% of the P will percolate through the root zone to groundwater.

6). In the hundreds of feet of travel by the percolate through the vadose zone (the unsaturated lavas between the ground surface and groundwater) and the thousands of feet of travel for groundwater to discharge at the shoreline, natural processes will remove approximately 80% of dissolved N and 95% of dissolved P.

7). Computed changes to groundwater reveal a 2.9% reduction in flowrate; a 0.62% increase in salinity; a reduction in N loading of 4.3%, and a reduction in P loading of 4.8%. The largest factor contributing to these results is that most of the groundwater supply (~75%) will come from offsite Kamaole wells.

Hence, based on the projected configuration of the Honua'ula project, the estimates of changes to groundwater and surface water would result in a decrease in nutrient loading to the ocean relative to the existing condition. With such a scenario, it is evident that there would be no expected impacts to the nearshore marine ecosystem owing to nutrient subsidies related to development of Honua'ula. As the nearshore marine community composition in Hawaii typically occur in oceanic waters, the small reduction in nutrient loading and, groundwater flow rate cannot be considered as a potential negative impact.

In addition to consideration of effects from nutrient additions, it is also important to consider the potential effect of sedimentation that may occur as a result of construction activities. The property is presently comprised of areas of exposed soil and rock, along with vegetative groundcover. During episodes of heavy rainfall, sediment is undoubtedly suspended in sheetflow drainage which flows off the property in a seaward direction. The proposed plan including numerous onsite detention basins will greatly reduce surface runoff across the project site, with a corresponding decrease in potential discharge to the ocean. In addition, while a portion of water caught in the detention basins will seep back to the groundwater,

the particulate sediment load will be retained within the basin. Hence, sediment loading to the ocean will decrease as a result of both lowered storm water discharge volume, and particulate concentrations relative to the present scenario.

During the construction phases, it is likely that permit regulations will limit the area of excavation at any one time, and require dust control measures. In addition, the predominant direction of wind (long-shore tradewinds) will not produce offshore winds that would carry construction-generated dust toward the ocean. As a result, there is little potential for any significant input of sediment to the marine environment resulting from the proposed project.

All of these considerations indicate that the proposed Honua'ula project will not have any significant negative effect on water quality in the coastal ocean offshore of the property.

IV. SUMMARY

- Six phases of water quality monitoring program for the planned Honua'ula project have been carried out since 2005, with the most recently taking place in September 2009. During each survey, sixty ocean water samples were collected on four transects spaced along the length of coastline makai of the project and one transect located outside of the project area as a control site. Site 1 was located at the southern boundary of the Gold Course (Five Graves), Site 2 was located near the central part of the Emerald Course (Palauea Beach), Site 3 was located off the juncture of the Emerald and Blue Courses, and Site 4 was located near the northern boundary of the Blue Course. Site 5 served as a control, and was located near the northern end of the 'Ahihi-kina'u Natural Area Reserve, approximately four km to the south of the project site. Transects extended from the shoreline out to the open coastal ocean. Water samples were analyzed for chemical criteria specified by DOH water quality standards, as well as several additional criteria. Water samples were also collected during surveys from seven irrigation wells and a golf-course reservoir in the Wailea area upslope of the sampling area to provide data on composition of groundwater flowing under the site.
- Water chemistry constituents that occur in high concentration in groundwater (Si, NO_3^- and TN) typically displayed steeply sloping horizontal gradients with highest concentrations nearest to shore and decreasing concentrations moving seaward. Salinity showed the opposite trend, with lowest values closest to shore, and increasing values with distance seaward. Gradients were steepest within 10 m of the shoreline, but often continued across the entire length of all transects. The steep nearshore gradients had the greatest magnitude (i.e., highest concentrations at the shoreline) at Sites 1 and 2. The steep horizontal gradients signify mixing of low salinity/high nutrient groundwater that discharges to the ocean at the shoreline and high salinity/low nutrient ocean water.

- Vertical stratification of the water column was also clearly evident at all sites for the chemical constituents that occur in high concentrations in groundwater relative to ocean water. Vertical stratification indicates that physical mixing processes generated by wind, waves and currents were often not sufficient to completely break down the density differences between the buoyant low salinity surface layer and denser underlying water.

- Most water chemistry constituents that do not occur in high concentrations in groundwater (NH_4^+, TOP, TON, Chl *a*, turbidity) did not display distinct horizontal or vertical trends.

- Scaling nutrient concentrations to salinity indicates that during the September 2009 survey there was no apparent subsidy of NO_3^- to the nearshore ocean at any of the sites. During previous surveys, substantial subsidies of NO_3^- at some locations had been evident. The likely cause of the subsidies of NO_3^- in past surveys was either leaching of golf course or landscaping fertilizers to groundwater that flows under the Wailea golf courses, or possibly leakage from old septic systems or cesspools that served residences in the vicinity of Site 1.

- Linear regression statistics of nutrient concentration plotted as functions of salinity are useful for evaluating changes to water quality over time. When the regression values of nutrient concentrations versus salinity are plotted as a function of time, there are no statistically significant increases or decreases over the five years of monitoring at any of the survey sites. The lack of increases in these slopes and intercepts indicate that there has been no consistent change in nutrient input from land to groundwater that enters the ocean from 2005 to 2009. Further monitoring will be of interest to note the future direction of the oscillating trends noted in the last six years.

- Comparing water chemistry parameters to DOH standards revealed numerous measurements of NO_3^- exceeded the DOH "not to exceed more than 10% of the time" criteria for both wet and dry conditions of open coastal waters. Numerous values of NO_3^-, NH_4^+, TN, Chl *a*, and to a lesser extent TP and turbidity, exceeded specified limits for geometric means. Such exceedances occurred at all survey sites, including the control site which is not influenced by the golf courses or other large-scale land uses. Such results indicate that the exceedances of the geometric mean water quality standards are not solely associated with golf course operation or other anthropogenic land uses. Rather, natural groundwater discharge can cause water chemistry characteristics to exceed DOH standards.

- With potable water supplied by reverse osmosis of brackish well water and irrigation water supplied from brackish well water and R-1 effluent from the wastewater treatment plant, there will be no adverse affect to groundwater resources in areas in the vicinity of the project. Evaluations of changes to

groundwater flux and composition resulting from the project performed by Tom Nance Water Resources Engineering indicate a 2.9% reduction in flowrate; a 0.62% increase in salinity; a reduction in N loading of 4.3%, and a reduction in P loading of 4.8%. The largest factor contributing to these results are that most of the groundwater supply (~75%) will come from offsite Kamaole wells to the north of the project area. In detaining onsite runoff, the detention basins will: 1) ensure that the volume of rain water runoff leaving the Property will not increase over current conditions; and 2) capture floatables and suspended solids in the basins, thus reducing sediment loads discharging to the marine environment at the shoreline.

- Based on the projected planning for the Honua'ula project, the estimates of changes to groundwater and surface water would result in a decrease in nutrient and sediment loading to the ocean relative to the existing condition. With such a scenario, it is evident that there would be no expected impacts to the nearshore marine ecosystem owing to development of Honua'ula.

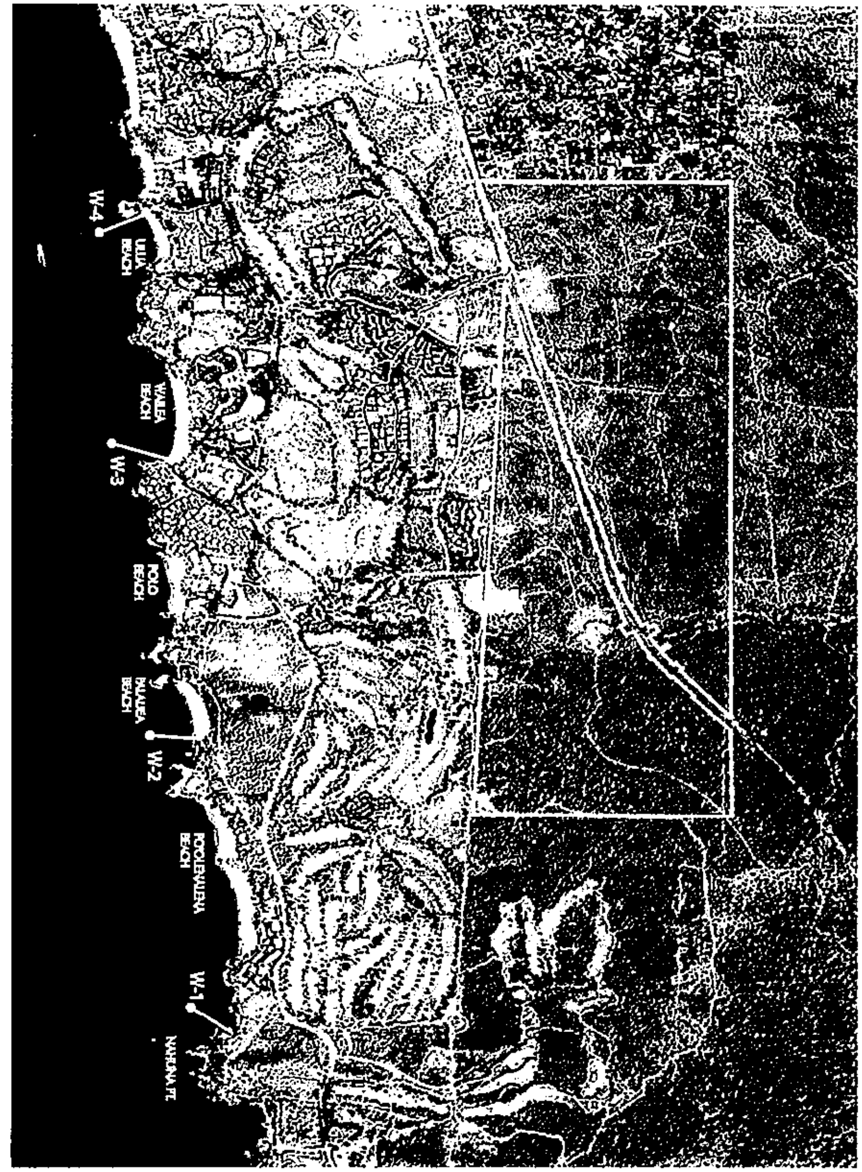

FIGURE 1. Aerial photograph of Wailea area showing boundaries of Honua'ula Project (in yellow) and locations of marine water quality sampling transects. Transect W-5 is considered a control and is located in the 'Ahihi-kina'u Natural Area Reserve approximately four km south of the Honua'ula Project site.

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TABLE 1. Water chemistry measurements from ocean water samples collected in the vicinity of the Honua'ula project site on September 4, 2009. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep, BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO4 (µM)	NO3 (µM)	NH4 (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
WAILEA 1	0 S	0.1	0.12	143.0	0.03	255.3	0.25	1.65	0.37	144.7	0.20	12.819	0.50	27.5	8.11	113.4
	2 S	0.1	0.30	57.36	0.14	108.18	0.27	4.32	0.57	61.82	0.29	27.397	1.20	27.6	8.19	111.2
	5 S	0.1	0.04	15.94	0.05	33.11	0.29	6.77	0.33	22.76	0.25	33.019	0.38	27.6	8.18	110.2
	5 D	1.0	0.44	10.54	2.69	25.00	0.36	11.02	0.80	24.25	0.21	33.588	0.44	27.5	8.16	109.2
	10 S	0.1	0.05	19.52	0.13	40.34	0.30	6.66	0.35	26.31	0.29	32.601	0.21	27.5	8.18	109.5
	10 D	1.7	0.06	4.86	0.06	12.19	0.33	7.25	0.39	12.17	0.18	34.457	0.26	27.0	8.16	108.9
	50 S	0.1	0.11	10.74	0.26	19.12	0.35	9.28	0.46	20.28	0.19	34.001	0.18	26.7	8.17	108.0
	50 D	4.4	0.13	0.92	0.08	3.50	0.34	7.23	0.47	8.23	0.13	35.096	0.73	26.7	8.16	104.8
	100 S	0.1	0.04	11.22	0.11	19.73	0.30	6.93	0.34	18.26	0.16	33.959	0.23	26.8	8.18	107.7
	100 D	6.2	0.03	0.11	0.04	2.85	0.31	7.33	0.34	7.48	0.13	35.135	0.12	26.7	8.17	105.9
	150 S	0.1	0.03	1.12	0.09	3.40	0.32	8.14	0.35	9.35	0.18	35.083	0.06	27.0	8.17	102.5
	150 D	11.7	0.03	0.06	0.05	2.05	0.32	7.00	0.35	7.11	0.12	35.219	0.09	26.7	8.17	105.0
WAILEA 2	0 S	0.1	0.05	170.5	0.02	146.0	0.24	4.33	0.29	174.8	0.22	16.982	0.60	27.3	8.24	111.0
	2 S	0.1	0.18	27.23	0.23	22.92	0.29	8.56	0.47	36.02	0.20	33.149	1.11	27.3	8.19	110.9
	5 S	0.1	0.05	5.47	0.06	9.28	0.30	6.80	0.35	12.33	0.18	34.790	0.24	27.3	8.16	108.2
	5 D	1.0	0.24	2.65	0.06	5.66	0.32	7.21	0.56	9.92	0.19	34.965	0.25	27.3	8.17	110.9
	10 S	0.1	0.31	2.46	0.42	5.92	0.37	12.97	0.68	15.85	0.24	34.991	0.14	27.2	8.17	109.5
	10 D	2.0	0.04	0.93	0.22	3.62	0.32	7.46	0.36	8.61	0.17	35.084	0.58	27.0	8.17	108.5
	50 S	0.1	0.05	6.15	BDL	12.09	0.31	8.96	0.36	15.11	0.18	34.678	0.19	26.9	8.17	105.4
	50 D	4.9	0.04	0.16	0.10	2.31	0.30	7.34	0.34	7.60	0.19	35.218	0.25	26.8	8.17	102.4
	100 S	0.2	0.04	4.93	0.03	9.95	0.32	7.33	0.36	12.29	0.16	34.928	0.18	26.8	8.16	103.0
	100 D	8.7	0.03	0.02	0.06	1.70	0.29	8.02	0.32	8.10	0.14	35.252	0.18	26.8	8.18	104.1
	150 S	0.1	0.03	4.49	0.08	9.27	0.28	7.60	0.31	12.17	0.19	34.724	0.14	27.1	8.14	99.6
	150 D	14.4	0.04	0.22	0.13	2.35	0.28	7.50	0.32	7.85	0.17	35.247	0.33	26.6	8.17	104.6
WAILEA 3	0 S	0.1	0.09	27.76	1.39	58.98	0.45	12.92	0.54	42.07	0.97	31.650	1.62	27.3	8.30	104.8
	2 S	0.1	0.19	32.63	0.13	65.75	0.29	5.32	0.48	38.08	0.33	31.137	0.39	27.3	8.18	103.7
	5 S	0.1	0.04	4.57	0.11	9.64	0.28	7.87	0.32	12.55	0.17	34.618	0.23	28.4	8.18	103.4
	5 D	1.0	0.13	4.01	0.14	9.91	0.29	7.16	0.42	11.31	0.20	34.623	0.24	28.2	8.19	104.2
	10 S	0.1	0.16	26.97	0.12	55.68	0.30	5.68	0.46	32.77	0.16	31.933	0.23	28.1	8.15	103.4
	10 D	1.0	0.03	8.73	0.13	19.52	0.28	8.42	0.31	17.28	0.28	34.086	0.27	27.5	8.17	102.3
	50 S	0.1	0.07	2.29	0.20	6.04	0.40	8.56	0.47	11.05	0.32	34.987	0.19	27.2	8.16	101.2
	50 D	4.0	0.12	0.01	0.44	1.56	0.37	8.54	0.49	8.99	0.13	35.161	0.19	27.2	8.18	100.9
	100 S	0.1	0.04	0.84	0.18	3.41	0.35	7.79	0.39	8.81	0.17	35.060	0.12	27.0	8.17	100.8
	100 D	6.1	0.07	0.02	0.13	1.38	0.34	8.33	0.41	8.48	0.12	35.196	0.19	26.8	8.19	103.5
	150 S	0.1	0.03	1.18	0.13	4.33	0.32	6.45	0.35	7.76	0.14	35.063	0.10	27.0	8.16	101.7
	150 D	11.2	0.12	0.07	0.15	1.09	0.31	7.43	0.43	7.65	0.09	35.203	0.09	26.7	8.19	106.9
WAILEA 4	0 S	0.1	0.03	24.63	0.04	37.00	0.31	6.95	0.34	31.62	0.41	32.242	0.67	28.4	8.25	118.3
	2 S	0.1	0.03	24.02	BDL	24.88	0.31	6.42	0.34	30.44	0.53	32.708	2.76	28.4	8.25	113.7
	5 S	0.1	0.04	2.36	0.06	5.27	0.32	8.20	0.36	10.62	0.35	34.829	0.65	28.4	8.19	116.4
	5 D	1.0	0.04	1.87	0.07	4.75	0.30	6.91	0.34	8.85	0.32	34.936	0.81	28.4	8.18	109.2
	10 S	0.1	0.04	0.61	0.10	4.56	0.32	8.19	0.36	8.90	0.37	35.085	0.20	28.1	8.25	106.5
	10 D	1.0	0.04	0.31	0.03	3.39	0.34	7.24	0.38	7.58	0.25	35.166	0.16	27.5	8.18	105.2
	50 S	0.1	0.25	25.32	0.32	39.61	0.37	7.10	0.62	32.74	0.13	33.011	0.14	27.0	8.11	104.1
	50 D	5.2	0.11	0.36	0.24	2.07	0.33	7.91	0.44	8.51	0.15	35.132	0.08	26.7	8.16	101.1
	100 S	0.1	0.04	7.14	0.17	10.55	0.34	6.40	0.38	13.71	0.17	34.550	0.21	27.4	8.13	101.1
	100 D	9.8	0.03	0.09	0.32	2.04	0.31	6.88	0.34	7.29	0.12	35.170	0.16	26.7	8.17	107.3
	150 S	0.1	0.03	BDL	0.04	1.74	0.33	7.27	0.36	7.31	0.09	35.205	0.12	27.7	8.18	102.4
	150 D	12.3	0.06	BDL	0.01	1.47	0.35	6.58	0.41	6.59	0.11	35.181	0.25	26.7	8.19	112.0
WAILEA 5	0 S	0.1	0.03	8.55	0.12	55.70	0.34	6.76	0.37	15.43	0.40	32.410	0.58	26.1	8.15	112.9
	2 S	0.1	0.01	7.05	0.22	49.39	0.32	7.46	0.33	14.73	0.29	32.877	0.42	26.7	8.16	115.7
	5 S	0.1	0.08	5.27	0.32	39.96	0.32	7.45	0.40	13.04	0.28	33.307	0.46	26.8	8.14	111.7
	5 D	1.0	0.02	4.76	0.33	37.44	0.35	9.34	0.37	14.43	0.21	33.491	0.50	26.7	8.14	112.7
	10 S	0.1	0.06	2.96	0.29	24.33	0.29	7.27	0.35	10.52	0.18	34.223	0.20	26.5	8.13	105.9
	10 D	2.0	0.07	2.44	0.17	20.48	0.31	6.66	0.38	9.27	0.18	34.763	0.14	26.2	8.12	100.3
	50 S	0.1	0.04	0.88	0.05	7.88	0.30	7.24	0.34	8.17	0.26	34.908	0.16	26.3	8.09	99.0
	50 D	4.4	0.11	0.16	0.04	4.98	0.31	7.02	0.42	7.22	0.15	35.138	1.71	26.3	8.10	102.8
	100 S	0.1	0.13	1.76	0.06	10.69	0.31	6.94	0.44	8.76	0.19	34.772	0.37	26.5	8.09	100.6
	100 D	6.4	0.05	0.05	0.02	2.68	0.31	7.03	0.36	7.10	0.26	35.154	0.29	26.7	8.12	102.8
	150 S	0.1	0.08	0.02	0.14	1.82	0.33	7.68	0.41	7.84	0.11	35.276	0.09	26.7	8.16	102.5
	150 D	7.7	0.08	0.01	0.02	2.12	0.34	7.76	0.42	7.79	0.12	35.185	0.07	26.6	8.16	104.6
DOH WQS		DRY	10%	0.71	0.36				0.96	12.86	0.50	*	0.50	**	***	****
			2%	1.43	0.64				1.45	17.86	1.00		1.00			
		WET	10%	1.00	0.61				1.29	17.85	1.25	*	0.90	**	***	****
			2%	1.78	1.07				1.93	25.00	2.00		1.75			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.
****Dissolved Oxygen not to be below 75% saturation.

TABLE 2. Water chemistry measurements from ocean water samples (in µg/L) collected off the Honua'ula project site on September 4, 2009. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep, BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
WAILEA 1	0 S	0.1	3.72	2003	0.42	7173	7.74	23.11	11.46	2026	0.20	12.819	0.50	27.5	8.11	113.4
	2 S	0.1	9.29	803.4	1.96	3040	8.36	60.51	17.65	865.9	0.29	27.397	1.20	27.6	8.19	111.2
	5 S	0.1	1.24	223.3	0.70	930.4	8.98	94.82	10.22	318.8	0.25	33.019	0.38	27.6	8.18	110.2
	5 D	1.0	13.63	147.6	37.68	702.5	11.15	154.3	24.78	339.6	0.21	33.588	0.44	27.5	8.16	109.2
	10 S	0.1	1.55	273.4	1.82	1134	9.29	93.28	10.84	368.5	0.29	32.601	0.21	27.5	8.18	109.5
	10 D	1.7	1.86	68.07	0.84	342.5	10.22	101.5	12.08	170.5	0.18	34.457	0.26	27.0	8.16	108.9
	50 S	0.1	3.41	150.4	3.64	537.3	10.84	130.0	14.25	284.0	0.19	34.001	0.18	26.7	8.17	108.0
	50 D	4.4	4.03	12.89	1.12	98.35	10.53	101.3	14.56	115.3	0.13	35.096	0.73	26.7	8.16	104.8
	100 S	0.1	1.24	157.1	1.54	554.4	9.29	97.06	10.53	255.7	0.16	33.959	0.23	26.8	8.18	107.7
	100 D	6.2	0.93	1.54	0.56	80.09	9.60	102.7	10.53	104.8	0.13	35.135	0.12	26.7	8.17	105.9
	150 S	0.1	0.93	15.69	1.26	95.54	9.91	114.0	10.84	131.0	0.18	35.083	0.06	27.0	8.17	102.5
	150 D	11.7	0.93	0.84	0.70	57.61	9.91	98.04	10.84	99.58	0.12	35.219	0.09	26.7	8.17	105.0
WAILEA 2	0 S	0.1	1.55	2388	0.28	4101	7.43	60.65	8.98	2449	0.22	16.982	0.60	27.3	8.24	111.0
	2 S	0.1	5.58	381.4	3.22	644.1	8.98	119.9	14.56	504.5	0.20	33.149	1.11	27.3	8.19	110.9
	5 S	0.1	1.55	76.61	0.84	260.8	9.29	95.24	10.84	172.7	0.18	34.790	0.24	27.3	8.16	108.2
	5 D	1.0	7.43	37.12	0.84	159.0	9.91	101.0	17.34	138.9	0.19	34.965	0.25	27.3	8.17	110.9
	10 S	0.1	9.60	34.45	5.88	166.4	11.46	181.7	21.06	222.0	0.24	34.991	0.14	27.2	8.17	109.5
	10 D	2.0	1.24	13.03	3.08	101.7	9.91	104.5	11.15	120.6	0.17	35.084	0.58	27.0	8.17	108.5
	50 S	0.1	1.55	86.14	BDL	339.7	9.60	125.5	11.15	211.6	0.18	34.678	0.19	26.9	8.17	105.4
	50 D	4.9	1.24	2.24	1.40	64.91	9.29	102.8	10.53	106.4	0.19	35.218	0.25	26.8	8.17	102.4
	100 S	0.2	1.24	69.05	0.42	279.6	9.91	102.7	11.15	172.1	0.16	34.928	0.18	26.8	8.16	103.0
	100 D	8.7	0.93	0.28	0.84	47.77	8.98	112.3	9.91	113.4	0.14	35.252	0.18	26.8	8.18	104.1
	150 S	0.1	0.93	62.89	1.12	260.5	8.67	106.4	9.60	170.5	0.19	34.724	0.14	27.1	8.14	99.6
	150 D	14.4	1.24	3.08	1.82	66.04	8.67	105.0	9.91	109.9	0.17	35.247	0.33	26.6	8.17	104.6
WAILEA 3	0 S	0.1	2.79	388.8	19.47	1657	13.94	181.0	16.73	589.2	0.97	31.650	1.62	27.3	8.30	104.8
	2 S	0.1	5.88	457.0	1.82	1848	8.98	74.51	14.87	533.3	0.33	31.137	0.39	27.3	8.18	103.7
	5 S	0.1	1.24	64.01	1.54	270.9	8.67	110.2	9.91	175.8	0.17	34.618	0.23	28.4	8.18	103.4
	5 D	1.0	4.03	56.16	1.96	278.5	8.98	100.3	13.01	158.4	0.20	34.623	0.24	28.2	8.19	104.2
	10 S	0.1	4.96	377.7	1.68	1565	9.29	79.55	14.25	459.0	0.16	31.933	0.23	28.1	8.15	103.4
	10 D	1.0	0.93	122.3	1.82	548.5	8.67	117.9	9.60	242.0	0.28	34.086	0.27	27.5	8.17	102.3
	50 S	0.1	2.17	32.07	2.80	169.7	12.39	119.9	14.56	154.8	0.32	34.987	0.19	27.2	8.16	101.2
	50 D	4.0	3.72	0.14	6.16	43.84	11.46	119.6	15.18	125.9	0.13	35.161	0.19	27.2	8.18	100.9
	100 S	0.1	1.24	11.77	2.52	95.82	10.84	109.1	12.08	123.4	0.17	35.060	0.12	27.0	8.17	100.8
	100 D	6.1	2.17	0.28	1.82	38.78	10.53	116.7	12.70	118.8	0.12	35.196	0.19	26.8	8.19	103.5
	150 S	0.1	0.93	16.53	1.82	121.7	9.91	90.34	10.84	108.7	0.14	35.063	0.10	27.0	8.16	101.7
	150 D	11.2	3.72	0.98	2.10	30.63	9.60	104.1	13.32	107.1	0.09	35.203	0.09	26.7	8.19	106.9
WAILEA 4	0 S	0.1	0.93	345.0	0.56	1040	9.60	97.34	10.53	442.9	0.41	32.242	0.67	28.4	8.25	118.3
	2 S	0.1	0.93	336.4	BDL	699.1	9.60	89.92	10.53	426.3	0.53	32.708	2.76	28.4	8.25	113.7
	5 S	0.1	1.24	33.05	0.84	148.1	9.91	114.8	11.15	148.7	0.35	34.829	0.65	28.4	8.19	116.4
	5 D	1.0	1.24	26.19	0.98	133.5	9.29	96.78	10.53	124.0	0.32	34.936	0.81	28.4	8.18	109.2
	10 S	0.1	1.24	8.54	1.40	128.1	9.91	114.7	11.15	124.7	0.37	35.085	0.20	28.1	8.25	106.5
	10 D	1.0	1.24	4.34	0.42	95.26	10.53	101.4	11.77	106.2	0.25	35.166	0.16	27.5	8.18	105.2
	50 S	0.1	7.74	354.6	4.48	1113	11.46	99.44	19.20	458.6	0.13	33.011	0.14	27.0	8.11	104.1
	50 D	5.2	3.41	5.04	3.36	58.17	10.22	110.8	13.63	119.2	0.15	35.132	0.08	26.7	8.16	101.1
	100 S	0.1	1.24	100.0	2.38	296.5	10.53	89.64	11.77	192.0	0.17	34.550	0.21	27.4	8.13	101.1
	100 D	9.8	0.93	1.26	4.48	57.32	9.60	96.36	10.53	102.1	0.12	35.170	0.16	26.7	8.17	107.3
	150 S	0.1	0.93	BDL	0.56	48.89	10.22	101.8	11.15	102.4	0.09	35.205	0.12	27.7	8.18	102.4
	150 D	12.3	1.86	BDL	0.14	41.31	10.84	92.16	12.70	92.30	0.11	35.181	0.25	26.7	8.19	112.0
WAILEA 5	0 S	0.1	0.93	119.8	1.68	1565	10.53	94.68	11.46	216.1	0.40	32.410	0.58	26.1	8.15	112.9
	2 S	0.1	0.31	98.74	3.08	1388	9.91	104.5	10.22	206.3	0.29	32.877	0.42	26.7	8.16	115.7
	5 S	0.1	2.48	73.81	4.48	1123	9.91	104.3	12.39	182.6	0.28	33.307	0.46	26.8	8.14	111.7
	5 D	1.0	0.62	66.67	4.62	1052	10.84	130.8	11.46	202.1	0.21	33.491	0.50	26.7	8.14	112.7
	10 S	0.1	1.86	41.46	4.06	683.7	8.98	101.8	10.84	147.3	0.18	34.223	0.20	26.5	8.13	105.9
	10 D	2.0	2.17	34.17	2.38	575.5	9.60	93.28	11.77	129.8	0.18	34.763	0.14	26.2	8.12	100.3
	50 S	0.1	1.24	12.33	0.70	221.4	9.29	101.4	10.53	114.4	0.26	34.908	0.16	26.3	8.09	99.0
	50 D	4.4	3.41	2.24	0.56	139.9	9.60	98.32	13.01	101.1	0.15	35.138	1.71	26.3	8.10	102.8
	100 S	0.1	4.03	24.65	0.84	300.39	9.60	97.20	13.63	122.7	0.19	34.772	0.37	26.5	8.09	100.6
	100 D	6.4	1.55	0.70	0.28	75.31	9.60	98.46	11.15	99.44	0.26	35.154	0.29	26.7	8.12	102.8
	150 S	0.1	2.48	0.28	1.96	51.14	10.22	107.6	12.70	109.8	0.11	35.276	0.09	26.7	8.16	102.5
	150 D	7.7	2.48	0.14	0.28	59.57	10.53	108.7	13.01	109.1	0.12	35.185	0.07	26.6	8.16	104.6
DOH WQS		DRY	10%	10.00	5.00				30.00	180.0	0.50	*	0.50	**	***	****
			2%	20.00	9.00				45.00	250.0	1.00		1.00			
		WET	10%	14.00	8.50				40.00	250.0	1.25	*	0.90	**	***	****
			2%	25.00	15.00				60.00	350.0	2.00		1.75			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.
****Dissolved Oxygen not to be below 75% saturation.

TABLE 3. Geometric mean data from water chemistry measurements (in µM) collected at five sites off of Honua'ula, Wailea, Maui since the inception of monitoring in June 2005 (N=6). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO4 (µM)	NO3 (µM)	NH4 (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
WAILEA 1	0 S	1	0.13	51.56	0.26	89.05	0.27	5.53	0.43	63.69	0.20	25.260	1.00	26.22	8.14	105.5
	2 S	1	0.13	35.38	0.06	67.94	0.28	6.94	0.44	45.72	0.18	29.813	1.39	26.26	8.17	106.7
	5 S	1	0.05	12.22	0.04	27.22	0.30	8.70	0.36	22.49	0.16	32.859	0.53	26.27	8.13	104.9
	5 D	2.5	0.09	6.86	0.33	17.59	0.30	9.14	0.42	16.88	0.10	33.869	0.32	26.25	8.13	103.9
	10 S	1	0.06	5.92	0.20	15.54	0.29	8.22	0.36	16.13	0.13	33.790	0.36	26.30	8.13	108.3
	10 D	3	0.06	1.96	0.20	6.46	0.30	8.33	0.37	11.15	0.12	34.546	0.32	26.14	8.12	107.5
	50 S	1	0.05	3.47	0.32	9.53	0.30	8.72	0.37	14.49	0.11	34.241	0.30	26.04	8.13	103.0
	50 D	4.5	0.07	0.33	0.16	2.48	0.31	8.50	0.39	9.32	0.10	34.792	0.33	25.81	8.12	96.3
	100 S	1	0.05	3.35	0.21	8.86	0.29	8.05	0.37	13.81	0.11	34.246	0.24	26.13	8.13	99.2
	100 D	10	0.04	0.12	0.17	1.97	0.30	8.36	0.35	8.88	0.11	34.893	0.16	25.81	8.14	95.9
	150 S	1	0.05	0.74	0.26	3.32	0.31	9.75	0.38	11.84	0.17	34.689	0.19	26.22	8.13	97.4
	150 D	15	0.06	0.08	0.17	1.52	0.31	9.06	0.38	9.45	0.10	34.907	0.17	25.78	8.14	95.0
WAILEA 2	0 S	1	0.16	28.98	0.09	44.19	0.20	5.98	0.56	54.54	0.17	23.642	0.45	26.29	8.11	100.0
	2 S	1	0.20	16.71	0.18	27.09	0.27	7.36	0.57	33.41	0.16	30.588	0.54	26.30	8.12	102.6
	5 S	1	0.10	6.37	0.16	12.49	0.28	8.40	0.42	17.01	0.16	33.892	0.31	26.36	8.12	102.6
	5 D	2.5	0.13	3.52	0.19	7.90	0.29	8.43	0.44	12.73	0.16	34.488	0.35	26.31	8.13	103.2
	10 S	1	0.10	1.42	0.22	6.13	0.30	9.09	0.42	11.97	0.13	34.678	0.20	26.31	8.13	101.8
	10 D	3	0.06	1.10	0.20	3.70	0.29	7.46	0.38	9.16	0.12	34.766	0.31	26.31	8.13	102.1
	50 S	1	0.08	3.27	0.13	6.93	0.28	8.07	0.38	11.86	0.13	34.594	0.20	26.20	8.13	98.2
	50 D	4.5	0.10	0.21	0.29	1.93	0.28	7.53	0.41	8.31	0.12	34.919	0.23	25.89	8.13	93.6
	100 S	1	0.09	1.17	0.25	3.72	0.29	8.25	0.41	10.41	0.12	34.784	0.17	25.87	8.14	96.0
	100 D	10	0.07	0.07	0.19	1.49	0.29	7.31	0.37	7.71	0.12	34.949	0.20	25.84	8.15	94.0
	150 S	1	0.06	0.33	0.17	2.88	0.29	8.30	0.36	9.76	0.13	34.799	0.14	26.39	8.14	96.8
	150 D	15	0.07	0.08	0.19	1.38	0.29	8.15	0.36	8.54	0.09	34.975	0.16	25.84	8.15	94.4
WAILEA 3	0 S	1	0.14	8.13	0.51	23.67	0.32	8.98	0.49	21.92	0.26	31.437	0.69	26.47	8.15	100.4
	2 S	1	0.12	4.71	0.32	14.43	0.30	7.54	0.44	16.10	0.22	33.597	0.51	26.50	8.14	99.7
	5 S	1	0.08	2.60	0.26	8.94	0.29	7.16	0.39	11.12	0.17	34.376	0.40	26.80	8.13	100.1
	5 D	2.5	0.11	2.89	0.35	9.71	0.30	8.33	0.43	12.58	0.20	34.351	0.35	26.77	8.13	100.6
	10 S	1	0.12	3.39	0.34	12.06	0.28	7.12	0.41	13.36	0.15	33.883	0.24	26.79	8.13	99.9
	10 D	5	0.08	1.90	0.34	8.79	0.28	7.29	0.38	10.82	0.18	34.365	0.33	26.54	8.13	100.3
	50 S	1	0.14	1.20	0.51	5.54	0.33	9.04	0.50	11.63	0.16	34.671	0.34	26.20	8.14	98.0
	50 D	10	0.09	0.13	0.50	2.18	0.34	8.27	0.44	9.23	0.13	34.890	0.27	26.08	8.15	95.8
	100 S	1	0.08	0.81	0.38	4.42	0.31	8.48	0.40	10.49	0.16	34.697	0.27	26.26	8.14	97.2
	100 D	15	0.07	0.04	0.21	1.82	0.32	9.01	0.40	9.41	0.12	34.927	0.21	25.91	8.14	94.3
	150 S	1	0.06	0.42	0.36	3.07	0.30	7.56	0.38	8.98	0.14	34.827	0.16	26.24	8.14	94.4
	150 D	20	0.08	0.07	0.35	1.61	0.29	7.55	0.38	8.16	0.10	34.952	0.17	25.85	8.15	93.1
WAILEA 4	0 S	1	0.08	12.63	0.21	23.27	0.27	6.85	0.40	29.37	0.28	31.969	0.50	26.81	8.14	105.6
	2 S	1	0.07	8.15	0.26	15.40	0.28	7.53	0.39	22.68	0.23	33.286	0.71	26.79	8.17	103.7
	5 S	1	0.08	2.01	0.20	6.43	0.30	8.19	0.41	12.21	0.18	34.483	0.53	26.80	8.16	108.0
	5 D	2.5	0.08	1.83	0.20	6.28	0.30	8.70	0.39	12.60	0.16	34.488	0.39	26.79	8.15	105.5
	10 S	1	0.10	0.80	0.34	4.57	0.30	10.21	0.42	12.39	0.19	34.769	0.33	26.75	8.15	105.2
	10 D	3	0.12	0.47	0.20	3.60	0.30	7.67	0.45	9.13	0.16	34.843	0.29	26.65	8.14	103.8
	50 S	1	0.13	4.58	0.29	9.12	0.31	8.68	0.46	15.69	0.19	34.201	0.34	26.59	8.11	96.8
	50 D	10	0.09	0.20	0.18	2.43	0.27	8.72	0.39	9.51	0.12	34.922	0.28	25.92	8.13	93.4
	100 S	1	0.08	3.70	0.31	8.17	0.29	8.22	0.41	14.32	0.15	34.272	0.25	26.41	8.12	96.0
	100 D	15	0.08	0.10	0.17	1.84	0.33	8.78	0.44	9.43	0.10	34.955	0.19	25.87	8.13	93.8
	150 S	1	0.07	0.44	0.14	3.25	0.33	7.81	0.41	9.21	0.10	34.826	0.15	26.53	8.13	94.8
	150 D	25	0.06	0.05	0.09	1.60	0.33	7.54	0.42	7.92	0.11	34.943	0.20	25.80	8.14	94.6
WAILEA 5	0 S	1	0.24	19.19	0.66	85.95	0.29	5.11	0.66	34.77	0.27	27.291	0.90	25.49	8.07	96.3
	2 S	1	0.17	14.40	1.10	66.76	0.25	6.88	0.62	30.13	0.24	28.746	0.66	25.82	8.07	98.2
	5 S	1	0.13	5.87	0.70	33.60	0.30	8.94	0.48	17.05	0.22	32.914	0.49	25.86	8.09	100.7
	5 D	1.5	0.05	3.68	0.44	21.96	0.30	8.50	0.40	12.88	0.15	33.781	0.44	25.88	8.11	101.0
	10 S	1	0.05	1.75	0.45	11.19	0.28	8.19	0.36	10.54	0.13	34.415	0.25	25.97	8.09	99.6
	10 D	2.5	0.11	1.76	0.48	11.22	0.27	6.88	0.39	9.30	0.14	34.476	0.38	25.81	8.09	97.6
	50 S	1	0.08	0.86	0.39	6.97	0.30	7.86	0.40	9.39	0.15	34.654	0.25	25.66	8.11	94.0
	50 D	9	0.07	0.16	0.27	3.09	0.30	7.20	0.39	7.79	0.13	34.869	0.38	25.65	8.11	93.5
	100 S	1	0.12	0.39	0.36	5.99	0.30	7.12	0.44	8.32	0.15	34.677	0.19	25.91	8.11	95.1
	100 D	14	0.06	0.11	0.22	2.81	0.30	6.85	0.37	7.55	0.15	34.846	0.22	25.73	8.13	93.3
	150 S	1	0.06	0.18	0.31	2.50	0.29	7.72	0.38	8.53	0.12	34.888	0.16	25.93	8.13	95.3
	150 D	18	0.05	0.03	0.14	1.72	0.30	7.66	0.38	7.99	0.11	34.935	0.18	25.76	8.14	94.4
DOH WQS GEOMETRIC MEAN	DRY			0.25	0.14				0.52	7.86	0.20	*	0.15	**	***	
	WET			0.36	0.25				0.64	10.71	0.50		0.30			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 4. Geometric mean data from water chemistry measurements (in µg/L) collected at five sites off of Honua'ula, Wailea, Maui since the inception of monitoring in June 2005 (N=6). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
WAILEA 1	0 S	1	4.02	722.14	3.64	2,501.41	8.36	77.45	13.31	892.04	0.20	25.26	1.00	26.22	8.14	105.48
	2 S	1	4.02	495.53	0.84	1,908.43	8.67	97.20	13.62	640.35	0.18	29.81	1.39	26.26	8.17	106.69
	5 S	1	1.54	171.15	0.56	764.61	9.29	121.85	11.15	314.99	0.16	32.86	0.53	26.27	8.13	104.91
	5 D	2.5	2.78	96.08	4.62	494.10	9.29	128.01	13.00	236.42	0.10	33.87	0.32	26.25	8.13	103.93
	10 S	1	1.85	82.91	2.80	436.52	8.98	115.12	11.15	225.91	0.13	33.79	0.36	26.30	8.13	108.29
	10 D	3	1.85	27.45	2.80	181.46	9.29	116.66	11.46	156.16	0.12	34.55	0.32	26.14	8.12	107.45
	50 S	1	1.54	48.60	4.48	267.70	9.29	122.13	11.46	202.94	0.11	34.24	0.30	26.04	8.13	103.04
	50 D	4.5	2.16	4.62	2.24	69.66	9.60	119.05	12.07	130.53	0.10	34.79	0.33	25.81	8.12	96.34
	100 S	1	1.54	46.92	2.94	248.88	8.98	112.74	11.46	193.42	0.11	34.25	0.24	26.13	8.13	99.16
	100 D	10	1.23	1.68	2.38	55.34	9.29	117.09	10.84	124.37	0.11	34.89	0.16	25.81	8.14	95.90
	150 S	1	1.54	10.36	3.64	93.26	9.60	136.55	11.76	165.83	0.17	34.69	0.19	26.22	8.13	97.36
	150 D	15	1.85	1.12	2.38	42.70	9.60	126.89	11.76	132.35	0.10	34.91	0.17	25.78	8.14	95.01
WAILEA 2	0 S	1	4.95	405.89	1.26	1,241.30	6.19	83.75	17.34	763.88	0.17	23.64	0.45	26.29	8.11	100.00
	2 S	1	6.19	234.04	2.52	760.96	8.36	103.08	17.65	467.94	0.16	30.59	0.54	26.30	8.12	102.58
	5 S	1	3.09	89.21	2.24	350.84	8.67	117.65	13.00	238.24	0.16	33.89	0.31	26.36	8.12	102.61
	5 D	2.5	4.02	49.30	2.66	221.91	8.98	118.07	13.62	178.29	0.16	34.49	0.35	26.31	8.13	103.19
	10 S	1	3.09	19.88	3.08	172.19	9.29	127.31	13.00	167.65	0.13	34.68	0.20	26.31	8.13	101.75
	10 D	3	1.85	15.40	2.80	103.93	8.98	104.48	11.76	128.29	0.12	34.77	0.31	26.31	8.13	102.13
	50 S	1	2.47	45.79	1.82	194.66	8.67	113.02	11.76	166.11	0.13	34.59	0.20	26.20	8.13	98.17
	50 D	4.5	3.09	2.94	4.06	54.21	8.67	105.46	12.69	116.38	0.12	34.92	0.23	25.89	8.13	93.64
	100 S	1	2.78	16.38	3.50	104.49	8.98	115.54	12.69	145.80	0.12	34.78	0.17	25.87	8.14	95.96
	100 D	10	2.16	0.98	2.66	41.85	8.98	102.38	11.46	107.98	0.12	34.95	0.20	25.84	8.15	93.99
	150 S	1	1.85	4.62	2.38	80.90	8.98	116.24	11.15	136.69	0.13	34.80	0.14	26.39	8.14	96.84
	150 D	15	2.16	1.12	2.66	38.76	8.98	114.14	11.15	119.61	0.09	34.98	0.16	25.84	8.15	94.41
WAILEA 3	0 S	1	4.33	113.86	7.14	664.89	9.91	125.77	15.17	307.01	0.26	31.44	0.69	26.47	8.15	100.41
	2 S	1	3.71	65.96	4.48	405.34	9.29	105.60	13.62	225.49	0.22	33.60	0.51	26.50	8.14	99.67
	5 S	1	2.47	36.41	3.64	251.12	8.98	100.28	12.07	155.74	0.17	34.38	0.40	26.80	8.13	100.11
	5 D	2.5	3.40	40.47	4.90	272.75	9.29	116.66	13.31	176.19	0.20	34.35	0.35	26.77	8.13	100.56
	10 S	1	3.71	47.48	4.76	338.77	8.67	99.72	12.69	187.12	0.15	33.88	0.24	26.79	8.13	99.87
	10 D	5	2.47	26.61	4.76	246.91	8.67	102.10	11.76	151.54	0.18	34.37	0.33	26.54	8.13	100.32
	50 S	1	4.33	16.80	7.14	155.62	10.22	126.61	15.48	162.88	0.16	34.67	0.34	26.20	8.14	98.03
	50 D	10	2.78	1.82	7.00	61.24	10.53	115.82	13.62	129.27	0.13	34.89	0.27	26.08	8.15	95.78
	100 S	1	2.47	11.34	5.32	124.16	9.60	118.77	12.38	146.92	0.16	34.70	0.27	26.26	8.14	97.22
	100 D	15	2.16	0.56	2.94	51.12	9.91	126.19	12.38	131.79	0.12	34.93	0.21	25.91	8.14	94.31
	150 S	1	1.85	5.88	5.04	86.24	9.29	105.88	11.76	125.77	0.14	34.83	0.16	26.24	8.14	94.35
	150 D	20	2.47	0.98	4.90	45.22	8.98	105.74	11.76	114.28	0.10	34.95	0.17	25.85	8.15	93.07
WAILEA 4	0 S	1	2.47	176.89	2.94	653.65	8.36	95.94	12.38	411.35	0.28	31.97	0.50	26.81	8.14	105.64
	2 S	1	2.16	114.14	3.64	432.59	8.67	105.46	12.07	317.65	0.23	33.29	0.71	26.79	8.17	103.71
	5 S	1	2.47	28.15	2.80	180.62	9.29	114.70	12.69	171.01	0.18	34.48	0.53	26.80	8.16	108.01
	5 D	2.5	2.47	25.63	2.80	176.41	9.29	121.85	12.07	176.47	0.16	34.49	0.39	26.79	8.15	105.51
	10 S	1	3.09	11.20	4.76	128.37	9.29	143.00	13.00	173.53	0.19	34.77	0.33	26.75	8.15	105.19
	10 D	3	3.71	6.58	2.80	101.12	9.29	107.42	13.93	127.87	0.16	34.84	0.29	26.65	8.14	103.82
	50 S	1	4.02	64.14	4.06	256.18	9.60	121.57	14.24	219.75	0.19	34.20	0.34	26.59	8.11	96.81
	50 D	10	2.78	2.80	2.52	68.26	8.36	122.13	12.07	133.19	0.12	34.92	0.28	25.92	8.13	93.39
	100 S	1	2.47	51.82	4.34	229.50	8.98	115.12	12.69	200.56	0.15	34.27	0.25	26.41	8.12	96.03
	100 D	15	2.47	1.40	2.38	51.69	10.22	122.97	13.62	132.07	0.10	34.96	0.19	25.87	8.13	93.77
	150 S	1	2.16	6.16	1.96	91.29	10.22	109.38	12.69	128.99	0.10	34.83	0.15	26.53	8.13	94.83
	150 D	25	1.85	0.70	1.26	44.94	10.22	105.60	13.00	110.92	0.11	34.94	0.20	25.80	8.14	94.64
WAILEA 5	0 S	1	7.43	268.77	9.24	2,414.34	8.98	71.57	20.44	486.98	0.27	27.29	0.90	25.49	8.07	96.25
	2 S	1	5.26	201.68	15.40	1,875.29	7.74	96.36	19.20	422.00	0.24	28.75	0.66	25.82	8.07	98.15
	5 S	1	4.02	82.21	9.80	943.82	9.29	125.21	14.86	238.80	0.22	32.91	0.49	25.86	8.09	100.66
	5 D	1.5	1.54	51.54	6.16	616.86	9.29	119.05	12.38	180.39	0.15	33.78	0.44	25.88	8.11	101.04
	10 S	1	1.54	24.51	6.30	314.33	8.67	114.70	11.15	147.62	0.13	34.42	0.25	25.97	8.09	99.63
	10 D	2.5	3.40	24.65	6.72	315.17	8.36	96.36	12.07	130.25	0.14	34.48	0.38	25.81	8.09	97.55
	50 S	1	2.47	12.04	5.46	195.79	9.29	110.08	12.38	131.51	0.15	34.65	0.25	25.66	8.11	94.02
	50 D	9	2.16	2.24	3.78	86.80	9.29	100.84	12.07	109.10	0.13	34.87	0.38	25.65	8.11	93.45
	100 S	1	3.71	5.46	5.04	168.26	9.29	99.72	13.62	116.52	0.15	34.68	0.19	25.91	8.11	95.09
	100 D	14	1.85	1.54	3.08	78.93	9.29	95.94	11.46	105.74	0.15	34.85	0.22	25.73	8.13	93.31
	150 S	1	1.85	2.52	4.34	70.23	8.98	108.12	11.76	119.47	0.12	34.89	0.16	25.93	8.13	95.25
	150 D	18	1.54	0.42	1.96	48.31	9.29	107.28	11.76	111.90	0.11	34.94	0.18	25.76	8.14	94.39
DOH WQS GEOMETRIC MEAN	DRY			3.50	2.00				16.00	110.00	0.20	*	0.15	**	***	
	WET			5.00	3.50				20.00	150.00	0.50		0.30			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 5. Water chemistry measurements in µM and µg/L (shaded) from irrigation wells and an irrigation lake (Res) collected at the Wailea Golf Courses in the vicinity of the Honua'ula project site on February 11, 2009. For sampling site locations, see Figure 1.

WELLS	PO4 (µM)	PO4 (µg/L)	NO3 (µM)	NO3 (µg/L)	NH4 (µM)	NH4 (µg/L)	Si (µM)	Si (µg/L)	TOP (µM)	TOP (µg/L)	TON (µM)	TON (µg/L)	TP (µM)	TP (µg/L)	TN (µM)	TN (µg/L)	SALINITY (ppt)
2	2.00	62.00	225.6	3159	0.00	0.00	524.2	14729	0.16	4.96	9.36	131.0	2.16	66.96	235.0	3290	1.48
5	2.16	66.96	337.6	4727	1.96	27.44	513.1	14418	0.08	2.48	2.40	33.6	2.24	69.44	342.0	4788	1.78
6	2.00	62.00	158.7	2222	1.96	27.44	516.6	14515	0.16	4.96	33.48	468.7	2.16	66.96	194.2	2718	1.27
7	2.32	71.92	257.6	3606	1.60	22.40	511.6	14375	0.16	4.96	4.40	61.6	2.48	76.88	263.6	3690	1.89
8	1.96	60.76	170.2	2383	2.48	34.72	495.2	13915	0.36	11.16	24.08	337.1	2.32	71.92	196.8	2755	2.13
9	1.84	57.04	142.0	1987	0.60	8.40	482.5	13559	0.60	18.60	72.94	1021.2	2.44	75.64	215.5	3017	1.84
10	2.00	62.00	218.9	3065	0.64	8.96	479.3	13469	0.44	13.64	17.28	241.9	2.44	75.64	236.8	3316	1.58
Res	0.44	13.64	145.3	2034	4.48	62.72	301.8	8482	1.36	42.16	53.56	749.8	1.80	55.80	203.3	2846	1.98

TABLE 4. Geometric mean data from water chemistry measurements (in µg/L) collected at five sites off of Honua'ula, Wailea, Maui since the inception of monitoring in June 2005 (N=6). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
WAILEA 1	0 S	1	4.02	722.14	3.64	2,501.41	8.36	77.45	13.31	892.04	0.20	25.26	1.00	26.22	8.14	105.48
	2 S	1	4.02	495.53	0.84	1,908.43	8.67	97.20	13.62	640.35	0.18	29.81	1.39	26.26	8.17	106.69
	5 S	1	1.54	171.15	0.56	764.61	9.29	121.85	11.15	314.99	0.16	32.86	0.53	26.27	8.13	104.91
	5 D	2.5	2.78	96.08	4.62	494.10	9.29	128.01	13.00	236.42	0.10	33.87	0.32	26.25	8.13	103.93
	10 S	1	1.85	82.91	2.80	436.52	8.98	115.12	11.15	225.91	0.13	33.79	0.36	26.30	8.13	108.29
	10 D	3	1.85	27.45	2.80	181.46	9.29	116.66	11.46	156.16	0.12	34.55	0.32	26.14	8.12	107.45
	50 S	1	1.54	48.60	4.48	267.70	9.29	122.13	11.46	202.94	0.11	34.24	0.30	26.04	8.13	103.04
	50 D	4.5	2.16	4.62	2.24	69.66	9.60	119.05	12.07	130.53	0.10	34.79	0.33	25.81	8.12	96.34
	100 S	1	1.54	46.92	2.94	248.88	8.98	112.74	11.46	193.42	0.11	34.25	0.24	26.13	8.13	99.16
	100 D	10	1.23	1.68	2.38	55.34	9.29	117.09	10.84	124.37	0.11	34.89	0.16	25.81	8.14	95.90
	150 S	1	1.54	10.36	3.64	93.26	9.60	136.55	11.76	165.83	0.17	34.69	0.19	26.22	8.13	97.36
	150 D	15	1.85	1.12	2.38	42.70	9.60	126.89	11.76	132.35	0.10	34.91	0.17	25.78	8.14	95.01
WAILEA 2	0 S	1	4.95	405.89	1.26	1,241.30	6.19	83.75	17.34	763.88	0.17	23.64	0.45	26.29	8.11	100.00
	2 S	1	6.19	234.04	2.52	760.96	8.36	103.08	17.65	467.94	0.16	30.59	0.54	26.30	8.12	102.58
	5 S	1	3.09	89.21	2.24	350.84	8.67	117.65	13.00	238.24	0.16	33.89	0.31	26.36	8.12	102.61
	5 D	2.5	4.02	49.30	2.66	221.91	8.98	118.07	13.62	178.29	0.16	34.49	0.35	26.31	8.13	103.19
	10 S	1	3.09	19.88	3.08	172.19	9.29	127.31	13.00	167.65	0.13	34.68	0.20	26.31	8.13	101.75
	10 D	3	1.85	15.40	2.80	103.93	8.98	104.48	11.76	128.29	0.12	34.77	0.31	26.31	8.13	102.13
	50 S	1	2.47	45.79	1.82	194.66	8.67	113.02	11.76	166.11	0.13	34.59	0.20	26.20	8.13	98.17
	50 D	4.5	3.09	2.94	4.06	54.21	8.67	105.46	12.69	116.38	0.12	34.92	0.23	25.89	8.13	93.64
	100 S	1	2.78	16.38	3.50	104.49	8.98	115.54	12.69	145.80	0.12	34.78	0.17	25.87	8.14	95.96
	100 D	10	2.16	0.98	2.66	41.85	8.98	102.38	11.46	107.98	0.12	34.95	0.20	25.84	8.15	93.99
	150 S	1	1.85	4.62	2.38	80.90	8.98	116.24	11.15	136.69	0.13	34.80	0.14	26.39	8.14	96.84
	150 D	15	2.16	1.12	2.66	38.76	8.98	114.14	11.15	119.61	0.09	34.98	0.16	25.84	8.15	94.41
WAILEA 3	0 S	1	4.33	113.86	7.14	664.89	9.91	125.77	15.17	307.01	0.26	31.44	0.69	26.47	8.15	100.41
	2 S	1	3.71	65.96	4.48	405.34	9.29	105.60	13.62	225.49	0.22	33.60	0.51	26.50	8.14	99.67
	5 S	1	2.47	36.41	3.64	251.12	8.98	100.28	12.07	155.74	0.17	34.38	0.40	26.80	8.13	100.11
	5 D	2.5	3.40	40.47	4.90	272.75	9.29	116.66	13.31	176.19	0.20	34.35	0.35	26.77	8.13	100.56
	10 S	1	3.71	47.48	4.76	338.77	8.67	99.72	12.69	187.12	0.15	33.88	0.24	26.79	8.13	99.87
	10 D	5	2.47	26.61	4.76	246.91	8.67	102.10	11.76	151.54	0.18	34.37	0.33	26.54	8.13	100.32
	50 S	1	4.33	16.80	7.14	155.62	10.22	126.61	15.48	162.88	0.16	34.67	0.34	26.20	8.14	98.03
	50 D	10	2.78	1.82	7.00	61.24	10.53	115.82	13.62	129.27	0.13	34.89	0.27	26.08	8.15	95.78
	100 S	1	2.47	11.34	5.32	124.16	9.60	118.77	12.38	146.92	0.16	34.70	0.27	26.26	8.14	97.22
	100 D	15	2.16	0.56	2.94	51.12	9.91	126.19	12.38	131.79	0.12	34.93	0.21	25.91	8.14	94.31
	150 S	1	1.85	5.88	5.04	86.24	9.29	105.88	11.76	125.77	0.14	34.83	0.16	26.24	8.14	94.35
	150 D	20	2.47	0.98	4.90	45.22	8.98	105.74	11.76	114.28	0.10	34.95	0.17	25.85	8.15	93.07
WAILEA 4	0 S	1	2.47	176.89	2.94	653.65	8.36	95.94	12.38	411.35	0.28	31.97	0.50	26.81	8.14	105.64
	2 S	1	2.16	114.14	3.64	432.59	8.67	105.46	12.07	317.65	0.23	33.29	0.71	26.79	8.17	103.71
	5 S	1	2.47	28.15	2.80	180.62	9.29	114.70	12.69	171.01	0.18	34.48	0.53	26.80	8.16	108.01
	5 D	2.5	2.47	25.63	2.80	176.41	9.29	121.85	12.07	176.47	0.16	34.49	0.39	26.79	8.15	105.51
	10 S	1	3.09	11.20	4.76	128.37	9.29	143.00	13.00	173.53	0.19	34.77	0.33	26.75	8.15	105.19
	10 D	3	3.71	6.58	2.80	101.12	9.29	107.42	13.93	127.87	0.16	34.84	0.29	26.65	8.14	103.82
	50 S	1	4.02	64.14	4.06	256.18	9.60	121.57	14.24	219.75	0.19	34.20	0.34	26.59	8.11	96.81
	50 D	10	2.78	2.80	2.52	68.26	8.36	122.13	12.07	133.19	0.12	34.92	0.28	25.92	8.13	93.39
	100 S	1	2.47	51.82	4.34	229.50	8.98	115.12	12.69	200.56	0.15	34.27	0.25	26.41	8.12	96.03
	100 D	15	2.47	1.40	2.38	51.69	10.22	122.97	13.62	132.07	0.10	34.96	0.19	25.87	8.13	93.77
	150 S	1	2.16	6.16	1.96	91.29	10.22	109.38	12.69	128.99	0.10	34.83	0.15	26.53	8.13	94.83
	150 D	25	1.85	0.70	1.26	44.94	10.22	105.60	13.00	110.92	0.11	34.94	0.20	25.80	8.14	94.64
WAILEA 5	0 S	1	7.43	268.77	9.24	2,414.34	8.98	71.57	20.44	486.98	0.27	27.29	0.90	25.49	8.07	96.25
	2 S	1	5.26	201.68	15.40	1,875.29	7.74	96.36	19.20	422.00	0.24	28.75	0.66	25.82	8.07	98.15
	5 S	1	4.02	82.21	9.80	943.82	9.29	125.21	14.86	238.80	0.22	32.91	0.49	25.86	8.09	100.66
	5 D	1.5	1.54	51.54	6.16	616.86	9.29	119.05	12.38	180.39	0.15	33.78	0.44	25.88	8.11	101.04
	10 S	1	1.54	24.51	6.30	314.33	8.67	114.70	11.15	147.62	0.13	34.42	0.25	25.97	8.09	99.63
	10 D	2.5	3.40	24.65	6.72	315.17	8.36	96.36	12.07	130.25	0.14	34.48	0.38	25.81	8.09	97.55
	50 S	1	2.47	12.04	5.46	195.79	9.29	110.08	12.38	131.51	0.15	34.65	0.25	25.66	8.11	94.02
	50 D	9	2.16	2.24	3.78	86.80	9.29	100.84	12.07	109.10	0.13	34.87	0.38	25.65	8.11	93.45
	100 S	1	3.71	5.46	5.04	168.26	9.29	99.72	13.62	116.52	0.15	34.68	0.19	25.91	8.11	95.09
	100 D	14	1.85	1.54	3.08	78.93	9.29	95.94	11.46	105.74	0.15	34.85	0.22	25.73	8.13	93.31
	150 S	1	1.85	2.52	4.34	70.23	8.98	108.12	11.76	119.47	0.12	34.89	0.16	25.93	8.13	95.25
	150 D	18	1.54	0.42	1.96	48.31	9.29	107.28	11.76	111.90	0.11	34.94	0.18	25.76	8.14	94.39
DOH WQS GEOMETRIC MEAN	DRY			3.50	2.00				16.00	110.00	0.20	*	0.15	**	***	
	WET			5.00	3.50				20.00	150.00	0.50		0.30			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 6. Linear regression statistics (y-intercept and slope) of surface concentrations of silica as functions of salinity from five ocean transect sites in the vicinity of Honua'ula collected during monitoring surveys from June 2005 to September 2009. Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. "REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. Surveys were conducted once per year between 2005-2008 (N=7), twice per year beginning in 2009 (N=14). For location of transect sites, see Figure 1.

SILICA -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	497.88	3.56	488.73	507.03
2006	539.75	3.21	531.50	548.00
2007	301.46	37.05	206.21	396.70
2008	441.78	21.87	385.57	497.98
2009	410.31	16.55	374.24	446.38
REGSLOPE	-27.31	29.39	-120.83	66.20
SITE 2				
2005	448.61	94.10	206.72	690.51
2006	445.83	27.79	374.40	517.26
2007	605.37	2.41	599.18	611.55
2008	736.44	124.97	415.20	1057.68
2009	348.37	26.00	291.71	405.03
REGSLOPE	9.01	55.78	-168.49	186.52
SITE 3				
2005	471.10	29.51	395.24	546.97
2006	521.67	9.12	498.22	545.12
2007	264.62	10.69	237.14	292.10
2008	389.25	28.52	315.95	462.55
2009	580.96	11.67	555.53	606.39
REGSLOPE	8.73	44.69	-133.51	150.96
SITE 4				
2005	539.62	153.92	143.97	935.28
2006	415.26	8.33	393.86	436.66
2007	388.49	16.11	347.07	429.90
2008	310.16	38.90	210.18	410.15
2009	476.61	535.93	441.76	545.61
REGSLOPE	-23.11	28.91	-115.11	68.89
SITE 5				
2005	736.03	2.23	730.30	741.75
2006	711.37	7.83	691.25	731.48
2007	712.08	6.64	695.02	729.15
2008	739.31	9.75	714.26	764.36
2009	648.43	51.18	536.92	759.94
REGSLOPE	-14.73	10.27	-47.41	17.96

SILICA - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	-14.29	0.11	-14.57	-14.02
2006	-15.51	0.10	-15.76	-15.25
2007	-8.33	1.18	-11.37	-5.29
2008	-12.59	0.66	-14.29	-10.90
2009	-11.42	0.51	-12.53	-10.31
REGSLOPE	0.87	0.88	-1.94	3.67
SITE 2				
2005	-12.84	2.72	-19.84	-5.85
2006	-12.76	0.81	-14.83	-10.68
2007	-17.27	0.08	-17.47	-17.07
2008	-21.03	3.60	-30.28	-11.77
2009	-9.71	0.81	-11.47	-7.94
REGSLOPE	-0.20	1.62	-5.34	4.94
SITE 3				
2005	-13.49	0.86	-15.69	-11.29
2006	-14.95	0.27	-15.65	-14.26
2007	-7.39	0.32	-8.22	-6.56
2008	-11.04	0.82	-13.14	-8.93
2009	-16.51	0.34	-17.26	-15.77
REGSLOPE	-0.21	1.30	-4.35	3.92
SITE 4				
2005	-15.47	4.45	-26.91	-4.04
2006	-11.88	0.24	-12.51	-11.25
2007	-10.93	0.48	-12.17	-9.69
2008	-8.77	1.11	-11.63	-5.90
2009	-13.50	0.81	-15.26	-11.73
REGSLOPE	0.71	0.83	-1.95	3.36
SITE 5				
2005	-21.13	0.07	-21.30	-20.96
2006	-20.28	0.23	-20.87	-19.68
2007	-20.28	0.23	-20.86	-19.70
2008	-21.16	0.29	-21.90	-20.42
2009	-18.42	1.50	-21.68	-15.16
REGSLOPE	0.45	0.31	-0.53	1.44

TABLE 7. Linear regression statistics (y-intercept and slope) of surface concentrations of nitrate as functions of salinity from five ocean transect sites in the vicinity of Honua'ula collected during monitoring surveys from June 2005 to September 2009. Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. "REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

NITRATE -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	317.11	3.22	308.84	325.38
2006	342.14	4.13	331.53	352.76
2007	382.01	8.64	359.80	404.22
2008	279.63	6.14	263.85	295.42
2009	227.71	6.24	214.11	241.31
REGSLOPE	-24.13	16.47	-76.56	28.29
SITE 2				
2005	292.69	62.62	131.73	453.65
2006	368.09	7.37	349.13	387.04
2007	494.07	15.55	454.10	534.04
2008	248.17	183.53	-223.62	719.95
2009	321.60	4.51	311.76	331.43
REGSLOPE	-6.21	34.17	-114.96	102.54
SITE 3				
2005	306.11	22.88	247.30	364.91
2006	164.55	6.45	147.98	181.11
2007	83.21	1.95	78.20	88.23
2008	124.87	19.93	73.64	176.09
2009	291.51	15.21	258.38	324.65
REGSLOPE	-6.89	36.30	-122.40	108.62
SITE 4				
2005	437.11	80.65	229.78	644.43
2006	467.97	2.22	462.26	473.68
2007	447.63	6.29	431.45	463.81
2008	243.43	78.23	42.33	444.53
2009	297.19	15.13	264.23	330.15
REGSLOPE	-50.44	22.83	-123.09	22.21
SITE 5				
2005	123.09	4.56	111.38	134.80
2006	121.10	2.08	115.77	126.44
2007	272.43	1.83	267.72	277.15
2008	63.82	5.48	49.73	77.91
2009	216.23	58.47	88.84	343.63
REGSLOPE	12.90	29.59	-81.26	107.06

NITRATE - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	-9.13	0.10	-9.38	-8.88
2006	-9.85	0.13	-10.18	-9.53
2007	-11.02	0.28	-11.73	-10.31
2008	-8.05	0.19	-8.53	-7.58
2009	-6.48	0.19	-6.90	-6.06
REGSLOPE	0.71	0.48	-0.82	2.24
SITE 2				
2005	-8.40	1.81	-13.06	-3.75
2006	-10.59	0.21	-11.14	-10.04
2007	-14.13	0.51	-15.44	-12.81
2008	-7.09	5.29	-20.68	6.51
2009	-9.12	0.14	-9.43	-8.82
REGSLOPE	0.21	0.98	-2.90	3.32
SITE 3				
2005	-8.83	0.66	-10.53	-7.12
2006	-4.72	0.19	-5.21	-4.23
2007	-2.35	0.06	-2.50	-2.20
2008	-3.56	0.57	-5.03	-2.09
2009	-8.28	0.45	-9.25	-7.30
REGSLOPE	0.23	1.04	-3.09	3.54
SITE 4				
2005	-12.59	2.33	-18.58	-6.60
2006	-13.45	0.07	-13.62	-13.29
2007	-12.88	0.19	-13.36	-12.39
2008	-6.94	2.24	-12.70	-1.17
2009	-8.44	0.45	-9.42	-7.46
REGSLOPE	1.48	0.66	-0.62	3.58
SITE 5				
2005	-3.56	0.14	-3.91	-3.21
2006	-3.46	0.06	-3.62	-3.30
2007	-7.86	0.06	-8.02	-7.70
2008	-1.82	0.16	-2.24	-1.41
2009	-6.15	1.71	-9.88	-2.43
REGSLOPE	-0.36	0.85	-3.07	2.36

TABLE 8. Linear regression statistics (y-intercept and slope) of surface concentrations of orthophosphate phosphorus as functions of salinity from five ocean transect sites in the vicinity of Honua'ula collected during monitoring surveys from June 2005 to September 2009. Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes."REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

PHOSPHATE -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	0.09	0.09	-0.13	0.32
2006	1.19	0.13	0.85	1.53
2007	0.31	0.20	-0.21	0.82
2008	0.04	0.01	0.03	0.06
2009	0.27	0.13	-0.01	0.56
REGSLOPE	-0.08	0.16	-0.60	0.44
SITE 2				
2005	1.09	1.19	-1.98	4.16
2006	-0.78	2.81	-7.99	6.44
2007	2.08	0.03	2.00	2.16
2008	-0.56	13.34	-34.85	33.73
2009	0.78	0.26	0.21	1.34
REGSLOPE	-0.04	0.43	-1.42	1.34
SITE 3				
2005	1.28	1.92	-3.67	6.22
2006	2.69	0.12	2.38	3.01
2007	0.57	0.11	0.28	0.86
2008	-0.45	4.30	-11.49	10.60
2009	0.58	0.60	-0.73	1.88
REGSLOPE	-0.45	0.33	-1.51	0.61
SITE 4				
2005	-2.26	7.50	-21.53	17.02
2006	0.71	1.29	-2.62	4.03
2007	0.12	0.57	-1.35	1.58
2008	-0.79	4.43	-12.18	10.61
2009	2.31	0.63	0.93	3.69
REGSLOPE	0.76	0.44	-0.63	2.15
SITE 5				
2005	1.92	0.67	0.18	3.65
2006	2.33	0.26	1.65	3.01
2007	2.66	0.08	2.46	2.86
2008	2.85	1.24	-0.34	6.04
2009	-0.08	0.32	-0.77	0.61
REGSLOPE	-0.35	0.38	-1.56	0.87

PHOSPHATE - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	0.00	0.00	-0.01	0.01
2006	-0.03	0.00	-0.04	-0.02
2007	-0.01	0.01	-0.02	0.01
2008	0.00	0.00	0.00	0.00
2009	-0.01	0.00	-0.01	0.00
REGSLOPE	0.00	0.00	-0.01	0.02
SITE 2				
2005	-0.03	0.03	-0.12	0.06
2006	0.03	0.08	-0.18	0.24
2007	-0.06	0.00	-0.06	-0.05
2008	0.02	0.38	-0.97	1.01
2009	-0.02	0.01	-0.04	0.00
REGSLOPE	0.00	0.01	-0.04	0.04
SITE 3				
2005	-0.04	0.06	-0.18	0.11
2006	-0.07	0.00	-0.08	-0.06
2007	-0.01	0.00	-0.02	0.00
2008	0.02	0.12	-0.30	0.33
2009	-0.01	0.02	-0.05	0.02
REGSLOPE	0.01	0.01	-0.02	0.04
SITE 4				
2005	0.07	0.22	-0.49	0.62
2006	-0.02	0.04	-0.11	0.08
2007	0.00	0.02	-0.04	0.04
2008	0.02	0.13	-0.30	0.35
2009	-0.06	0.02	-0.11	-0.02
REGSLOPE	-0.02	0.01	-0.06	0.02
SITE 5				
2005	-0.05	0.02	-0.10	0.00
2006	-0.06	0.01	-0.08	-0.04
2007	-0.07	0.00	-0.08	-0.07
2008	-0.08	0.04	-0.17	0.01
2009	0.00	0.01	-0.02	0.02
REGSLOPE	0.01	0.01	-0.02	0.04

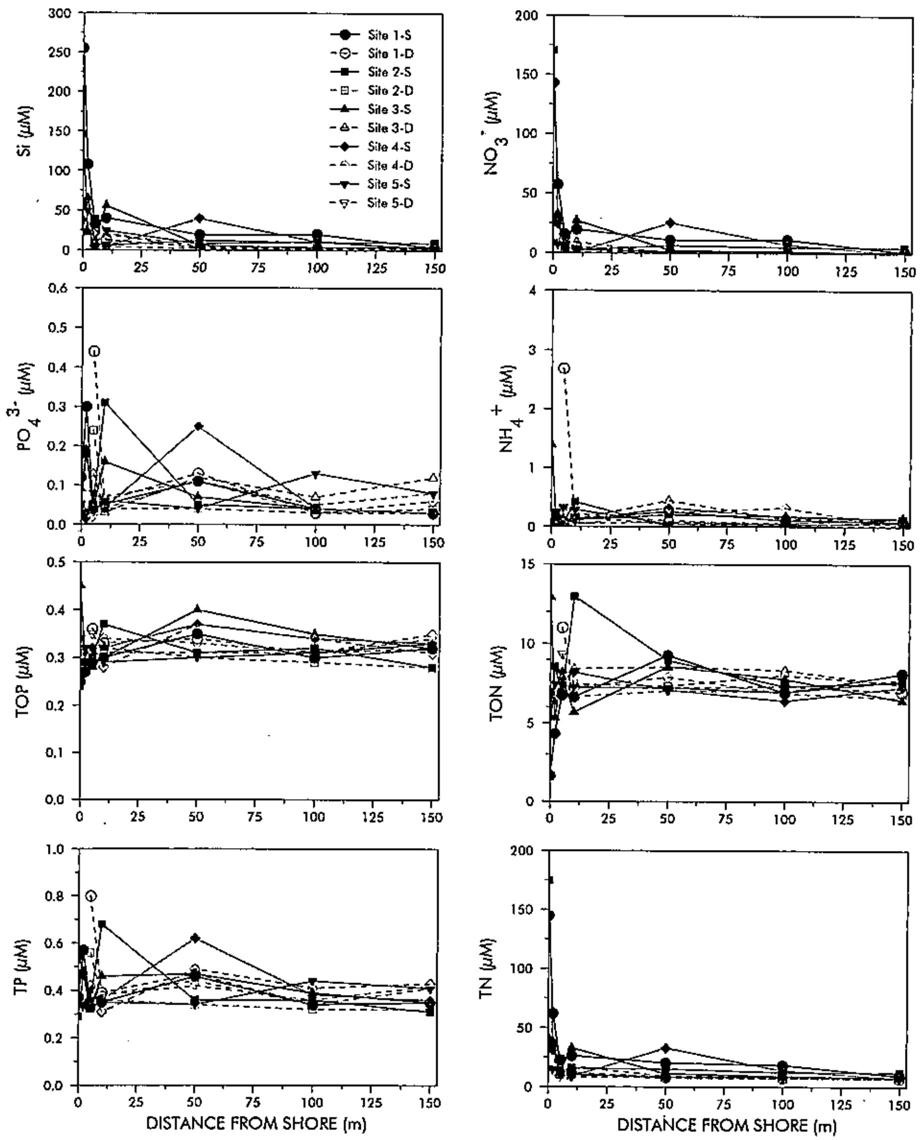

FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on September 4, 2009 as a function of distance from the shoreline offshore of Honua'ula, Wailea, Maui. For site locations, see Figure 1.

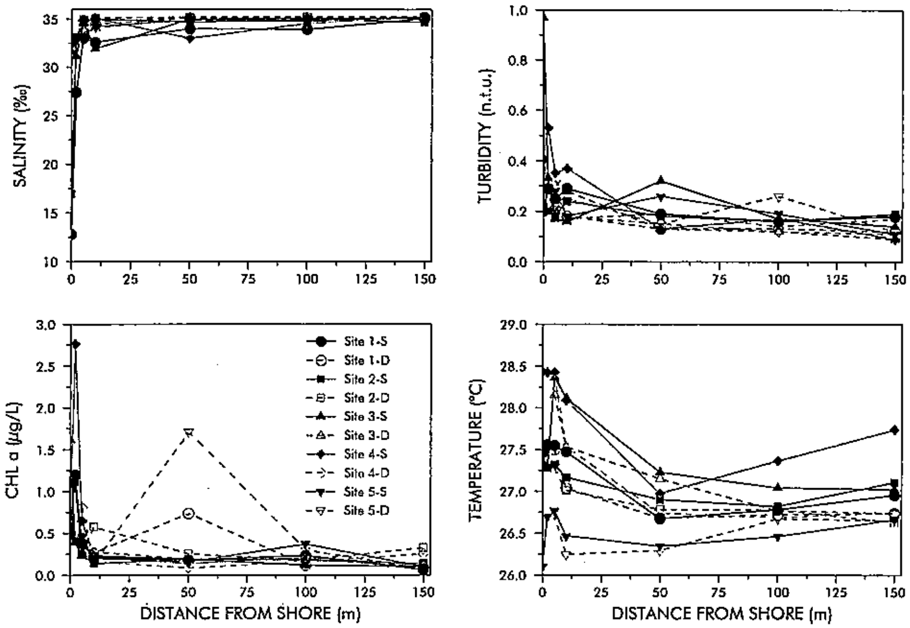

FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on September 4, 2009 as a function of distance from the shoreline offshore of Honua`ula, Wailea, Maui. For site locations, see Figure 1.

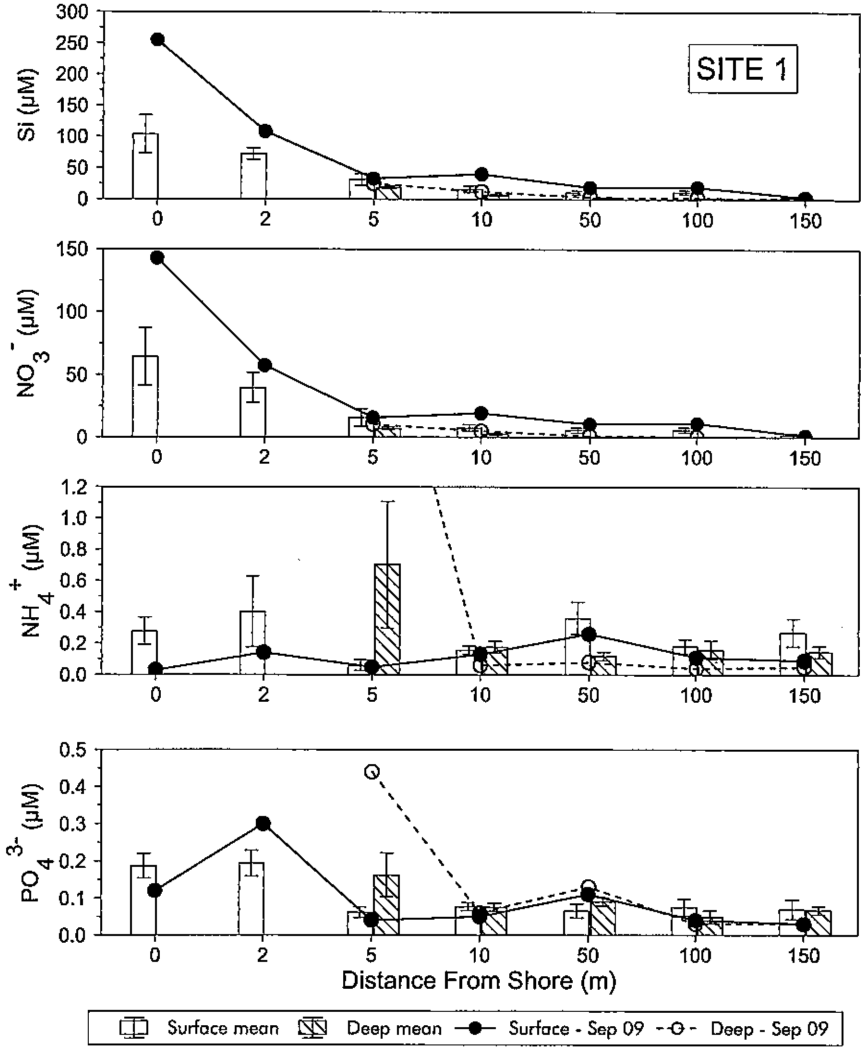

FIGURE 4. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 1, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

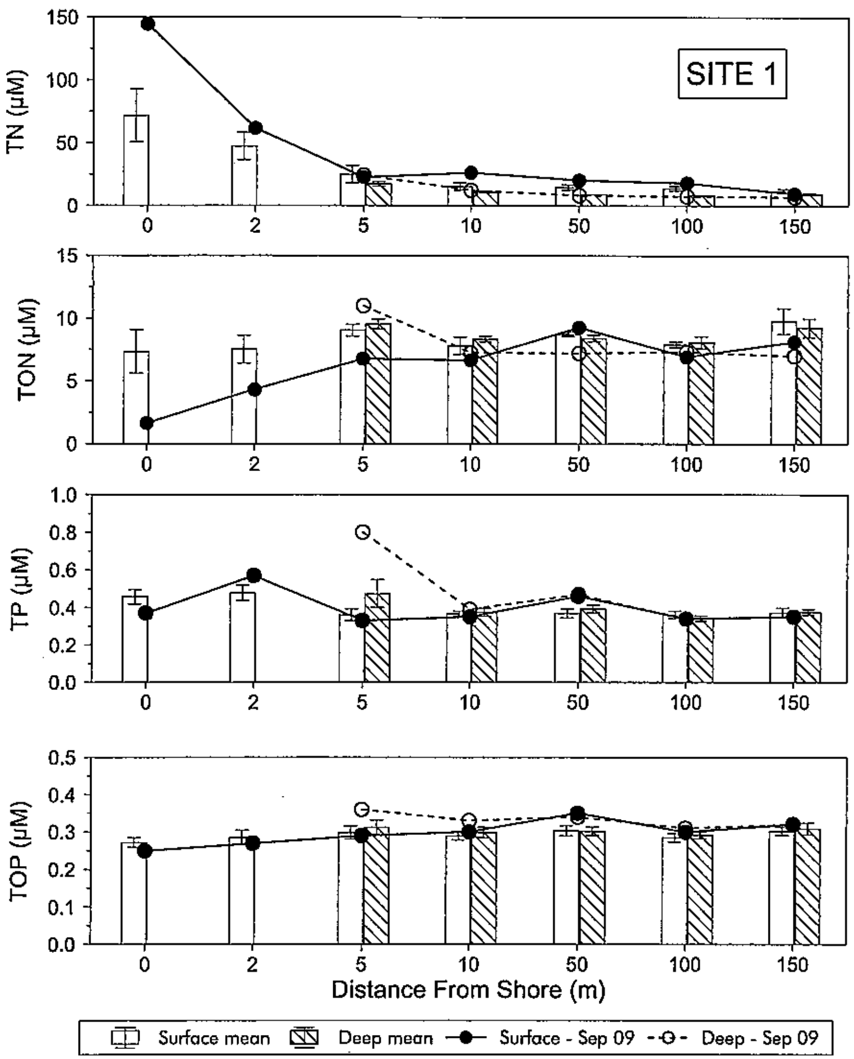

FIGURE 5. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 1, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

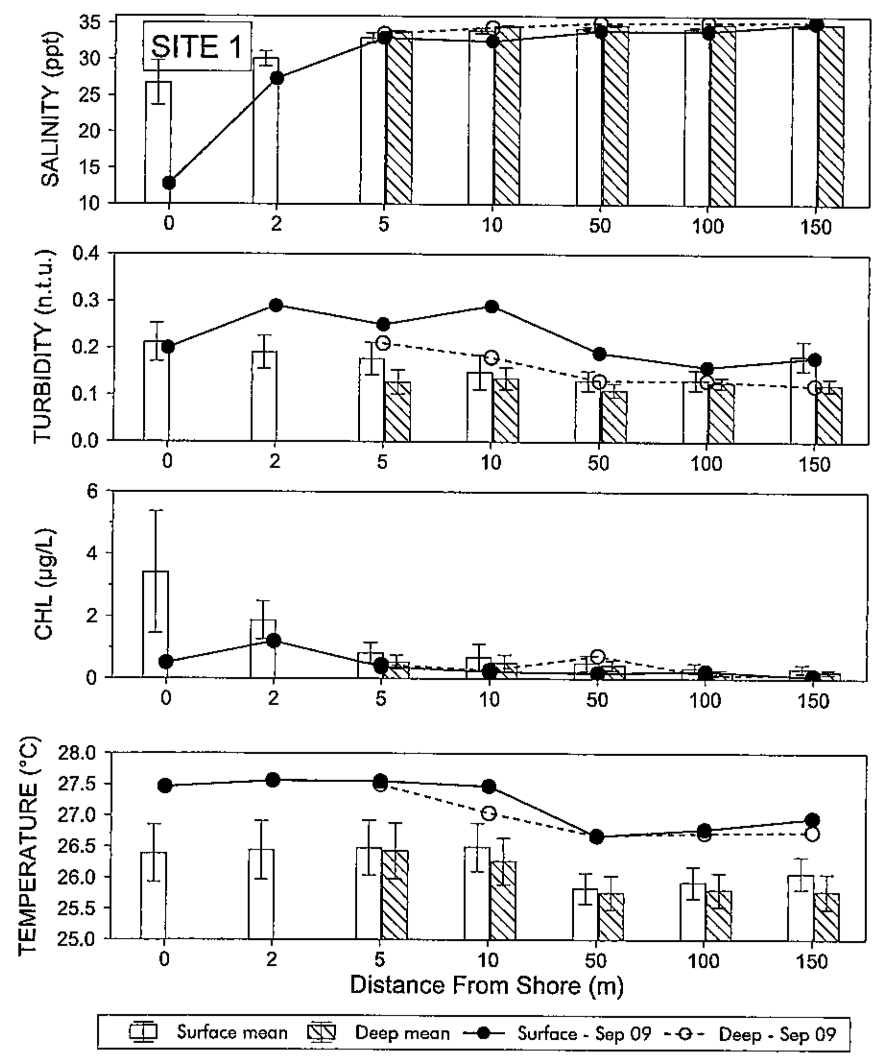

FIGURE 6. Plots of water quality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 1, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

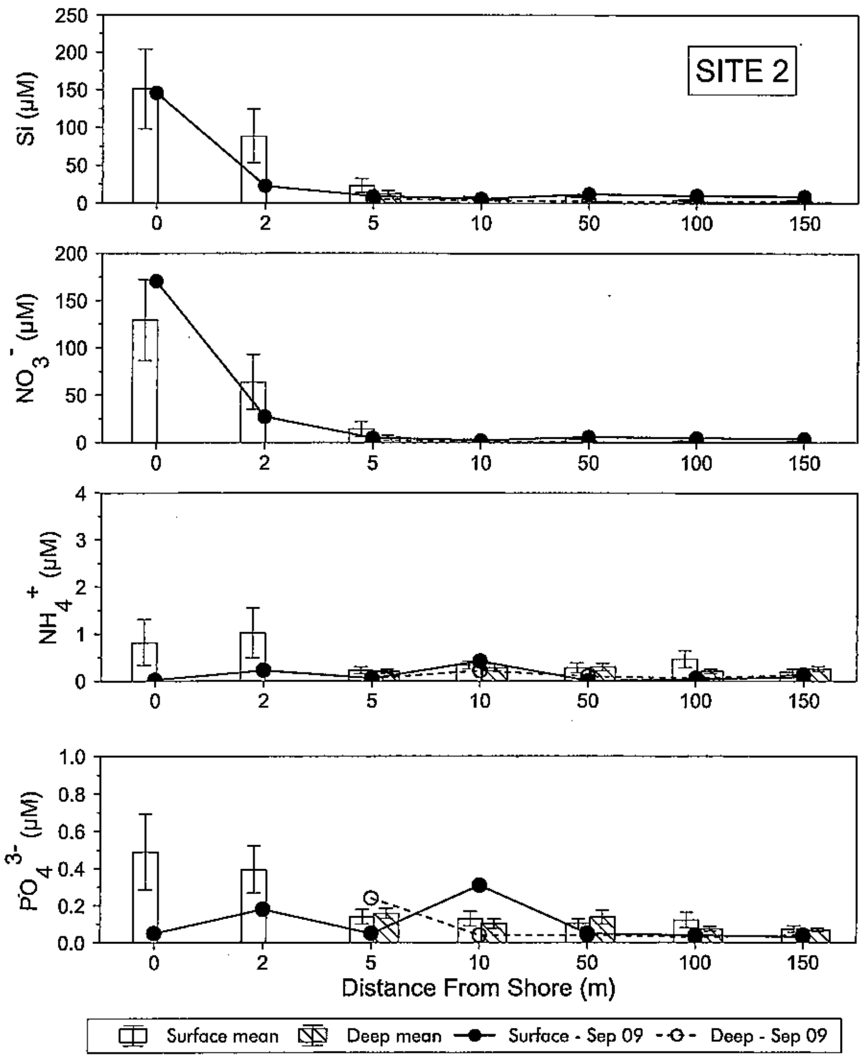

FIGURE 7. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 2, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

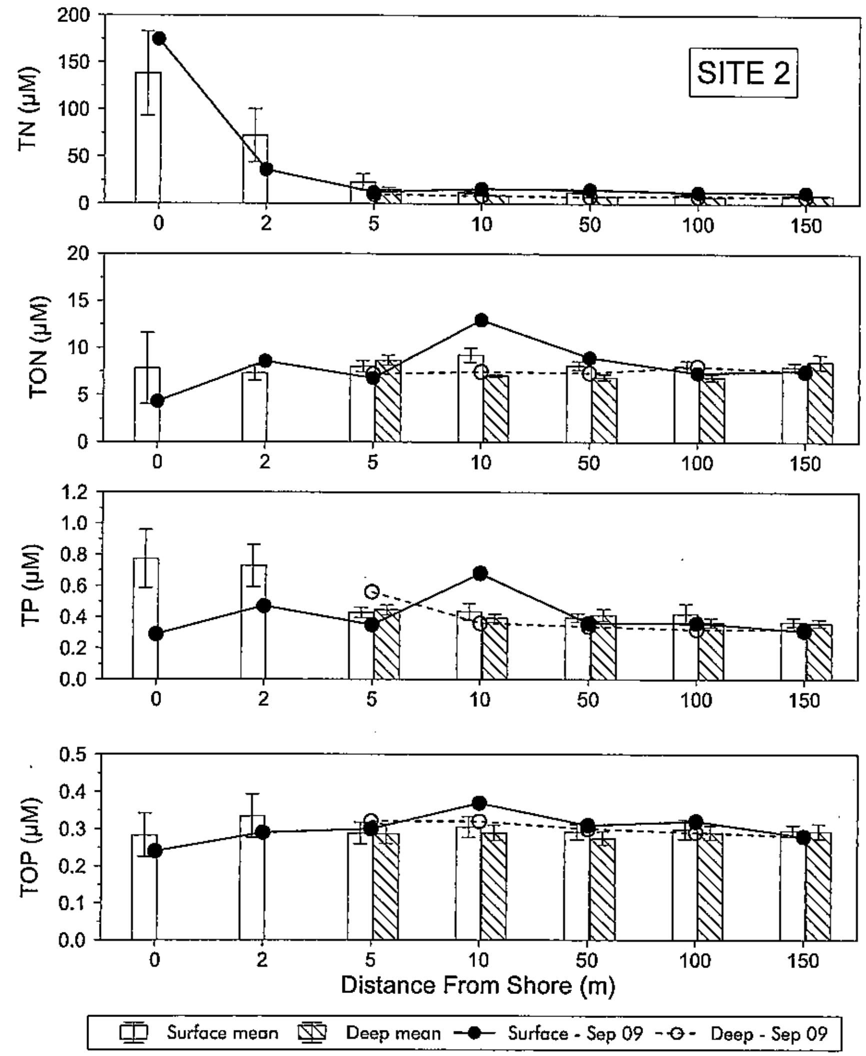

FIGURE 8. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 2, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

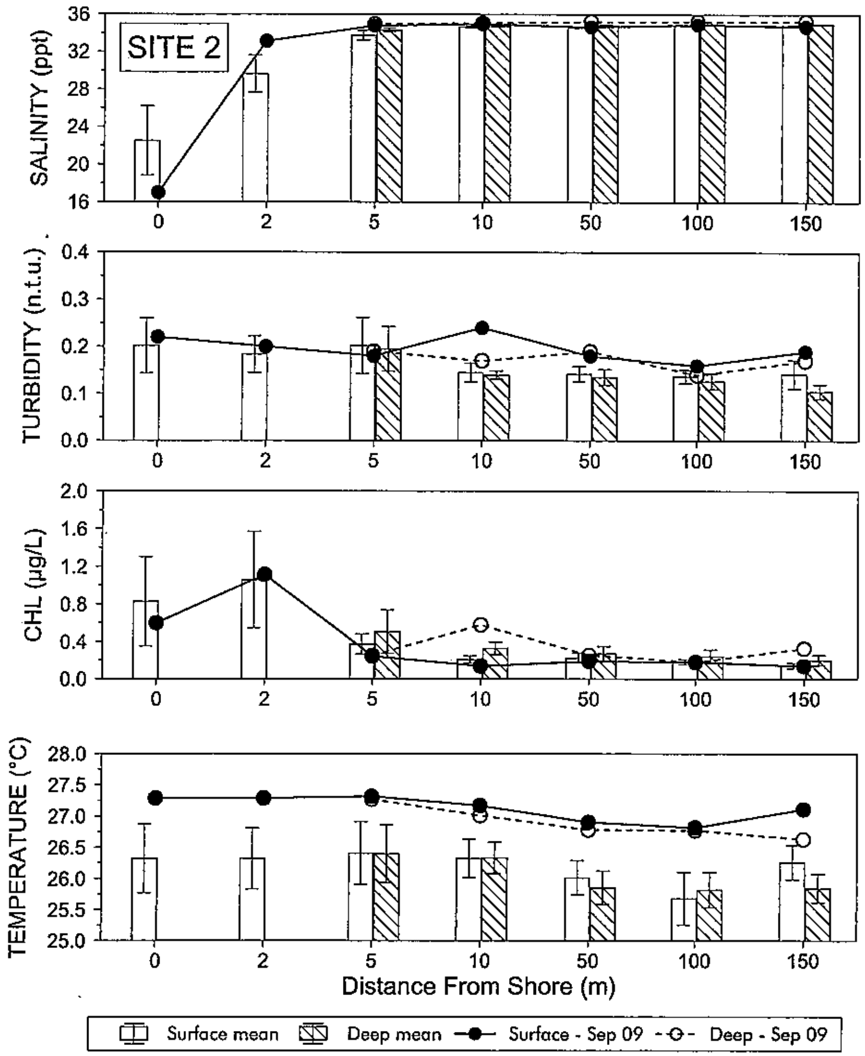

FIGURE 9. Plots of water quality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 2, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

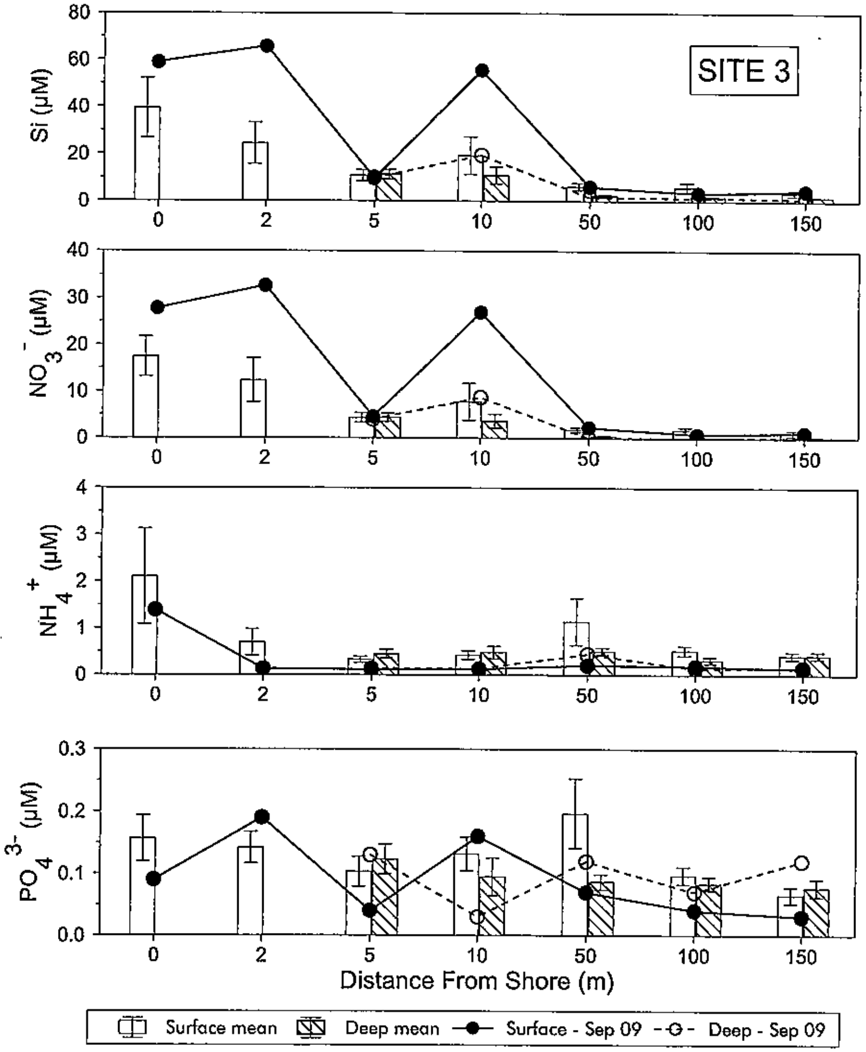

FIGURE 10. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 3, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

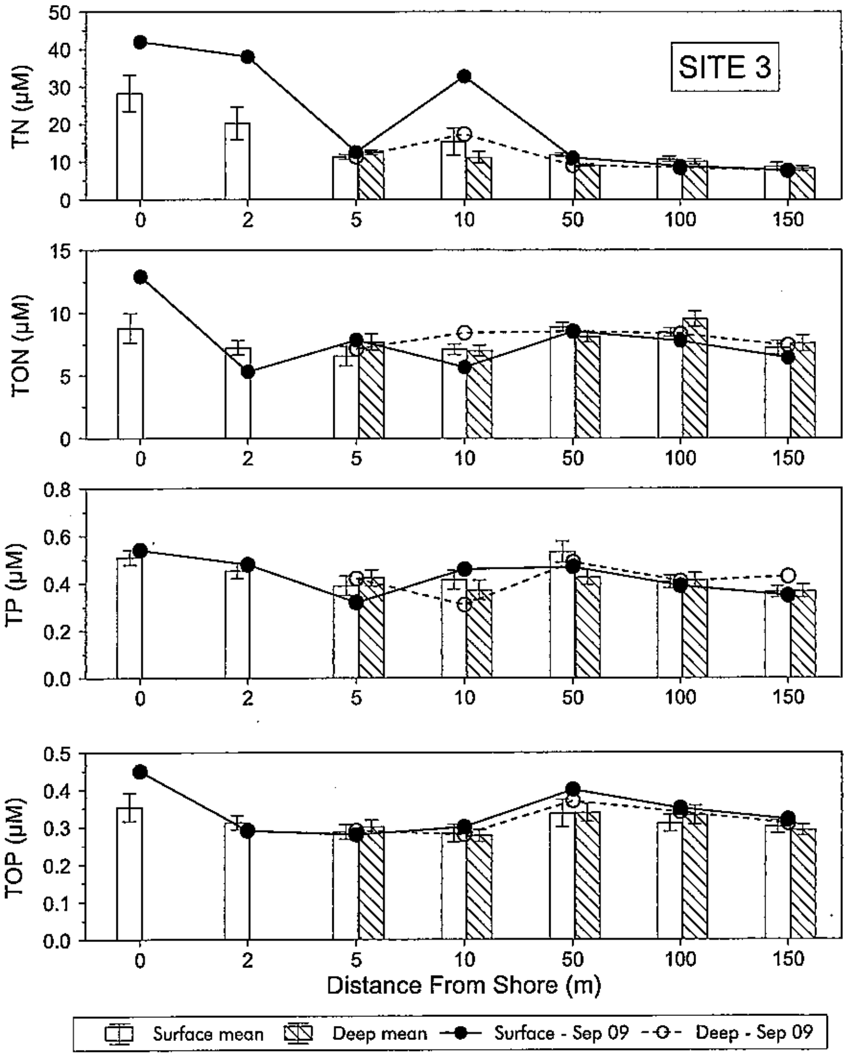

FIGURE 11. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 3, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

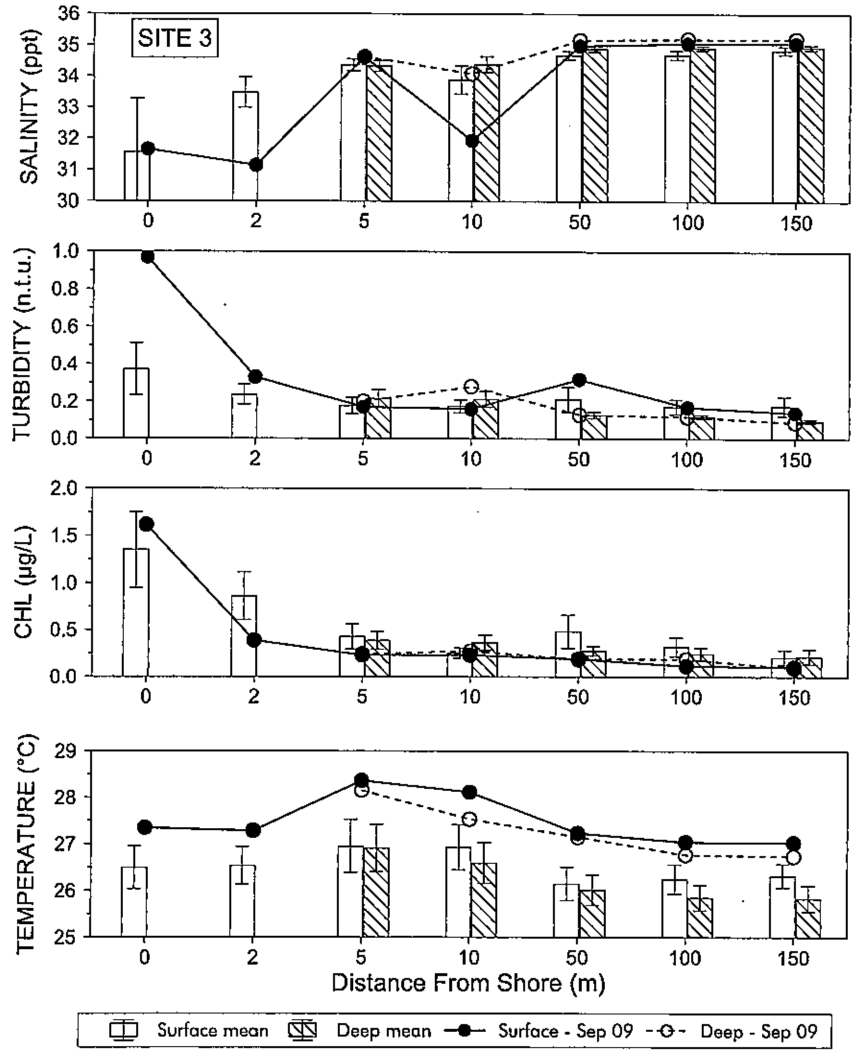

FIGURE 12. Plots of water quality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 3, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

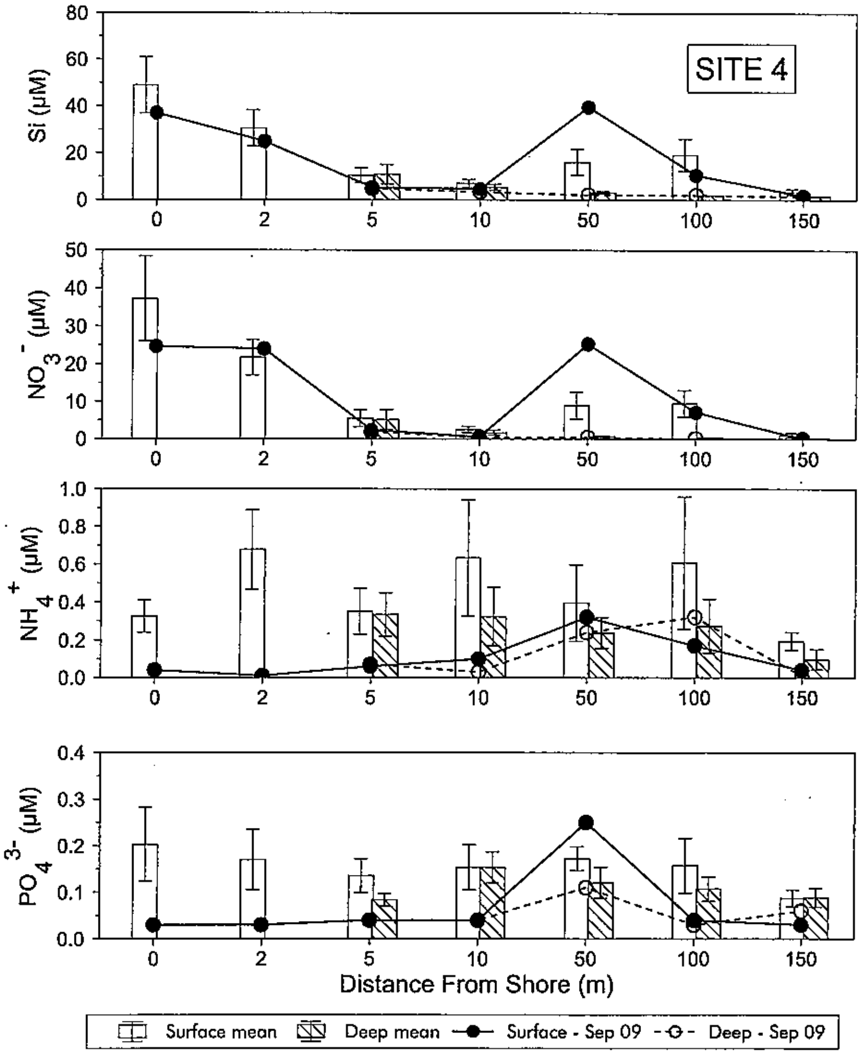

FIGURE 13. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 4, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

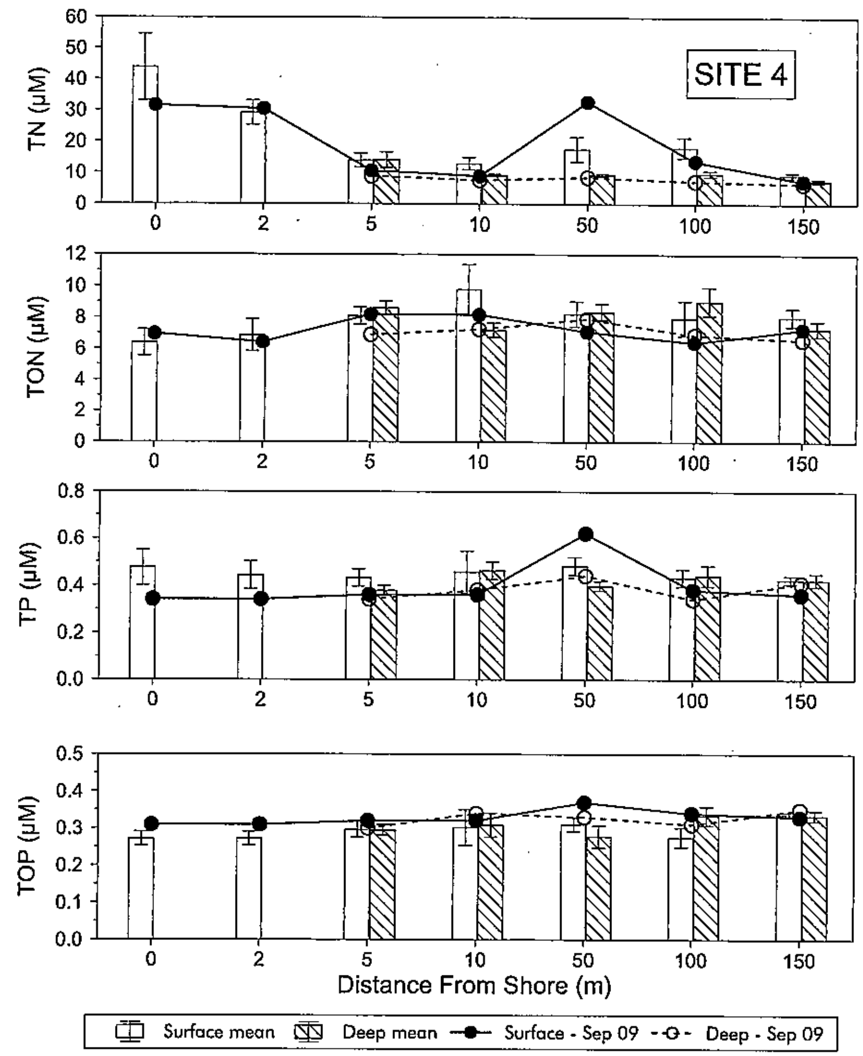

FIGURE 14. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 4, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

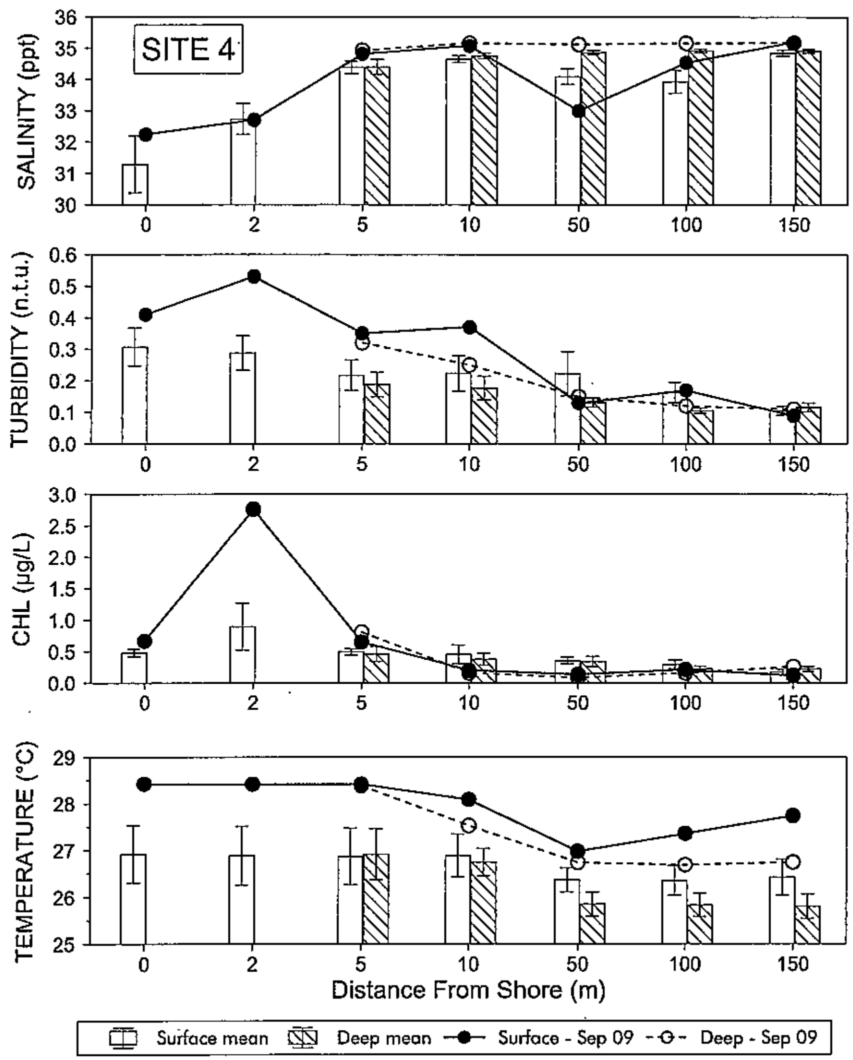

FIGURE 15. Plots of water quality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 4, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

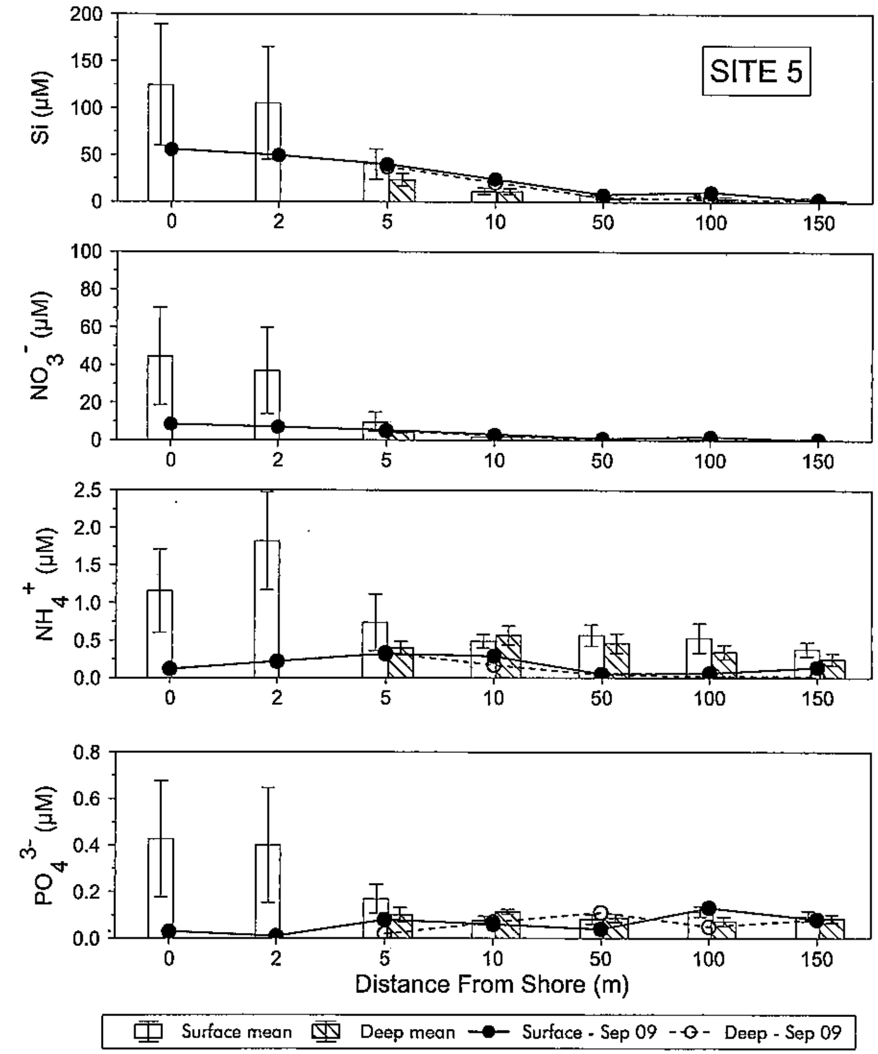

FIGURE 16. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 5, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

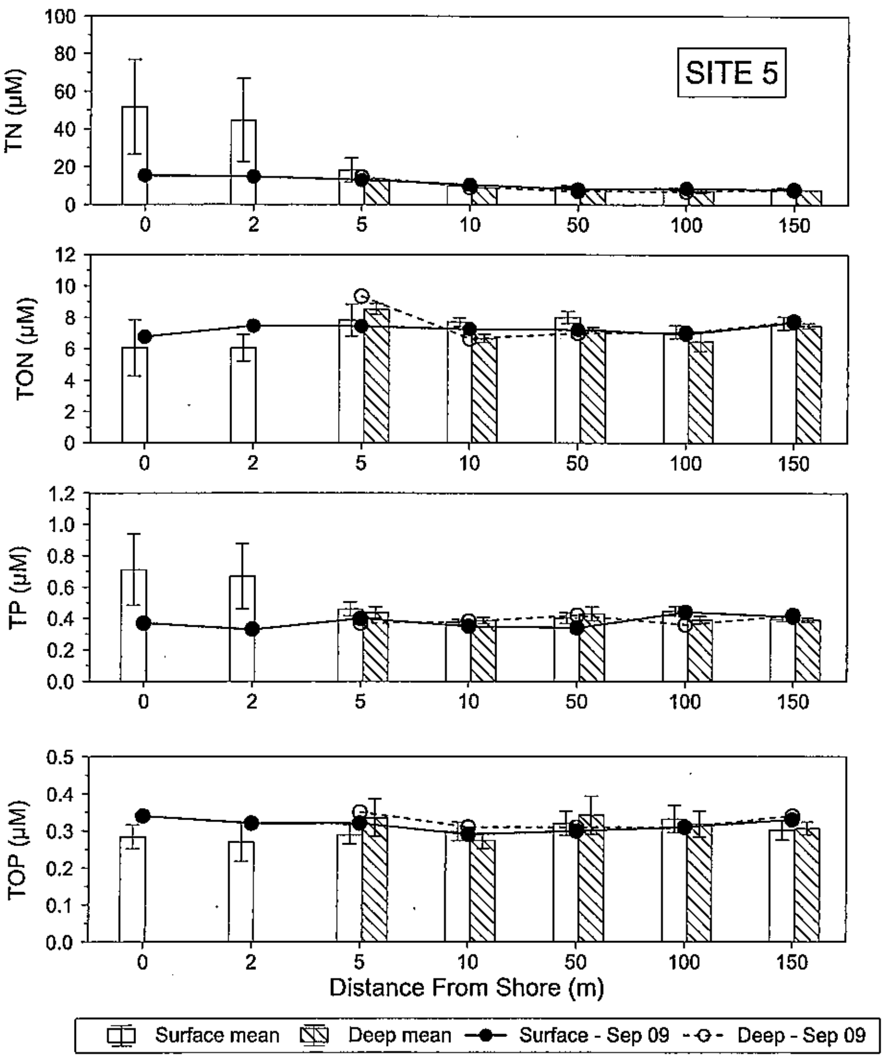

FIGURE 17. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 5, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

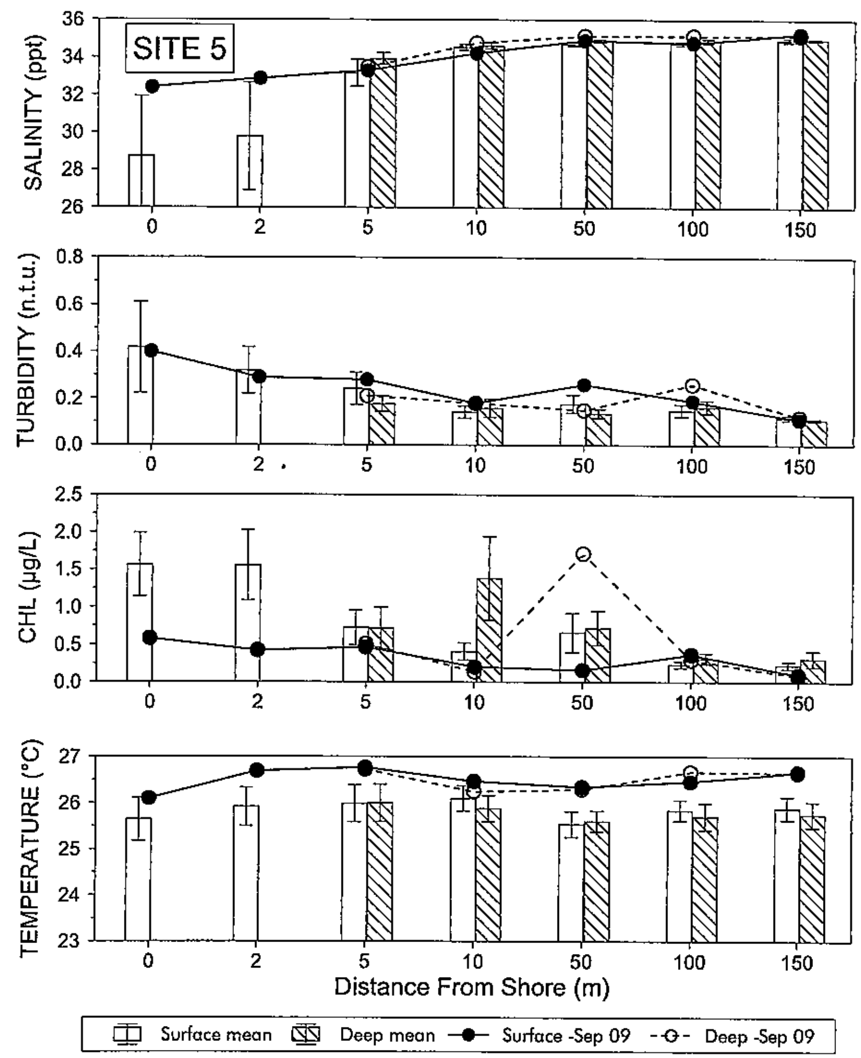

FIGURE 18Plots of water qality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 5, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=6). Error bars represent standard error of the mean. For site location, see Figure 1.

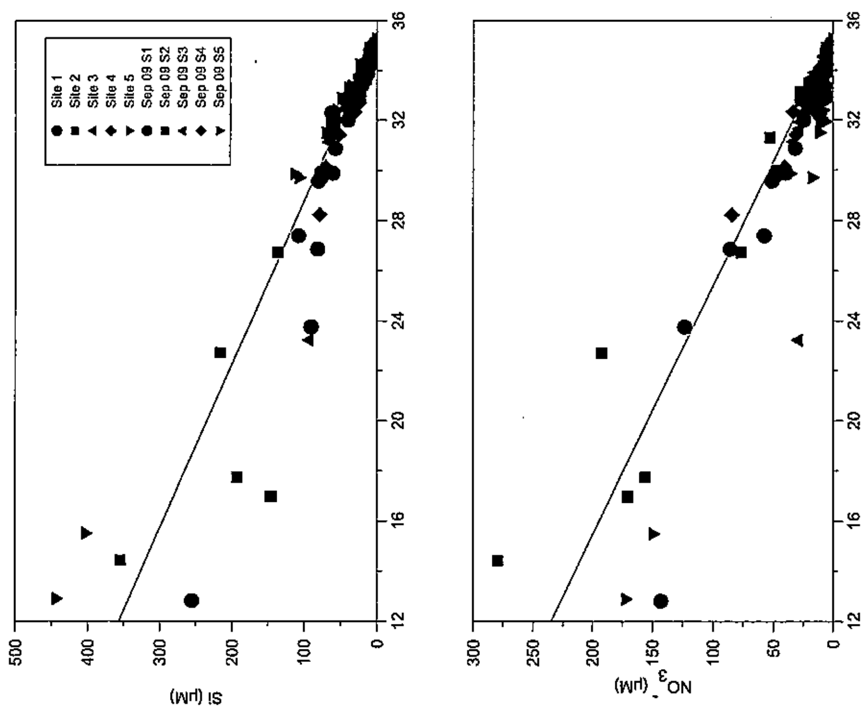

FIGURE 20. Silicate and nitrate, plotted as a function of salinity for surface samples collected since June 2005 at five sites offshore of Honua'ula, Wailea, Maui. Black symbols represent data from surveys conducted between June 2005 and January 2009 (N=5). Red symbols are data from the most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from a golf course irrigation well. For sampling site locations, see Figure 1.

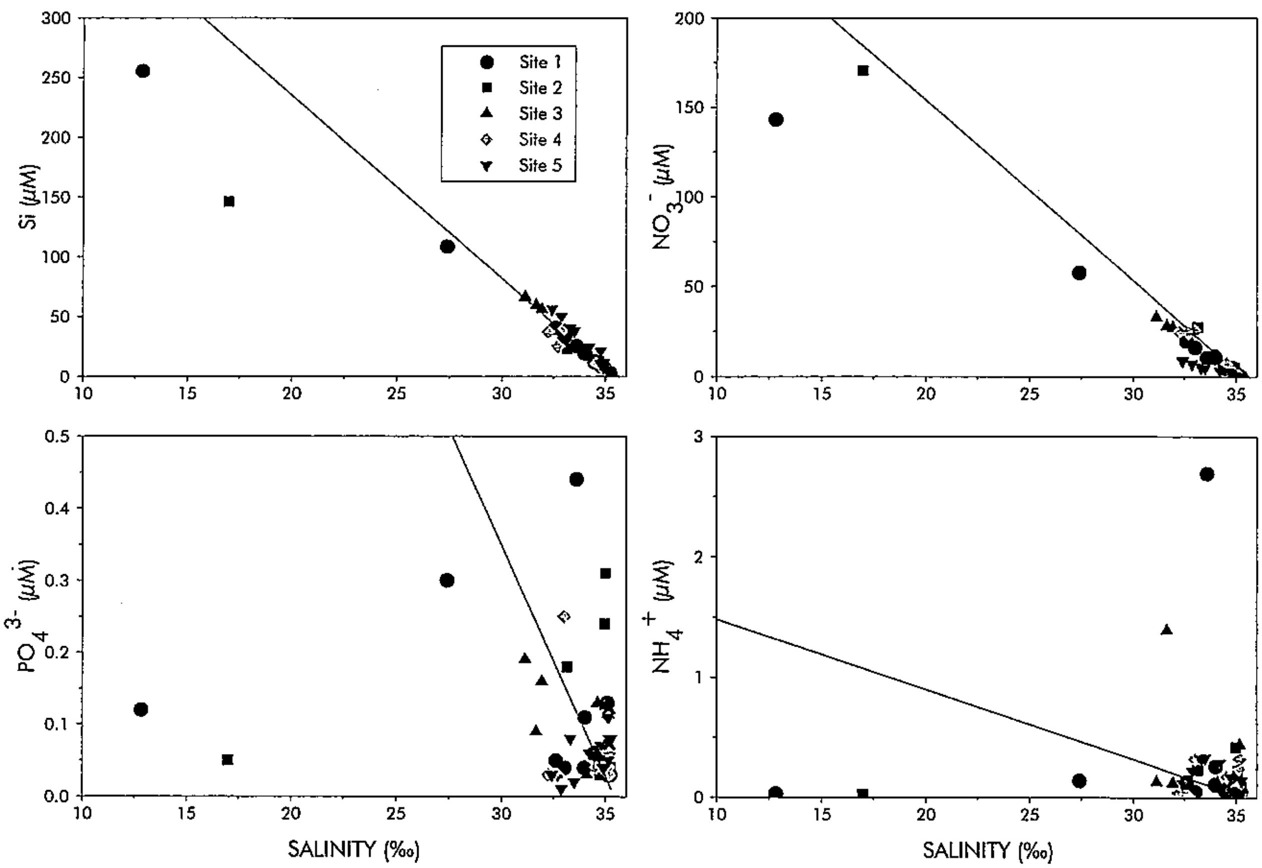

FIGURE 19. Mixing diagram showing concentration of dissolved nutrients from samples collected at five transect sites offshore of the Honua`ula project site in Wailea, Maui on September 4, 2009 as functions of salinity. Straight line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from a golf course irrigation well. For transect site locations, see Figure 1.

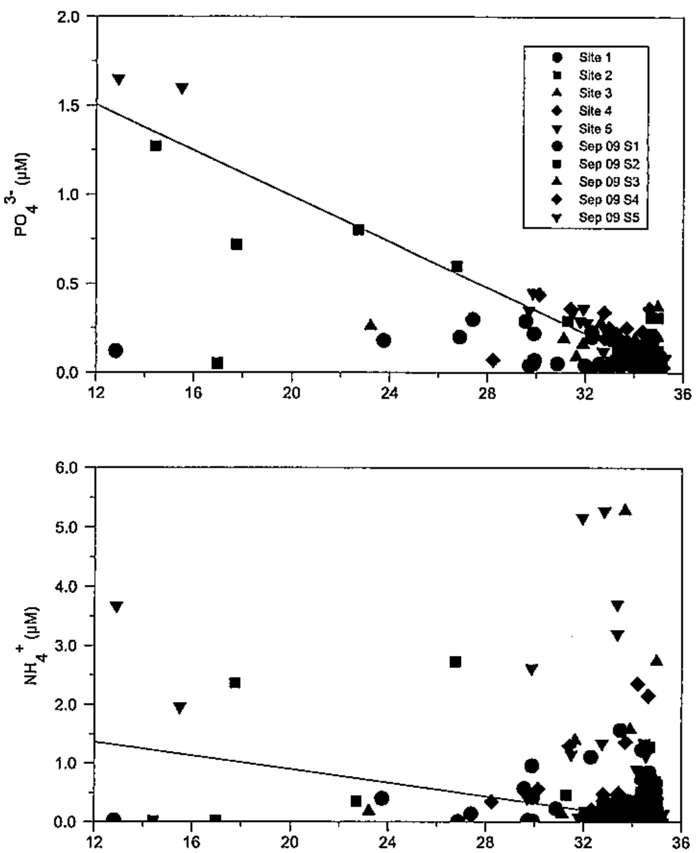

FIGURE 21. Phosphate and ammonium, plotted as a function of salinity for surface samples collected since June 2005 at five sites offshore of Honua`ula, Wailea, Maui. Black symbols represent data from surveys conducted between June 2005 and January 2009 (N=5). Red symbols are data from the most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from a golf course irrigation well. For sampling site locations, see Figure 1.

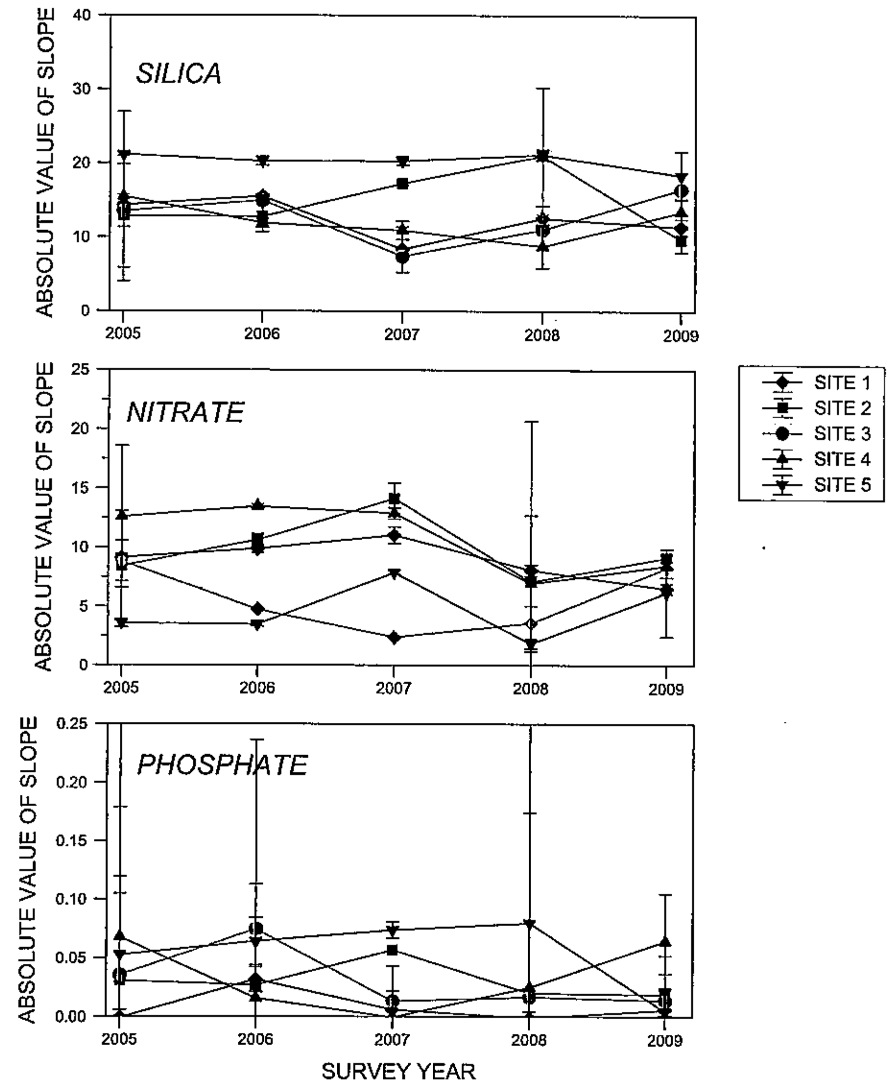

FIGURE 22. Time-course plots of absolute values of slopes of linear regressions of concentrations of silca, nitrate and phosphate as functions of salinity collected annually at each of the transect monitoring stations off of Honua`ula, Wailea, Maui. Error bars are 95% confidence limits. For locations of sampling transect sites, see Figure 1.

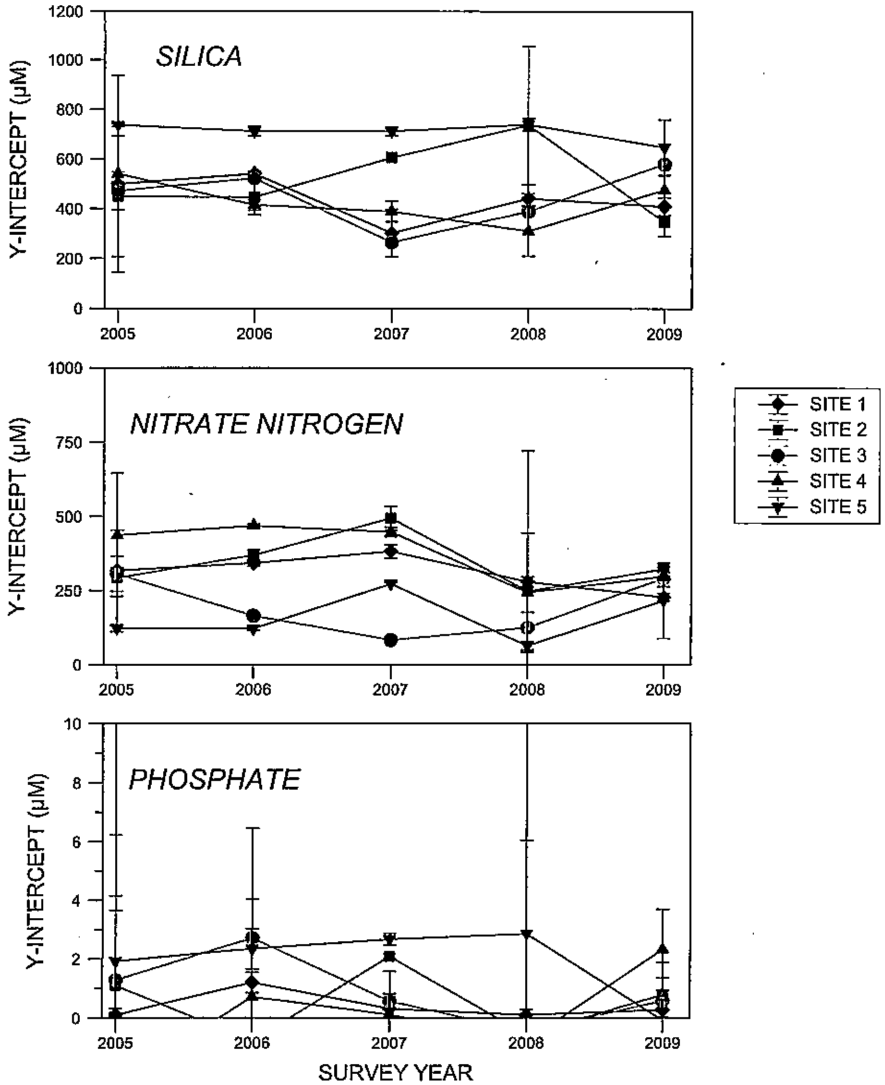

FIGURE 23. Time-course plots of Y-intercepts of linear regressions of concentrations of silca, nitrate and phosphorus as functions of salinity collected annually at each of the transect monitoring stations off of Honua`ula, Wailea, Maui. Error bars are 95% confidence limits. For locations of sampling transect sites, see Figure 1.

Marine Water Quality Monitoring Report 2011

MARINE ENVIRONMENTAL

MONITORING PROGRAM:

HONUA'ULA

WAILEA, MAUI

WATER CHEMISTRY

REPORT 1-2011

Prepared for

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I. PURPOSE

The Honua'ula project is situated on the slopes of Haleakala directly mauka of the Wailea Resort in South Maui, Hawaii. The project area is comprised of two parcels totaling 670 acres and is designated Project District 9 in the Kihei/Makena Community Plan. The project area is also zoned Project District 9 in the Maui County code. Current zoning includes provisions for 1,400 homes (including affordable workforce homes in conformance with the County's Residential Workforce Housing Policy (Chapter 2.96, MCC, 250 of which will be provided off-site, thus reducing the total number of homes on-site to 1,150), village mixed uses, a homeowner's golf course, and other recreational amenities as well as acreage for parks, and open space that will be utilized for landscape buffers and drainage ways. The project is immediately above three 18-hole golf courses (Blue, Gold and Emerald) within the southern area of Wailea Resort. The composite Wailea Resort/ Honua'ula encompasses approximately one mile of coastline. No aspect of the project involves direct alteration of the shoreline or nearshore marine environment. At the time of submission of this report, development of the project EIS and Phase II submittal is in progress. No construction activities associated with the project have commenced.

There is no *a priori* reason to indicate that responsible construction and operation of Honua'ula will cause any detrimental changes to the marine environment. Current project planning includes retention of surface drainage on the golf course, and a private waste system will treat effluent to the R-1 level which is suitable for irrigation re-use. Yet, there is always potential concern that construction and operation could cause environmental effects to the ocean off the project site. Of particular importance is the potential for cumulative effects from the combined Wailea Resort and Honua'ula projects. As the properties are oriented above one another with respect to the ocean, subsurface groundwater will flow under both project sites prior to discharge at the coastline. Hence, groundwater leachate from fertilizers and other materials that reach the ocean will be a mix from both projects.

With the intention of evaluating these effects, one of the Conditions of Zoning for Honua'ula (No. 20) stipulated:

> *"That marine monitoring programs shall be conducted which include monitoring and assessment of coastal water resources (groundwater and surface water) that receive surface water or groundwater discharges from the hydrologic unit where the project is located. Monitoring programs shall include both water quality and ecological monitoring.*
>
> *Water Quality Monitoring shall provide water quality data adequate to assess compliance with applicable State water quality standards at Hawaii Administrative Rules Chapter 11-54. Assessment procedures shall be in accordance with the current Hawaii Department of Health ("HIDOH") methodology for Clean Water Act Section 305(b) water quality assessment, including use of approved analytical methods and quality control/quality assurance measures. The water quality data shall be submitted annually to HIDOH for use in the State's Integrated Report of Assessed Waters prepared under Clean Water Act Sections 303(d) and 305(b). If this report lists the receiving waters as impaired and requiring a Total Maximum*

Daily Load ("TMDL") study, then the monitoring program shall be amended to evaluate land-based pollutants, including: (1) monitoring of surface water and groundwater quality for the pollutants identified as the source of the impairment; and (2) providing estimates of total mass discharge of those pollutants on a daily and annual basis from all sources, including infiltration, injection, and runoff. The results of the land-based pollution water quality monitoring and loading estimate shall be submitted to the HIDOH Environmental Planning Office, TMDL Program."

To date, HIDOH, which is the agency responsible for developing TMDL's (rather than property owners) has not performed this action for any marine areas off Maui.

This report represents the fifth monitoring effort to take place since the establishment of conditions of Zoning (Condition 20). However, prior to approval of the conditions several increments of monitoring to establish baseline conditions for Honuaʻula were conducted in 2005, 2006 and 2008. The following report conducted in March 2011 presents the results of the overall eighth phase of the monitoring program for the Honuaʻula project.

II. ANALYTICAL METHODS

Figure 1 is an aerial photograph showing the shoreline and topographical features of the Wailea area, and the location of the three existing Wailea golf courses. Also shown are the boundaries of the proposed Honuaʻula project. Ocean survey site locations are depicted as transects perpendicular to the shoreline extending from the highest wash of waves out to what is considered open coastal ocean (approximately the 20 m depth contour). Site 1 is located near the southern boundary of the Wailea Gold Course inside Nahuna Point offshore of an area locally known as "Five Graves"; Site 2 bisects the area off the center of the Wailea Emerald Course at the southern end of Palauʻea Beach (downslope from the southern boundary of the Honuaʻula project site); Site 3 is located off the southern end of Wailea Beach off the approximate boundary of the Emerald and Blue Courses (downslope from approximate center of the Honuaʻula project site), and Site 4 is off the northern end of the Blue Course at the northern end of Ulua Beach (downslope from the northern boundary of the Honuaʻula project site).

Survey Site 5 is located near the northern boundary of the ʻAhihi-kinaʻu natural area reserve, and just north of the 1790 lava flow. The site is approximately four kilometers (km) south of the Honuaʻula project site. Land uses of the coastal area landward of Site 5 include several private residences and pasture for cattle grazing. Site 5 serves as the best available "control" survey site, as it is located offshore of an area with minimal land-based development, and no golf course operations, residential or commercial "development". In order to maximize the similarity of the control and test sites, the location of Site 5 was in an area of similar geologic and oceanographic structure as the sites off of the Wailea Resort and Honuaʻula. Farther to the south of Site 5, land development is less, but geologic structure consists of the 1790 lava flow, which is dissimilar with respect to hydrologic characteristics from the other survey sites off of Wailea.

All field work was conducted on March 6, 2011 using a small boat and swimmers working from shore. Environmental conditions during sample collection consisted of calm seas, light winds and sunny skies.

Water samples were collected at five stations along transects that extend from the highest wash of waves to approximately 150 meters (m) offshore at each site. Such a sampling scheme is designed to span the greatest range of salinity with respect to groundwater/surface water efflux at the shoreline. Sampling is more concentrated in the nearshore zone because this area is most likely to show the effects of shoreline modification. With the exception of the two stations closest to the shoreline, samples were collected at two depths; a surface sample was collected within approximately 10 centimeters (cm) of the sea surface, and a bottom sample was collected within 1 m of the sea floor. The intermittent stream located at the base of Wailea Point (Site 3) was not flowing during this survey.

Samples from within 10 m of the shoreline were collected by swimmers working from the shoreline. Samples were collected by filling triple-rinsed 1 liter polyethylene bottles at the estimated distance from the shoreline. Samples beyond 10 m of the shoreline were collected using a small boat. Water samples were collected at stations locations determined by GPS using a 1.8-liter Niskin-type oceanographic sampling bottle. The bottle is lowered to the desired depth where spring-loaded endcaps are triggered to close by a messenger released from the surface. Upon recovery, each sample was transferred into a 1-liter polyethylene bottle until further processing.

Following collection, subsamples for nutrient analyses were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice until returned to Honolulu. Water for other analyses was kept in the 1-liter polyethylene bottles and kept chilled until analysis.

Typically, part of the monitoring program includes collection of water samples from irrigation wells on the Wailea golf course. Sampling of wells was not conducted during this phase of monitoring owing to logistic constraints. Data from the previous well sampling conducted on February 11, 2009 is used for evaluation of groundwater mixing with ocean water in the Results section below. Samples were collected from well #'s 2, 5, 6, 7, 8, 9 and 10) located on the Gold and Emerald courses and one reservoir located on the Gold course.

Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the Water Quality Standards, Department of Health, State of Hawaii. These criteria include: total nitrogen (TN) which is defined as inorganic nitrogen plus dissolved organic nitrogen, nitrate + nitrite nitrogen ($NO_3^- + NO_2^-$, hereafter referred to as NO_3^-), ammonium (NH_4^+), total phosphorus (TP) which is defined as inorganic phosphorus plus dissolved organic phosphorus, chlorophyll a (Chl *a*), turbidity, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) were reported because these constituents are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Analyses for NH_4^+, PO_4^{3-}, and $NO_3^- + NO_2^-$ (hereafter termed NO_3^-) were performed using a Technicon autoanalyzer according to standard methods for seawater analysis (Strickland and

Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion following digestion. Dissolved organic nitrogen (TON) and dissolved organic phosphorus (TOP) were calculated as the difference between TN and inorganic N, and TP and inorganic P, respectively. Limits of detection for the dissolved nutrients are 0.01 μM (0.14 μg/L) for NO_3^- and NH_4^+, 0.01 μM (0.31 μg/L) for PO_4^{3-}, 0.1 μM (1.4 μg/L) for TN and 0.1 μM (3.1 μg/L) for TP.

Chl *a* was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted in 90% acetone in the dark at -5°C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer (level of detection 0.01 μg/L). Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.0003‰.

In situ field measurements included water temperature, pH, dissolved oxygen and salinity which are acquired using an RBR Model XR-620 CTD calibrated to factory specifications. The CTD has a readability of 0.001°C, 0.001pH units, 0.001% oxygen saturation, and 0.001 parts per thousand (‰) salinity.

Analyses of nutrients, turbidity, pH, Chl *a* and salinity were conducted by Marine Analytical Specialists located in Honolulu, Hawaii. This laboratory possesses acceptable ratings from EPA-compliant proficiency and quality control testing.

III. RESULTS

A. Horizontal Stratification

Table 1 shows results of all marine and well water chemical analyses for samples collected off Wailea on March 6, 2011 reported in micromolar units (μM). Table 2 shows similar results presented in units of micrograms per liter (μg/L). Tables 3 and 4 show geometric means of ocean samples collected at the same sampling stations during surveys conducted since June 2005. Table 5 shows water chemistry measurements (in units of μM and μg/L) for samples collected from seven irrigation wells and a reservoir located on the Wailea Golf Courses. Concentrations of twelve chemical constituents in surface and deep water samples are plotted as functions of distance from the shoreline in Figures 2 and 3. Mean concentrations (±standard error) of twelve chemical constituents in surface and deep water samples from previous increments of sampling, as well as data from the most recent sampling, are plotted as functions of distance from the shoreline in Figures 4-18.

Evaluation of transect data reveals that at all five sites there was distinct horizontal stratification in the surface concentrations of dissolved Si, NO_3^-, TN , salinity and temperature. In addition, nutrient concentrations in surface waters are generally elevated compared to the concentration of the corresponding sample of bottom water (Figure 2 and 3, Tables 1 and 2).

For all nutrients with distinct horizontal gradients, slopes of concentrations were steepest within 10 m of the shoreline at all five transect sites. Beyond 10 m from the shoreline, concentrations of nutrients decreased progressively with distance from shore but at a substantially reduced gradient compared with the zone within 10 m of the shoreline. Salinity showed the opposite trend, with distinctly lower values within the nearshore zone, and progressive increases with

distance from shore (Figure 3). The pattern of decreasing nutrient concentration and increasing salinity with distance from shore is most evident at Site 1(Five Graves) , where surface concentrations of NO_3^- near the shoreline were three orders of magnitude higher than samples collected at the seaward end of the transect. Salinity was correspondingly lower near the shoreline compared to offshore samples, with values differing by 27.9‰ between the shoreline and offshore terminus of the transect at Site 1 (Tables 1 and 2). Similar patterns were evident at Sites 2, 3, 4 and 5, but the horizontal gradients were far less pronounced compared to the patterns at Transect 1.

The pattern of elevated Si, NO_3^-, and TN with corresponding low salinity is indicative of groundwater entering the ocean near the shoreline. Low salinity groundwater, which contains high concentrations of Si, and NO_3^-, (see values for well waters in Table 5), percolates to the ocean near the shoreline, resulting in a distinct zone of mixing in the nearshore region. The magnitude of the zone of mixing, in terms of both horizontal extent and range in nutrient concentration, depends on the magnitude of the flux of groundwater entering the ocean from land, and the magnitude of physical mixing processes (primarily wind and wave stirring) at the sampling location. During the March 2011 survey, horizontal gradients extended to 50 m from the shoreline at Sites 1, 3 and 5 while at Sites 2 and 4, the horizontal gradients dissipated at distances less than 50 m of the shoreline (Tables 1 and 3).

Surface concentrations of PO_4^{3-} and TP also showed a pattern of elevated concentration within 10 m of the shoreline at Transect sites 1, 5 and 3 (Figure 2, Tables 1 and 2). There were no consistent gradients of PO_4^{3-} and TP at the other sites.

Dissolved nutrient constituents that are not associated with groundwater input (NH_4^+, TON, TOP) show varying patterns of distribution with respect to distance from the shoreline and among the five sites (Figure 2). Surface concentrations of NH_4^+ were highest near the shoreline at all sites except Site 4; beyond the shoreline there was no distinct pattern (Figure 2, Tables 1 and 2). With the exception of a few shoreline samples at, surface concentrations of TOP and TON were relatively constant at all sampling locations on transect sites during the March 2011 survey (Figure 2).

Turbidity was elevated at the shoreline and decreased with distance from shore at all five transect sites during the March 2011 survey (Figure 3 and Tables 1 and 2). Site 3 (downslope of the middle of the project area) had distinctly higher turbidity levels compared to the other four sites, reaching a maximum of 1.4 NTU in the sample collected at the shoreline (Table 1). Similar to turbidity, values of Chl *a* were distinctly higher at Sites 1 and 3 compared to the other three sites. Surface temperature ranged between a low of 24.4°C near the shoreline to 27.9°C in the offshore waters with an approximate 2.5°C - 3.3°C difference within any one transect during March 2011 (Tables 1 and 2, Figure 3).

B. Vertical Stratification

In many areas of the Hawaiian Islands, input of low salinity groundwater to the nearshore ocean creates a distinct buoyant surface lens can persist for some distance from shore. Buoyant surface layers are generally found in areas with both conspicuous input of groundwater, and turbulent processes (primarily wave action) insufficient to completely mix the water column. During the March 2011 survey, vertical stratification was apparent in that concentrations of nutrients that occur in relatively high concentrations in groundwater (Si, NO_3^-, PO_4^{3-}, TN) were elevated in surface samples relative to bottom samples at all sites, while salinity showed a reverse trend with high values in bottom samples compared to surface values. Such gradients suggest that the groundwater was not completely mixed within the water column in the nearshore zone throughout the region of study.

Contrary to the nutrients listed above, there were no consistent patterns in vertical stratification in the concentrations of NH_4^+, TP, TOP, TON and Chl *a* during the March 2011 survey (Figures 2 and 3). In many instances, concentrations were higher in deep water compared to the surface water and in other cases, the opposite was evident. The lack of consistent trends in the stratification indicate that the variation is not likely a result of groundwater input, or any other factors associated with freshwater input from land. Temperature values did show stratification at Sites 1 and 4, with the deep water samples colder than the surface water. These results were most likely due to solar warming.

C. Temporal Comparison of Monitoring Results

Figures 4-18 show mean concentrations ($\pm$ standard error) of water chemistry constituents from surface and deep samples at all five sites over the course of the Honua'ula monitoring program. Also plotted separately are data from the most recent survey in March 2011.

Examination of the plots in Figures 4-18 reveal some indications of changes in water chemistry between the most recent survey and the average survey results, as well as between the different survey sites over the course of monitoring. With respect to groundwater efflux, similar patterns of decreasing concentrations of Si, NO_3^-, PO_4^{3-} and increasing salinity with distance from shore are evident in the mean values at all five sampling sites, and have been consistently highest at Site 1 (Five Graves), Site 2 (Palau'ea), and Control Site 5 (Figures 4-18). In the most recent survey (March 2011) the concentrations of Si, NO_3^-, TN, PO_4^{3-} and TP were higher than the mean values at Sites 1 and 3 (Figures 4,5, 10 and 11). Salinity during the March 2011 survey was distinctly lower than the mean values at Sites 1 and 3, while at Sites 2, 4 and 5 salinity in the nearshore was higher than the mean values (Figures 6, 9, 12, 15 and 18). Excursions from the mean values have been observed in past surveys, most notable in the December 2007 survey which was conducted three days after a major storm front moved through the area (rainfall to the area was recorded at 2.95 inches in a 24 hour period).

With the exception of Site 4, turbidity measurements during March 2011 were higher than the mean values. Measurements of Chl *a* at Site 3 had higher than mean values during March 2011 in samples collected within 50 m of the shoreline (Figure 12). Temperature during March 2011 was higher than the mean values near the shoreline at all stations (Figures 6, 9, 12, 15 and 18).

These comparisons suggest that while there are some differences between surveys; water chemistry of the nearshore zone at Sites 1 and 4 was influenced by greater groundwater efflux during the March 2011 survey compared to the average values of surveys conducted in past years. In addition, the concentrations and gradients in nutrients that occur at Site 5, located

beyond the influence of the Wailea Resort and other development in Wailea, were similar to the patterns on the transects located offshore of two of the sites off the Wailea Golf Courses (Sites 3 and 4). Therefore, it is apparent that the golf course operations are not solely responsible for changes that might be depicted in water quality.

D. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land involves a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity. Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question (Officer 1979, Dollar and Atkinson 1992, Smith and Atkinson 1993). Figure 19 shows plots of concentrations of four chemical constituents (Si, NO_3^-, PO_4^{3-} and NH_4^+) as functions of salinity for the samples collected at each site in March 2011. Figures 20 and 21 show similar plots with historical data compared with the most recent survey.

Each graph also shows conservative mixing lines that are constructed by connecting the end-member concentrations of open ocean water and groundwater from irrigation wells upslope of the sampling area. The conservative mixing line for Figure 19 was constructed using water from Irrigation Well No. 5 located to the northwest of the project area (sampled on February 11, 2009), and from the average concentrations of ocean water collected from near the bottom at the sampling locations 150 m offshore.

If the parameter in question displays purely conservative behavior (no input or removal from any process other than physical mixing), data points should fall on, or very near, the conservative mixing line. If, however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as uptake by biotic metabolic processes, data points will fall below the mixing line.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 19 that all data points from Sites 1-5 fall in a linear array on, or very close to the conservative mixing line for Si. Such linearity indicates that groundwater (as defined by the concentration of SI) entering the ocean at these sites is a nearly pure mix of groundwater similar to that from Well No. 5, and open coastal water. It can be seen in Figure 20 that while data points from the present survey in March 2011 lie close to the conservative mixing line, deviations in concentrations of silica as functions of salinity have occurred in previous surveys. Such deviations of data points above the mixing line suggest input of other sources of groundwater enriched in Si relative to groundwater from Well No. 5.

The plots of NO_3^- versus salinity reveal a pattern that is not similar to Si, as data points from transect fall on three separate mixing lines. Data points from transects 2 and 4 lie on a straight line that is slightly above the conservative mixing line, while points from transects 1 and 3 fall on a line slightly below the conservative mixing line. The data points from transect 5, which is considered the control site fall substantially farther below the mixing line than any of the other four transects (Figure 19). A similar pattern is evident over the course of sampling in Figure 20, where many of the NO_3^- data points from transects 1, 3 and 5 during previous surveys fell below the mixing line. The reduced slope of the line prescribed by the data points from these areas suggest the possibility of removal of NO_3^- by turfgrass on the golf course following irrigation, and subsequent leaching to the groundwater.

The linear relationship of the concentrations of NO_3^- as functions of salinity indicates little or no detectable uptake of this material in the marine environment (e.g., no upward concave curvature of the data lines). Lack of uptake indicates that NO_3^- is not being removed from the water column by metabolic reactions that could change the composition of the marine environment, particularly with respect to increased abundance of phytoplankton or benthic algae. Rather, the nutrients entering the ocean through groundwater efflux are dispersed by physical mixing processes. In addition, the distinct vertical stratification that is usually evident to a distance of at least 100 m from the shoreline suggests that water with increased concentrations of NO_3^- as a result of groundwater input are limited to a buoyant surface plume that does not mix through the entire water column. As a result, these analyses provide valid evidence to indicate that the increased nutrients fluxes from land have little potential to cause alteration to benthic biological community composition or function.

It has been documented in other locales in the Hawaiian Islands (e.g., Keauhou Bay on the Big Island) where similar nutrient subsidies from golf course leaching occur that excess NO_3^- does not cause changes in biotic community structure (Dollar and Atkinson 1992). It was shown at Keauhou that owing to the distinct vertical stratification in the nearshore zone, the excess nutrients do not normally come into contact with benthic communities, thereby limiting the potential for increased uptake by benthic algae. In addition, the residence time of the high nutrient water was short enough within the embayment to preclude phytoplankton blooms. As a result, while NO_3^- concentrations doubled in Keauhou Bay as a result of golf course leaching for a period of at least several years, there is no detectable negative effect to the marine environment. Owing to the unrestricted nature of circulation and mixing off the Wailea site with no confined embayments it is reasonable to assume that the excess NO_3^- subsidies that are apparent in the ongoing monitoring will not result in alteration to biological communities. Inspection of the region during the monitoring surveys indicates that indeed, there are no areas where excessive algal growth is presently occurring, or has occurred in the past.

The other form of dissolved nitrogen, NH_4^+, does not show a linear pattern of distribution with respect to salinity (Figure 19). Several of the samples with high (34-35‰) salinity also displayed high concentrations of NH_4^+, particularly at Transect Sites 2, 3 and 5. In contrast to the position of NO_3^- data points at nearshore sampling stations at Site 1 close to the mixing line, concentrations of NH_4^+ at these sampling sites fell far below the mixing line. The lack of a correlation between salinity and concentration of NH_4^+ suggests that this form of nitrogen is not present in the marine environment as a result of mixing from groundwater sources (Figure 19). Rather, NH_4^+ appears to be generated by natural biological activity in the ocean waters off of Wailea.

Phosphate phosphorus (PO_4^{3-}) is also a major component of fertilizer, but is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in

soils. It can be seen in Figure 19 that there is a correlation between PO_4^{3-} and salinity, with linearity similar to that of Si and NO_3^-. In the cumulative data, most of the data points at salinities below 32‰ from all the sites fall on or below the conservative mixing line (Figure 21). These results suggest that the operation of the golf course is not resulting in increased concentrations of PO_4^{3-} in the nearshore zone.

E. Time Course Mixing Analyses

While it is possible to evaluate temporal changes from repetitive surveys conducted over time in terms of concentrations of water chemistry constituents (See Section D), a more informative and accurate method of evaluating changes over time is to utilize the results of scaling nutrient concentrations to salinity. As discussed above, the simple hydrographic mixing model consisting of plotting concentrations of nutrient constituents versus salinity eliminates the ambiguity associated with comparing nutrient concentrations of samples collected at different stages of tide and sea conditions. Tables 6-8 show the numerical values of the Y-intercepts, slopes, and respective upper and lower 95% confidence limits of linear regressions fitted through the data points for Si, NO_3^-, and PO_4^{3-} as functions of salinity for each year of monitoring at Transect Sites 1-5.

The magnitude of the contribution of nutrients to groundwater originating from land-based activities will be reflected in both the steepness of the slope and the magnitude of the Y-intercept of the regression line fitted through the concentrations scaled to salinity (the Y-intercept can be interpreted as the nutrient concentration that would occur at a salinity of zero if the distribution of data points is linear). This relationship is valid because with increasing contributions from land, nutrient concentrations in any given parcel of water will increase with no corresponding change in salinity. Hence, if the contribution from land to groundwater nutrient composition is increasing over time, there would be progressive increases in the absolute value of the slopes, as well as the Y-intercepts of the regression lines fitted through each set of nutrient concentrations plotted as functions of salinity. Conversely, if the contributions to groundwater from land are decreasing, there will be decreases in the absolute values of the slopes and Y-intercepts.

Plots of the values of the slopes (Figure 22) and Y-intercepts (Figure 23) of regression lines fitted though concentrations of Si, NO_3^- and PO_4^{3-} scaled to salinity during each survey year provide an indication of the changes that have been occurring over time in the nearshore ocean off Wailea. As stated above, Si provides the best case for evaluating the effectiveness of the method, as Si is present in high concentration in groundwater but is not a component of fertilizers. NO_3^- and PO_4^{-3} are the forms of nitrogen and phosphorus, respectively, found in high concentrations in groundwater relative to ocean water, and is the major nutrient constituents found in fertilizers.

Examination of Figures 22 and 23, as well as Tables 6-8 reveal that none of the slopes or Y-intercepts of Si or NO_3^- from 2005 to 2011 at any of the transect sites exhibit any indication of progressively increasing or decreasing values over the course of monitoring. The term "REGSLOPE" in Tables 6-8 denotes the values of the slopes and 95% confidence limits of linear regressions of the values of the yearly slopes and Y-intercepts as a function of time. In all cases, the upper and lower 95% confidence limits of the REGSLOPE coefficients are not significantly different than zero, indicating that there is no statistically significant increase or decrease in the salinity-scaled concentrations of Si, NO_3^- and PO_4^{3-} over the course of the monitoring program (Tables 6-8). Notable excursions in the confidence limits for Sites 2 and 4 occurred during 2005 and 2008 (Tables 6 and 7). The weak linear relationship between Si, NO_3^- and salinity in these instances were possibly a result of extreme physical mixing of the water column during those surveys.

Patterns in the time course mixing analysis for PO_4^{3-} are not as definitive as for Si and NO_3^-. The inconsistent linearity between PO_4^{3-} and salinity between sites and surveys result in a wide variation in the confidence limits. Overall, the lack of any significant slope from zero indicates that there have been no increases or decreases in nutrient input to the ocean from the project site over the course of monitoring (2005-2011).

F. Compliance with DOH Standards

Tables 1 and 2 also show samples that exceed DOH water quality standards for open coastal waters under "wet" and "dry" conditions. The distinction between application of wet and dry criteria is based on whether the survey area is likely to receive less than ("dry") or greater than ("wet") 3 million gallons of freshwater input per mile per day. DOH standards include specific criteria for three situations; criteria that are not to be exceeded during either 10% or 2% of the time, and criteria that are not to be exceeded by the geometric mean of samples. Comparison of the 10% or 2% of the time criteria for the small data set presently acquired is not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Boxed values in Tables 1 and 2 indicate measurements which exceed the DOH 10% standards under "dry" conditions, while boxed and shaded values show measurements which exceed DOH 10% standards under "wet" conditions. About half of the sixty samples collected were above the 10% criteria for NO_3^- under "dry" or "wet" conditions in the March 2011 survey (Table 1). Most of the previous surveys have also had a high percentage of the samples exceeding the 10% limit for NO_3^-. In addition to NO_3^-, thirteen measurements of NH_4^+, two measurements of TP, twenty measurements of TN, six measurements of turbidity and nine measurements of Chl *a* exceeded the 10% DOH criteria under "wet" conditions in March 2011.

Tables 3 and 4 show geometric means of samples collected at the each sampling location during the eight increments of the monitoring program conducted to date. Also shown in these tables are the samples that exceed the DOH geometric mean limits for open coastal waters under "dry" (boxed) and "wet" (boxed and shaded) conditions. All but one surface water measurements of NO_3^-, and nearly all measurements of NH_4^+, TN and Chl *a* exceeded the DOH geometric mean standards for dry conditions. Conversely, only a few of the geometric means of TP and turbidity were exceeded under dry conditions. It is important to note that a similar pattern of exceedance of geometric means occurred at Site 5 compared to the other four sites. As described above, Site 5 is considered a control that is located beyond the influence of the golf courses or other major land uses. The large number of water chemistry values that exceed the DOH criteria at Site 5, and the similarity in the pattern of these exceedances relative to the four Sites located directly off the existing Wailea Golf Courses and the Honuaʻula site indicate that other factors, including natural components of groundwater efflux, are responsible

for water chemistry characteristics to exceed stated limits. Thus, the elevated concentrations of water chemistry constituents at sampling stations offshore of the developed Wailea area cannot be attributed completely to anthropogenic factors associated with land use development. As naturally occurring groundwater contains elevated nutrient concentrations relative to open coastal water, input of naturally occurring groundwater is likely a factor in the exceedances of DOH standards which do not include consideration of such natural factors.

IV. SUMMARY

- The eighth phase of the water quality monitoring program for the planned Honuaʻula project was carried out in March 2011. Sixty ocean water samples were collected on four transects spaced along the projects ocean frontage and one transect located outside of the project area. Site 1 was located at the southern boundary of the Gold Course (Five Graves), Site 2 was located near the central part of the Emerald Course (Palauʻea Beach), Site 3 was located off Palauʻea Beach downslope from the juncture of the Emerald and Blue Courses, and Site 4 was located off Ulua Beach near the northern boundary of the Blue Course. Site 5 served as a control, and was located near the northern end of the ʻAhihi-kinaʻu Natural Area Reserve approximately four km to the south of the Wailea golf courses. Transects extended from the shoreline out to the open coastal ocean. Water samples were analyzed for chemical criteria specified by DOH water quality standards, as well as several additional criteria. Water sample data collected in February 2009 from seven irrigation wells and a golf-course reservoir in the Wailea area upslope of the sampling area are given for comparison.

- Water chemistry constituents that occur in high concentration in groundwater (Si, NO_3^-, TN and PO_4^{3-}) displayed sloping horizontal gradients with highest concentrations nearest to shore and decreasing concentrations moving seaward. Salinity showed the opposite trend, with lowest values closest to shore, and increasing values with distance seaward. Gradients were steepest within 10 m of the shoreline, and generally extended 50 – 100 m offshore. The steepest nearshore gradients, indicating the highest input of groundwater at the shoreline occurred at Site 1 (Five Graves), while the weakest gradients occurred at Sites 2 (Palauʻea Beach) and Site 5 (ʻAhihi-kinaʻu). The steep horizontal gradients at all sampling sites signify mixing of low salinity/high nutrient groundwater that discharges to the ocean at the shoreline and high salinity/low nutrient ocean water.

- Vertical stratification of the water column was also clearly evident at all sites for the chemical constituents that occur in high concentrations in groundwater relative to ocean water. Vertical stratification indicates that physical mixing processes generated by wind, waves and currents were not sufficient to completely break down the density differences between the buoyant low salinity surface layer and denser underlying water.

- Water chemistry constituents that generally do not occur in high concentrations in groundwater (NH_4^+, TOP, TON, Chl *a*, turbidity) did not display distinct horizontal or vertical trends.

- Scaling nutrient concentrations to salinity indicates that during the March 2011 survey there was no apparent subsidy of NO_3^- from human activities on land to the nearshore ocean at any of the sites. During previous surveys substantial subsidies of NO_3^- at some locations had been evident. The likely cause of the subsidies of NO_3^- in past surveys was either leaching of golf course or landscaping fertilizers to groundwater that flows under the golf courses, or possibly leakage from old septic systems or cesspools that served residences in the vicinity of Site 1. Such subsidies were not evident in the most recent monitoring survey.

- Linear regression statistics of nutrient concentration plotted as functions of salinity are useful for evaluating changes to water quality over time. When the regression values of nutrient concentrations versus salinity are plotted as a function of time, there are no statistically significant increases or decreases over the seven years of monitoring at any of the survey sites. The lack of increases in these slopes and intercepts indicate that there has been no consistent change in nutrient input from land to groundwater that enters the ocean from 2005 to 2011. Further monitoring will be of interest to note the future direction of the oscillating trends noted in the last six years.

- Comparing water chemistry parameters to DOH standards revealed numerous measurements of NO_3^- exceeded the DOH "not to exceed more than 10% of the time" criteria for both wet and dry conditions of open coastal waters. Numerous values of NO_3^-, NH_4^+, TN, Chl *a*, and to a lesser extent TP and turbidity, exceeded specified limits for geometric means. Such exceedances occurred at all survey sites, including the control site which is not influenced by the golf courses or other large-scale land uses. Such results indicate that the exceedances of the geometric mean water quality standards are not solely associated with golf course operation or other anthropogenic land uses. Rather, natural groundwater discharge can cause water chemistry characteristics to exceed DOH standards.

- The next phase of the Honua'ula monitoring program is scheduled for the the last quarter of quarter of 2011.

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FIGURE 1. Aerial photograph of Wailea area showing boundaries of Honua'ula Project (in yellow) and locations of marine water quality sampling transects. Transect W-5 is considered a control and is located in the 'Ahihi-kina'u Natural Area Reserve approximately four km south of the Honua'ula Project site.

TABLE 1.Water chemistry measurements from ocean water samples collected in the vicinity of the Honua'ula project site on March 6, 2011. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep, BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO4 (μM)	NO3 (μM)	NH4 (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	TURB (NTU)	SALINITY (ppt)	CHL a (μg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
WAILEA 1	0 S	0.1	1.13	177.5	0.54	363.1	0.21	10.08	1.34	188.1	0.71	7.144	2.43	26.8	8.06	100.0
	2 S	0.1	0.85	122.6	0.01	222.9	0.18	6.68	1.03	129.3	0.48	19.117	0.77	27.0	8.13	99.0
	5 S	0.1	0.37	52.12	0.16	92.01	0.21	6.30	0.58	58.58	0.35	29.164	0.23	26.8	8.20	98.6
	5 D	1.0	0.20	20.46	0.10	41.95	0.25	5.94	0.45	26.50	0.24	32.535	0.19	25.3	8.22	97.6
	10 S	0.1	0.17	17.12	0.11	34.48	0.25	5.87	0.42	23.10	0.14	32.986	0.13	25.5	8.20	97.5
	10 D	1.7	0.10	7.17	0.21	15.61	0.27	6.21	0.37	13.59	0.22	34.189	0.10	25.4	8.18	97.6
	50 S	0.1	0.10	4.50	0.15	9.09	0.27	5.98	0.37	10.63	0.15	34.586	0.47	24.5	8.09	97.0
	50 D	4.4	0.06	0.24	0.18	1.67	0.26	5.14	0.32	5.56	0.12	35.105	0.16	24.8	8.14	97.2
	100 S	0.1	0.06	0.23	0.04	1.50	0.28	6.62	0.34	6.89	0.12	35.123	0.10	24.9	8.15	95.8
	100 D	6.2	0.04	0.17	0.14	1.28	0.27	6.03	0.31	6.34	0.16	35.137	0.09	24.9	8.16	95.7
	150 S	0.1	0.05	0.19	0.12	1.23	0.31	5.75	0.36	6.06	0.08	35.086	0.08	24.9	8.15	95.4
	150 D	11.7	0.07	0.10	0.11	1.36	0.30	6.41	0.37	6.62	0.09	35.099	0.07	24.9	8.15	94.5
WAILEA 2	0 S	0.1	0.08	14.05	1.59	21.33	0.45	9.82	0.53	25.46	0.48	33.979	0.37	27.9	8.36	100.4
	2 S	0.1	0.13	11.68	0.60	18.88	0.29	5.47	0.42	17.75	0.24	34.171	0.16	26.3	8.23	99.4
	5 S	0.1	0.10	9.51	0.08	13.52	0.28	5.68	0.38	15.27	0.28	34.385	0.17	26.4	8.18	99.4
	5 D	1.0	0.11	3.27	0.29	5.33	0.28	6.12	0.39	9.68	0.24	34.862	0.33	26.2	8.15	101.9
	10 S	0.1	0.07	1.21	0.03	3.10	0.29	7.43	0.36	8.67	0.11	35.038	0.08	24.6	8.12	100.7
	10 D	2.0	0.13	0.28	0.05	1.81	0.30	6.19	0.43	6.52	0.12	35.092	0.13	24.7	8.14	99.4
	50 S	0.1	0.04	0.15	0.08	2.08	0.27	5.11	0.31	5.34	0.12	35.109	0.14	24.8	8.14	99.7
	50 D	4.9	0.08	0.16	0.32	1.48	0.30	4.72	0.38	5.20	0.12	35.125	0.10	24.8	8.15	97.4
	100 S	0.2	0.09	0.06	0.53	1.17	0.29	5.18	0.38	5.77	0.09	35.129	0.09	24.8	8.16	96.4
	100 D	8.7	0.08	0.04	0.13	1.19	0.30	5.41	0.38	5.58	0.13	35.117	0.21	24.9	8.16	97.3
	150 S	0.1	0.04	0.03	0.27	1.32	0.30	5.94	0.34	6.24	0.11	35.122	0.12	24.9	8.16	96.2
	150 D	14.4	0.06	0.01	1.03	1.20	0.29	5.18	0.35	6.22	0.12	35.148	0.08	24.9	8.17	96.4
WAILEA 3	0 S	0.1	0.28	23.61	0.86	47.14	0.34	5.78	0.62	30.25	1.40	31.599	1.28	27.3	8.17	100.4
	2 S	0.1	0.27	15.01	0.28	31.16	0.33	6.33	0.60	21.62	1.19	32.917	1.12	26.1	8.17	101.6
	5 S	0.1	0.17	13.78	0.19	29.79	0.36	7.36	0.53	21.33	0.86	33.065	1.83	26.1	8.17	101.5
	5 D	1.0	0.32	14.11	1.05	31.18	0.32	8.40	0.64	23.56	0.80	33.029	1.32	26.1	8.17	101.7
	10 S	0.1	0.15	5.58	0.37	12.91	0.28	6.72	0.43	12.67	0.46	34.288	0.80	26.1	8.17	98.7
	10 D	1.0	0.19	4.73	0.12	11.35	0.38	7.10	0.57	11.95	0.49	34.394	0.70	26.1	8.17	98.2
	50 S	0.1	0.09	3.31	0.14	8.89	0.27	5.95	0.36	9.40	0.17	34.675	0.14	24.6	8.12	98.4
	50 D	4.0	0.11	0.31	0.29	2.39	0.31	6.81	0.42	7.41	0.18	35.060	0.10	24.7	8.15	98.2
	100 S	0.1	0.10	0.71	BDL	2.93	0.31	6.12	0.41	6.83	0.17	35.034	0.09	24.6	8.14	99.3
	100 D	6.1	0.15	0.15	0.01	1.79	0.35	5.92	0.50	6.08	0.13	35.087	0.09	24.8	8.16	99.1
	150 S	0.1	0.13	0.20	0.13	1.70	0.37	7.17	0.50	7.50	0.11	35.093	0.37	24.8	8.16	97.5
	150 D	11.2	0.15	0.12	0.40	1.45	0.37	5.28	0.52	5.80	0.14	35.097	0.46	24.8	8.16	96.5
WAILEA 4	0 S	0.1	0.13	27.54	0.07	35.11	0.37	8.34	0.50	35.95	0.29	32.927	0.59	27.1	8.21	103.0
	2 S	0.1	0.06	23.93	0.06	31.83	0.31	6.99	0.37	30.98	0.20	33.236	0.30	26.9	8.22	100.2
	5 S	0.1	0.14	7.02	0.04	11.69	0.36	6.74	0.50	13.80	0.17	34.524	0.22	26.8	8.23	101.3
	5 D	1.0	0.09	2.18	0.01	4.94	0.30	6.14	0.39	8.33	0.20	34.915	0.19	26.5	8.20	100.4
	10 S	0.1	0.04	0.17	0.25	1.08	0.31	5.46	0.35	5.88	0.14	35.119	0.21	24.8	8.17	100.1
	10 D	1.0	0.11	0.22	0.04	1.37	0.39	6.32	0.50	6.58	0.10	35.145	0.07	24.8	8.16	99.3
	50 S	0.1	0.05	0.05	0.07	1.41	0.29	7.40	0.34	7.52	0.11	35.118	0.13	24.8	8.17	99.3
	50 D	5.2	0.06	0.06	0.12	1.38	0.31	6.86	0.37	7.04	0.08	35.144	0.13	24.9	8.17	99.1
	100 S	0.1	0.09	0.02	BDL	1.34	0.31	6.48	0.40	6.50	0.09	35.135	0.13	24.9	8.17	99.3
	100 D	9.8	0.11	0.06	0.08	1.28	0.39	5.64	0.50	5.78	0.10	35.123	0.09	24.9	8.17	98.3
	150 S	0.1	0.11	0.02	0.53	1.32	0.37	6.58	0.48	7.13	0.07	35.120	0.18	24.9	8.17	97.2
	150 D	12.3	0.04	BDL	BDL	1.35	0.31	5.40	0.35	5.40	0.09	35.145	0.09	24.8	8.17	96.9
WAILEA 5	0 S	0.1	0.35	15.74	1.11	85.87	0.32	4.89	0.67	21.74	0.54	30.748	0.26	26.8	8.20	100.4
	2 S	0.1	0.34	15.26	0.06	83.08	0.32	6.07	0.66	21.39	0.39	30.946	0.18	26.3	8.20	100.3
	5 S	0.1	0.29	11.05	0.10	62.68	0.32	6.22	0.61	17.37	0.26	32.041	0.20	25.7	8.19	101.2
	5 D	1.0	0.25	8.35	0.05	49.46	0.34	6.14	0.59	14.54	0.22	32.737	0.27	25.8	8.18	100.4
	10 S	0.1	0.12	0.79	0.38	7.56	0.28	4.55	0.40	5.72	0.16	34.906	0.09	25.3	8.10	99.2
	10 D	2.0	0.13	0.81	0.07	7.11	0.27	5.26	0.40	6.14	0.18	34.884	0.13	25.3	8.11	99.4
	50 S	0.1	0.13	3.60	0.18	16.60	0.29	5.56	0.42	9.34	0.15	34.407	0.12	24.7	8.12	97.2
	50 D	4.4	0.09	0.25	0.03	2.71	0.29	5.40	0.38	5.68	0.12	35.059	0.07	24.7	8.11	96.3
	100 S	0.1	0.08	0.12	0.07	1.86	0.29	5.77	0.37	5.96	0.15	35.063	0.07	24.7	8.13	95.5
	100 D	6.4	0.10	0.11	0.04	2.68	0.28	6.57	0.38	6.72	0.16	35.035	0.10	24.7	8.12	96.2
	150 S	0.1	0.09	0.12	0.06	2.31	0.28	5.73	0.37	5.91	0.10	35.049	0.08	24.7	8.14	95.9
	150 D	7.7	0.07	0.04	1.49	2.11	0.29	4.67	0.36	6.20	0.12	35.043	0.08	24.7	8.15	95.3
DOH WQS	DRY		10%	0.71	0.36				0.96	12.86	0.50	*	0.50	**	***	****
			2%	1.43	0.64				1.45	17.86	1.00		1.00			
	WET		10%	1.00	0.61				1.29	17.85	1.25	*	0.90	**	***	****
			2%	1.78	1.07				1.93	25.00	2.00		1.75			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.
****Dissolved Oxygen not to be below 75% saturation.

TABLE 2. Water chemistry measurements from ocean water samples (in μg/L) collected off the Honua'ula project site on March 6, 2011. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep, BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
WAILEA 1	0 S	0.1	35.00	2486	7.56	10204	6.50	141.2	41.50	2635	0.71	7.144	2.43	26.8	8.06	100.0
	2 S	0.1	26.33	1718	0.14	6264	5.58	93.6	31.90	1811	0.48	19.117	0.77	27.0	8.13	99.0
	5 S	0.1	11.46	730.0	2.24	2585	6.50	88.2	17.96	820.5	0.35	29.164	0.23	26.8	8.20	98.6
	5 D	1.0	6.19	286.6	1.40	1179	7.74	83.2	13.94	371.2	0.24	32.535	0.19	25.3	8.22	97.6
	10 S	0.1	5.27	239.8	1.54	968.9	7.74	82.2	13.01	323.5	0.14	32.986	0.13	25.5	8.20	97.5
	10 D	1.7	3.10	100.4	2.94	438.6	8.36	87.0	11.46	190.3	0.22	34.189	0.10	25.4	8.18	97.6
	50 S	0.1	3.10	63.03	2.10	255.4	8.36	83.8	11.46	148.9	0.15	34.586	0.47	24.5	8.09	97.0
	50 D	4.4	1.86	3.36	2.52	46.93	8.05	72.0	9.91	77.87	0.12	35.105	0.16	24.8	8.14	97.2
	100 S	0.1	1.86	3.22	0.56	42.15	8.67	92.7	10.53	96.50	0.12	35.123	0.10	24.9	8.15	95.8
	100 D	6.2	1.24	2.38	1.96	35.97	8.36	84.5	9.60	88.80	0.16	35.137	0.09	24.9	8.16	95.7
	150 S	0.1	1.55	2.66	1.68	34.56	9.60	80.5	11.15	84.88	0.08	35.086	0.08	24.9	8.15	95.4
	150 D	11.7	2.17	1.40	1.54	38.22	9.29	89.8	11.46	92.72	0.09	35.099	0.07	24.9	8.15	94.5
WAILEA 2	0 S	0.1	2.48	196.8	22.27	599.4	13.94	137.5	16.42	356.6	0.48	33.979	0.37	27.9	8.36	100.4
	2 S	0.1	4.03	163.6	8.40	530.5	8.98	76.6	13.01	248.6	0.24	34.171	0.16	26.3	8.23	99.4
	5 S	0.1	3.10	133.2	1.12	379.9	8.67	79.6	11.77	213.9	0.28	34.385	0.17	26.4	8.18	99.4
	5 D	1.0	3.41	45.80	4.06	149.8	8.67	85.7	12.08	135.6	0.24	34.862	0.33	26.2	8.15	101.9
	10 S	0.1	2.17	16.95	0.42	87.11	8.98	104.1	11.15	121.4	0.11	35.038	0.08	24.6	8.12	100.7
	10 D	2.0	4.03	3.92	0.70	50.86	9.29	86.7	13.32	91.32	0.12	35.092	0.13	24.7	8.14	99.4
	50 S	0.1	1.24	2.10	1.12	58.45	8.36	71.6	9.60	74.79	0.12	35.109	0.14	24.8	8.14	99.7
	50 D	4.9	2.48	2.24	4.48	41.59	9.29	66.1	11.77	72.83	0.12	35.125	0.10	24.8	8.15	97.4
	100 S	0.2	2.79	0.84	7.42	32.88	8.98	72.6	11.77	80.81	0.09	35.129	0.09	24.8	8.16	96.4
	100 D	8.7	2.48	0.56	1.82	33.44	9.29	75.8	11.77	78.15	0.13	35.117	0.21	24.9	8.16	97.3
	150 S	0.1	1.24	0.42	3.78	37.09	9.29	83.2	10.53	87.40	0.11	35.122	0.12	24.9	8.16	96.2
	150 D	14.4	1.86	0.14	14.43	33.72	8.98	72.6	10.84	87.12	0.12	35.148	0.08	24.9	8.17	96.4
WAILEA 3	0 S	0.1	8.67	330.7	12.05	1325	10.53	81.0	19.20	423.7	1.40	31.599	1.28	27.3	8.17	100.4
	2 S	0.1	8.36	210.2	3.92	875.6	10.22	88.7	18.58	302.8	1.19	32.917	1.12	26.1	8.17	101.6
	5 S	0.1	5.27	193.0	2.66	837.1	11.15	103.1	16.42	298.7	0.86	33.065	1.83	26.1	8.17	101.5
	5 D	1.0	9.91	197.6	14.71	876.2	9.91	117.7	19.82	330.0	0.80	33.029	1.32	26.1	8.17	101.7
	10 S	0.1	4.65	78.15	5.18	362.8	8.67	94.1	13.32	177.5	0.46	34.288	0.80	26.1	8.17	98.7
	10 D	1.0	5.88	66.25	1.68	318.9	11.77	99.4	17.65	167.4	0.49	34.394	0.70	26.1	8.17	98.2
	50 S	0.1	2.79	46.36	1.96	249.8	8.36	83.3	11.15	131.7	0.17	34.675	0.14	24.6	8.12	98.4
	50 D	4.0	3.41	4.34	4.06	67.16	9.60	95.4	13.01	103.8	0.18	35.060	0.10	24.7	8.15	98.2
	100 S	0.1	3.10	9.94	BDL	82.33	9.60	85.7	12.70	95.66	0.17	35.034	0.09	24.6	8.14	99.3
	100 D	6.1	4.65	2.10	0.14	50.30	10.84	82.9	15.49	85.16	0.13	35.087	0.09	24.8	8.16	99.1
	150 S	0.1	4.03	2.80	1.82	47.77	11.46	100.4	15.49	105.0	0.11	35.093	0.37	24.8	8.16	97.5
	150 D	11.2	4.65	1.68	5.60	40.75	11.46	74.0	16.11	81.23	0.14	35.097	0.46	24.8	8.16	96.5
WAILEA 4	0 S	0.1	4.03	385.7	0.98	986.6	11.46	116.8	15.49	503.5	0.29	32.927	0.59	27.1	8.21	103.0
	2 S	0.1	1.86	335.2	0.84	894.4	9.60	97.9	11.46	433.9	0.20	33.236	0.30	26.9	8.22	100.2
	5 S	0.1	4.34	98.32	0.56	328.5	11.15	94.4	15.49	193.3	0.17	34.524	0.22	26.8	8.23	101.3
	5 D	1.0	2.79	30.53	0.14	138.8	9.29	86.0	12.08	116.7	0.20	34.915	0.19	26.5	8.20	100.4
	10 S	0.1	1.24	2.38	3.50	30.35	9.60	76.5	10.84	82.36	0.14	35.119	0.21	24.8	8.17	100.1
	10 D	1.0	3.41	3.08	0.56	38.50	12.08	88.5	15.49	92.16	0.10	35.145	0.07	24.8	8.16	99.3
	50 S	0.1	1.55	0.70	0.98	39.62	8.98	103.6	10.53	105.3	0.11	35.118	0.13	24.8	8.17	99.3
	50 D	5.2	1.86	0.84	1.68	38.78	9.60	96.1	11.46	98.60	0.08	35.144	0.13	24.9	8.17	99.1
	100 S	0.1	2.79	0.28	BDL	37.65	9.60	90.8	12.39	91.04	0.09	35.135	0.13	24.9	8.17	99.3
	100 D	9.8	3.41	0.84	1.12	35.97	12.08	79.0	15.49	80.95	0.10	35.123	0.09	24.9	8.17	98.3
	150 S	0.1	3.41	0.28	7.42	37.09	11.46	92.2	14.87	99.86	0.07	35.120	0.18	24.9	8.17	97.2
	150 D	12.3	1.24	BDL	BDL	37.94	9.60	75.6	10.84	75.63	0.09	35.145	0.09	24.8	8.17	96.9
WAILEA 5	0 S	0.1	10.84	220.5	15.55	2412.9	9.91	68.5	20.75	304.5	0.54	30.748	0.26	26.8	8.20	100.4
	2 S	0.1	10.53	213.7	0.84	2334.5	9.91	85.0	20.44	299.6	0.39	30.946	0.18	26.3	8.20	100.3
	5 S	0.1	8.98	154.8	1.40	1761.3	9.91	87.1	18.89	243.3	0.26	32.041	0.20	25.7	8.19	101.2
	5 D	1.0	7.74	117.0	0.70	1389.8	10.53	86.0	18.27	203.6	0.22	32.737	0.27	25.8	8.18	100.4
	10 S	0.1	3.72	11.06	5.32	212.4	8.67	63.7	12.39	80.11	0.16	34.906	0.09	25.3	8.10	99.2
	10 D	2.0	4.03	11.34	0.98	199.8	8.36	73.7	12.39	86.00	0.18	34.884	0.13	25.3	8.11	99.4
	50 S	0.1	4.03	50.42	2.52	466.5	8.98	77.9	13.01	130.8	0.15	34.407	0.12	24.7	8.12	97.2
	50 D	4.4	2.79	3.50	0.42	76.15	8.98	75.6	11.77	79.55	0.12	35.059	0.07	24.7	8.11	96.3
	100 S	0.1	2.48	1.68	0.98	52.27	8.98	80.8	11.46	83.48	0.15	35.063	0.07	24.7	8.13	95.5
	100 D	6.4	3.10	1.54	0.56	75.31	8.67	92.0	11.77	94.12	0.16	35.035	0.10	24.7	8.12	96.2
	150 S	0.1	2.79	1.68	0.84	64.91	8.67	80.3	11.46	82.78	0.10	35.049	0.08	24.7	8.14	95.9
	150 D	7.7	2.17	0.56	20.87	59.29	8.98	65.4	11.15	86.84	0.12	35.043	0.08	24.7	8.15	95.3
DOH WQS		DRY	10%	10.00	5.00				30.00	180.0	0.50	*	0.50	**	***	****
			2%	20.00	9.00				45.00	250.0	1.00		1.00			
		WET	10%	14.00	8.50				40.00	250.0	1.25	*	0.90	**	***	****
			2%	25.00	15.00				60.00	350.0	2.00		1.75			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.
****Dissolved Oxygen not to be below 75% saturation.

TABLE 3. Geometric mean data from water chemistry measurements (in μM) collected at five sites off of Honua'ula, Wailea, Maui since the inception of monitoring in June 2005 (N=8). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO4 (µM)	NO3 (µM)	NH4 (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
WAILEA 1	0 S	1	0.23	70.49	0.33	127.7	0.28	7.16	0.60	84.53	0.24	19.005	1.04	26.11	8.11	104.93
	2 S	1	0.21	49.37	0.08	93.90	0.30	7.93	0.58	61.37	0.22	26.011	1.28	26.14	8.14	104.49
	5 S	1	0.08	18.17	0.05	38.95	0.28	8.22	0.41	29.54	0.19	31.248	0.46	25.89	8.13	103.64
	5 D	2.5	0.12	9.60	0.26	23.51	0.29	8.55	0.44	20.01	0.13	33.175	0.29	25.92	8.13	103.53
	10 S	1	0.08	7.31	0.17	18.35	0.28	7.95	0.38	17.33	0.17	33.620	0.29	26.00	8.12	105.56
	10 D	3	0.07	2.58	0.22	7.95	0.29	7.81	0.37	11.53	0.14	34.441	0.26	25.90	8.12	104.95
	50 S	1	0.06	3.42	0.27	9.42	0.30	8.11	0.36	13.25	0.14	34.295	0.30	25.77	8.12	101.46
	50 D	4.5	0.07	0.29	0.13	2.23	0.30	7.81	0.38	8.48	0.11	34.836	0.29	25.63	8.12	96.97
	100 S	1	0.07	2.26	0.19	7.03	0	7.68	0.38	12.07	0.12	34.374	0.20	25.90	8.13	98.59
	100 D	10	0.04	0.12	0.15	1.76	0.29	7.87	0.35	8.31	0.11	34.919	0.14	25.63	8.13	96.05
	150 S	1	0.05	0.70	0.25	3.22	0.31	8.79	0.38	10.60	0.16	34.721	0.16	25.95	8.12	96.89
	150 D	15	0.06	0.07	0.17	1.49	0.31	8.24	0.38	8.59	0.10	34.925	0.14	25.59	8.13	95.07
WAILEA 2	0 S	1	0.14	23.20	0.14	36.46	0.24	6.40	0.54	42.71	0.20	25.890	0.42	26.39	8.14	98.80
	2 S	1	0.17	15.13	0.18	24.78	0.28	7.04	0.52	28.54	0.18	31.432	0.40	26.15	8.14	100.11
	5 S	1	0.10	6.74	0.15	12.65	0.29	7.86	0.41	16.41	0.18	34.010	0.26	26.20	8.13	100.42
	5 D	2.5	0.12	3.71	0.20	7.86	0.29	7.86	0.43	12.28	0.17	34.527	0.31	26.14	8.14	100.88
	10 S	1	0.08	1.70	0.17	6.21	0.30	8.89	0.40	11.96	0.14	34.682	0.17	25.92	8.13	100.20
	10 D	3	0.06	1.04	0.16	3.66	0.30	7.35	0.38	9.00	0.13	34.795	0.26	25.94	8.13	100.18
	50 S	1	0.07	2.29	0.13	6.20	0.27	7.67	0.36	10.86	0.13	34.647	0.18	25.88	8.14	97.71
	50 D	4.5	0.09	0.14	0.28	1.81	0.28	7.03	0.39	7.69	0.12	34.945	0.20	25.67	8.14	94.16
	100 S	1	0.09	0.79	0.27	3.33	0.30	7.92	0.41	9.69	0.12	34.822	0.15	25.72	8.14	96.19
	100 D	10	0.07	0.05	0.18	1.43	0.30	7.05	0.38	7.39	0.12	34.968	0.18	25.65	8.15	95.03
	150 S	1	0.06	0.26	0.17	2.67	0.29	7.73	0.36	8.89	0.13	34.842	0.12	26.10	8.14	96.33
	150 D	15	0.06	0.04	0.25	1.40	0.29	7.82	0.36	8.31	0.10	34.992	0.14	25.64	8.15	94.90
WAILEA 3	0 S	1	0.14	9.39	0.44	25.49	0.32	8.27	0.49	21.98	0.30	31.704	0.62	26.41	8.15	99.21
	2 S	1	0.13	5.42	0.29	15.52	0.31	7.22	0.45	15.94	0.26	33.584	0.49	26.24	8.14	99.27
	5 S	1	0.09	3.24	0.24	10.22	0.31	7.19	0.41	11.94	0.20	34.218	0.42	26.44	8.14	99.25
	5 D	2.5	0.12	3.27	0.37	10.40	0.30	8.12	0.44	12.97	0.23	34.216	0.38	26.43	8.14	99.18
	10 S	1	0.11	3.67	0.28	11.96	0.28	7.12	0.41	13.02	0.17	33.985	0.26	26.43	8.13	98.11
	10 D	5	0.09	2.22	0.26	8.96	0.29	7.44	0.40	11.05	0.21	34.386	0.35	26.27	8.14	98.33
	50 S	1	0.11	0.97	0.39	5.30	0.32	8.44	0.45	10.86	0.15	34.700	0.26	25.85	8.14	97.41
	50 D	10	0.07	0.13	0.41	2.25	0.33	8.11	0.42	8.94	0.13	34.912	0.21	25.78	8.15	95.89
	100 S	1	0.07	0.79	0.21	4.37	0.31	8.02	0.39	9.67	0.16	34.740	0.20	25.96	8.14	97.25
	100 D	15	0.07	0.05	0.13	1.74	0.32	8.25	0.40	8.58	0.12	34.946	0.17	25.69	8.15	95.27
	150 S	1	0.07	0.33	0.28	2.74	0.31	7.51	0.39	8.64	0.14	34.865	0.16	25.96	8.14	94.81
	150 D	20	0.07	0.08	0.33	1.53	0.30	7.04	0.39	7.59	0.11	34.965	0.19	25.63	8.15	93.96
WAILEA 4	0 S	1	0.10	17.14	0.21	28.76	0.30	7.78	0.44	34.29	0.26	31.610	0.41	26.25	8.13	101.62
	2 S	1	0.07	11.63	0.17	20.52	0.32	8.33	0.42	26.95	0.22	32.885	0.49	26.43	8.15	101.05
	5 S	1	0.08	2.83	0.15	7.79	0.30	7.89	0.41	12.87	0.17	34.421	0.39	26.41	8.15	103.23
	5 D	2.5	0.08	2.12	0.12	6.48	0.30	8.25	0.39	12.03	0.17	34.522	0.29	26.41	8.15	100.80
	10 S	1	0.09	0.70	0.29	3.75	0.30	8.98	0.41	10.75	0.18	34.810	0.27	26.10	8.15	101.13
	10 D	3	0.11	0.45	0.16	3.10	0.31	7.54	0.45	8.74	0.14	34.874	0.22	26.07	8.14	100.51
	50 S	1	0.10	2.38	0.21	6.31	0.31	8.37	0.43	13.52	0.17	34.376	0.25	26.13	8.12	96.86
	50 D	10	0.08	0.15	0.17	2.14	0.27	8.35	0.39	8.98	0.11	34.942	0.21	25.41	8.14	93.52
	100 S	1	0.08	1.93	0.16	6.53	0.29	7.88	0.40	12.59	0.14	34.408	0.19	26.08	8.13	96.49
	100 D	15	0.09	0.09	0.16	1.72	0.33	8.10	0.44	8.61	0.10	34.967	0.15	25.68	8.14	94.81
	150 S	1	0.07	0.31	0.15	2.84	0.33	7.50	0.42	8.67	0.10	34.856	0.14	26.18	8.14	95.21
	150 D	25	0.06	0.03	0.07	1.56	0.33	7.15	0.40	7.43	0.10	34.953	0.16	25.61	8.15	95.13
WAILEA 5	0 S	1	0.23	17.09	0.57	81.67	0.30	5.37	0.63	30.06	0.30	28.274	0.59	25.63	8.10	96.85
	2 S	1	0.18	14.19	0.58	66.96	0.26	6.13	0.59	26.53	0.29	29.441	0.41	25.76	8.10	97.99
	5 S	1	0.15	6.22	0.48	36.57	0.30	8.32	0.49	16.44	0.21	32.854	0.39	25.70	8.11	99.65
	5 D	1.5	0.07	4.26	0.28	26.01	0.30	8.04	0.43	13.07	0.16	33.579	0.37	25.72	8.12	99.98
	10 S	1	0.06	1.50	0.37	10.88	0.29	7.60	0.37	9.61	0.14	34.486	0.19	25.70	8.10	98.95
	10 D	2.5	0.11	1.47	0.32	10.74	0.28	6.84	0.40	8.87	0.14	34.531	0.30	25.59	8.10	97.38
	50 S	1	0.09	1.12	0.31	8.72	0.30	7.36	0.40	9.26	0.15	34.569	0.19	25.44	8.12	94.61
	50 D	9	0.07	0.12	0.19	3.16	0.30	6.93	0.39	7.42	0.13	34.891	0.26	25.43	8.11	93.92
	100 S	1	0.10	0.40	0.22	5.91	0.30	6.97	0.42	8.06	0.15	34.671	0.15	25.63	8.11	95.20
	100 D	14	0.06	0.09	0.16	2.74	0.29	6.95	0.37	7.52	0.15	34.877	0.18	25.51	8.13	94.18
	150 S	1	0.07	0.22	0.23	3.13	0.29	7.24	0.39	8.09	0.11	34.834	0.13	25.65	8.13	95.44
	150 D	18	0.06	0.04	0.24	2.00	0.30	6.98	0.38	7.59	0.12	34.930	0.15	25.54	8.14	94.65
DOH WQS GEOMETRIC MEAN		DRY		0.25	0.14				0.52	7.86	0.20	*	0.15	**	***	
		WET		0.36	0.25				0.64	10.71	0.50		0.30			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 5. Water chemistry measurements in µM and µg/L (shaded) from irrigation wells and an irrigation lake (Res) collected at the Wailea Golf Courses in the vicinity of the Honua'ula project site on February 11, 2009. For sampling site locations, see Figure 1.

WELLS	PO4 (µM)	PO4 (µg/L)	NO3 (µM)	NO3 (µg/L)	NH4 (µM)	NH4 (µg/L)	Si (µM)	Si (µg/L)	TOP (µM)	TOP (µg/L)	TON (µM)	TON (µg/L)	TP (µM)	TP (µg/L)	TN (µM)	TN (µg/L)	SALINITY (ppt)
2	2.00	62.00	225.6	3159	0.00	0.00	524.2	14729	0.16	4.96	9.36	131.0	2.16	66.96	235.0	3290	1.48
5	2.16	66.96	337.6	4727	1.96	27.44	513.1	14418	0.08	2.48	2.40	33.6	2.24	69.44	342.0	4788	1.78
6	2.00	62.00	158.7	2222	1.96	27.44	516.6	14515	0.16	4.96	33.48	468.7	2.16	66.96	194.2	2718	1.27
7	2.32	71.92	257.6	3606	1.60	22.40	511.6	14375	0.16	4.96	4.40	61.6	2.48	76.88	263.6	3690	1.89
8	1.96	60.76	170.2	2383	2.48	34.72	495.2	13915	0.36	11.16	24.08	337.1	2.32	71.92	196.8	2755	2.13
9	1.84	57.04	142.0	1987	0.60	8.40	482.5	13559	0.60	18.60	72.94	1021.2	2.44	75.64	215.5	3017	1.84
10	2.00	62.00	218.9	3065	0.64	8.96	479.3	13469	0.44	13.64	17.28	241.9	2.44	75.64	236.8	3316	1.58
Res	0.44	13.64	145.3	2034	4.48	62.72	301.8	8482	1.36	42.16	53.56	749.8	1.80	55.80	203.3	2846	1.98

TABLE 4. Geometric mean data from water chemistry measurements (in µg/L) collected at five sites off of Honua'ula, Wailea, Maui since the inception of monitoring in June 2005 (N=8). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
WAILEA 1	0 S	1	7.12	987.3	4.62	3586	8.67	100.3	18.58	1184	0.24	19.01	1.04	26.11	8.11	104.93
	2 S	1	6.50	691.5	1.12	2638	9.29	111.1	17.96	859.5	0.22	26.01	1.28	26.14	8.14	104.49
	5 S	1	2.47	254.5	0.70	1094	8.67	115.1	12.69	413.7	0.19	31.25	0.46	25.89	8.13	103.64
	5 D	2.5	3.71	134.5	3.64	660.4	8.98	119.8	13.62	280.3	0.13	33.18	0.29	25.92	8.13	103.53
	10 S	1	2.47	102.4	2.38	515.5	8.67	111.3	11.76	242.7	0.17	33.62	0.29	26.00	8.12	105.56
	10 D	3	2.16	36.13	3.08	223.3	8.98	109.4	11.46	161.5	0.14	34.44	0.26	25.90	8.12	104.95
	50 S	1	1.85	47.90	3.78	264.6	9.29	113.6	11.15	185.6	0.14	34.30	0.30	25.77	8.12	101.46
	50 D	4.5	2.16	4.06	1.82	62.64	9.29	109.4	11.76	118.8	0.11	34.84	0.29	25.63	8.12	96.97
	100 S	1	2.16	31.65	2.66	197.5	5.88	107.6	11.76	169.1	0.12	34.37	0.20	25.90	8.13	98.59
	100 D	10	1.23	1.68	2.10	49.44	8.98	110.2	10.84	116.4	0.11	34.92	0.14	25.63	8.13	96.05
	150 S	1	1.54	9.80	3.50	90.45	9.60	123.1	11.76	148.5	0.16	34.72	0.16	25.95	8.12	96.89
	150 D	15	1.85	0.98	2.38	41.85	9.60	115.4	11.76	120.3	0.10	34.93	0.14	25.59	8.13	95.07
WAILEA 2	0 S	1	4.33	324.9	1.96	1024	7.43	89.63	16.72	598.2	0.20	25.89	0.42	26.39	8.14	98.80
	2 S	1	5.26	211.9	2.52	696.1	8.67	98.60	16.10	399.7	0.18	31.43	0.40	26.15	8.14	100.11
	5 S	1	3.09	94.40	2.10	355.3	8.98	110.1	12.69	229.8	0.18	34.01	0.26	26.20	8.13	100.42
	5 D	2.5	3.71	51.96	2.80	220.8	8.98	110.1	13.31	172.0	0.17	34.53	0.31	26.14	8.14	100.88
	10 S	1	2.47	23.81	2.38	174.4	9.29	124.5	12.38	167.5	0.14	34.68	0.17	25.92	8.13	100.20
	10 D	3	1.85	14.56	2.24	102.8	9.29	102.9	11.76	126.1	0.13	34.80	0.26	25.94	8.13	100.18
	50 S	1	2.16	32.07	1.82	174.2	8.36	107.4	11.15	152.1	0.13	34.65	0.18	25.88	8.14	97.71
	50 D	4.5	2.78	1.96	3.92	50.84	8.67	98.46	12.07	107.7	0.12	34.95	0.20	25.67	8.14	94.16
	100 S	1	2.78	11.06	3.78	93.54	9.29	110.9	12.69	135.7	0.12	34.82	0.15	25.72	8.14	96.19
	100 D	10	2.16	0.70	2.52	40.17	9.29	98.74	11.76	103.5	0.12	34.97	0.18	25.65	8.15	95.03
	150 S	1	1.85	3.64	2.38	75.00	8.98	108.3	11.15	124.5	0.13	34.84	0.12	26.10	8.14	96.33
	150 D	15	1.85	0.56	3.50	39.33	8.98	109.5	11.15	116.4	0.10	34.99	0.14	25.64	8.15	94.90
WAILEA 3	0 S	1	4.33	131.5	6.16	716.0	9.91	115.8	15.17	307.9	0.30	31.70	0.62	26.41	8.15	99.21
	2 S	1	4.02	75.91	4.06	436.0	9.60	101.1	13.93	223.3	0.26	33.58	0.49	26.24	8.14	99.27
	5 S	1	2.78	45.37	3.36	287.1	9.60	100.7	12.69	167.2	0.20	34.22	0.42	26.44	8.14	99.25
	5 D	2.5	3.71	45.79	5.18	292.1	9.29	113.7	13.62	181.7	0.23	34.22	0.38	26.43	8.14	99.18
	10 S	1	3.40	51.40	3.92	336.0	8.67	99.72	12.69	182.4	0.17	33.99	0.26	26.43	8.13	98.11
	10 D	5	2.78	31.09	3.64	251.7	8.98	104.2	12.38	154.8	0.21	34.39	0.35	26.27	8.14	98.33
	50 S	1	3.40	13.58	5.46	148.9	9.91	118.2	13.93	152.1	0.15	34.70	0.26	25.85	8.14	97.41
	50 D	10	2.16	1.82	5.74	63.20	10.22	113.6	13.00	125.2	0.13	34.91	0.21	25.78	8.15	95.89
	100 S	1	2.16	11.06	2.94	122.8	9.60	112.3	12.07	135.4	0.16	34.74	0.20	25.96	8.14	97.25
	100 D	15	2.16	0.70	1.82	48.88	9.91	115.5	12.38	120.2	0.12	34.95	0.17	25.69	8.15	95.27
	150 S	1	2.16	4.62	3.92	76.97	9.60	105.2	12.07	121.0	0.14	34.87	0.16	25.96	8.14	94.81
	150 D	20	2.16	1.12	4.62	42.98	9.29	98.60	12.07	106.3	0.11	34.97	0.19	25.63	8.15	93.96
WAILEA 4	0 S	1	3.09	240.1	2.94	807.9	9.29	109.0	13.62	480.3	0.26	31.61	0.41	26.25	8.13	101.62
	2 S	1	2.16	162.9	2.38	576.4	9.91	116.7	13.00	377.5	0.22	32.89	0.49	26.43	8.15	101.05
	5 S	1	2.47	39.63	2.10	218.8	9.29	110.5	12.69	180.3	0.17	34.42	0.39	26.41	8.15	103.23
	5 D	2.5	2.47	29.69	1.68	182.0	9.29	115.5	12.07	168.5	0.17	34.52	0.29	26.41	8.15	100.80
	10 S	1	2.78	9.80	4.06	105.3	9.29	125.8	12.69	150.6	0.18	34.81	0.27	26.10	8.15	101.13
	10 D	3	3.40	6.30	2.24	87.08	9.60	105.6	13.93	122.4	0.14	34.87	0.22	26.07	8.14	100.51
	50 S	1	3.09	33.33	2.94	177.2	9.60	117.2	13.31	189.4	0.17	34.38	0.25	26.13	8.12	96.86
	50 D	10	2.47	2.10	2.38	60.11	8.36	117.0	12.07	125.8	0.11	34.94	0.21	25.41	8.14	93.52
	100 S	1	2.47	27.03	2.24	183.4	8.98	110.4	12.38	176.3	0.14	34.41	0.19	26.08	8.13	96.49
	100 D	15	2.78	1.26	2.24	48.31	10.22	113.4	13.62	120.6	0.10	34.97	0.15	25.68	8.14	94.81
	150 S	1	2.16	4.34	2.10	79.78	10.22	105.0	13.00	121.4	0.10	34.86	0.14	26.18	8.14	95.21
	150 D	25	1.85	0.42	0.98	43.82	10.22	100.1	12.38	104.1	0.10	34.95	0.16	25.61	8.15	95.13
WAILEA 5	0 S	1	7.12	239.4	7.98	2294	9.29	75.21	19.51	421.0	0.30	28.27	0.59	25.63	8.10	96.85
	2 S	1	5.57	198.7	8.12	1881	8.05	85.85	18.27	371.6	0.29	29.44	0.41	25.76	8.10	97.99
	5 S	1	4.64	87.11	6.72	1027	9.29	116.5	15.17	230.3	0.21	32.85	0.39	25.70	8.11	99.65
	5 D	1.5	2.16	59.66	3.92	730.6	9.29	112.6	13.31	183.1	0.16	33.58	0.37	25.72	8.12	99.98
	10 S	1	1.85	21.00	5.18	305.6	8.98	106.4	11.46	134.6	0.14	34.49	0.19	25.70	8.10	98.95
	10 D	2.5	3.40	20.58	4.48	301.7	8.67	95.80	12.38	124.2	0.14	34.53	0.30	25.59	8.10	97.38
	50 S	1	2.78	15.68	4.34	244.9	9.29	103.1	12.38	129.7	0.15	34.57	0.19	25.44	8.12	94.61
	50 D	9	2.16	1.68	2.66	88.76	9.29	97.06	12.07	103.9	0.13	34.89	0.26	25.43	8.11	93.92
	100 S	1	3.09	5.60	3.08	166.0	9.29	97.62	13.00	112.9	0.15	34.67	0.15	25.63	8.11	95.20
	100 D	14	1.85	1.26	2.24	76.97	8.98	97.34	11.46	105.3	0.15	34.88	0.18	25.51	8.13	94.18
	150 S	1	2.16	3.08	3.22	87.92	8.98	101.4	12.07	113.3	0.11	34.83	0.13	25.65	8.13	95.44
	150 D	18	1.85	0.56	3.36	56.18	9.29	97.76	11.76	106.3	0.12	34.93	0.15	25.54	8.14	94.65
DOH WQS GEOMETRIC MEAN		DRY		3.50	2.00				16.00	110.00	0.20	*	0.15	**	***	
		WET		5.00	3.50				20.00	150.00	0.50		0.30			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.

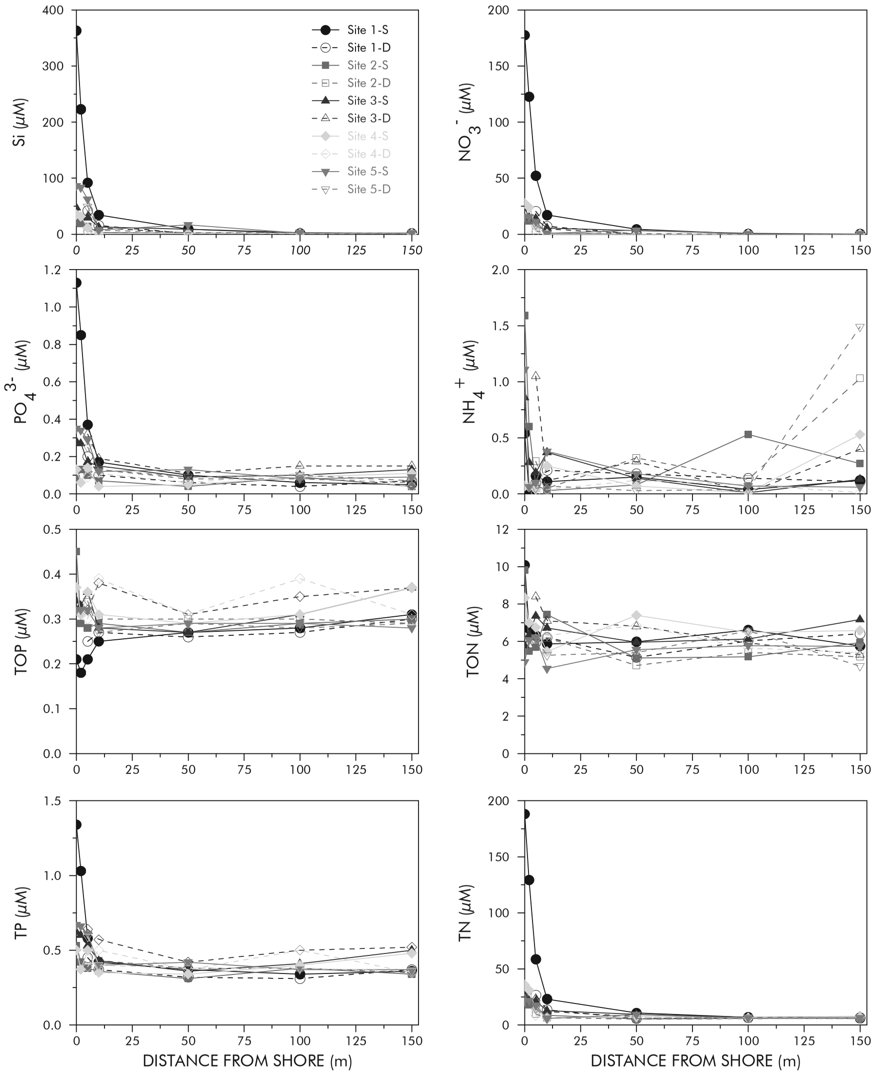

FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on March 6, 2011 as a function of distance from the shoreline offshore of Honua`ula, Wailea, Maui. For site locations, see Figure 1.

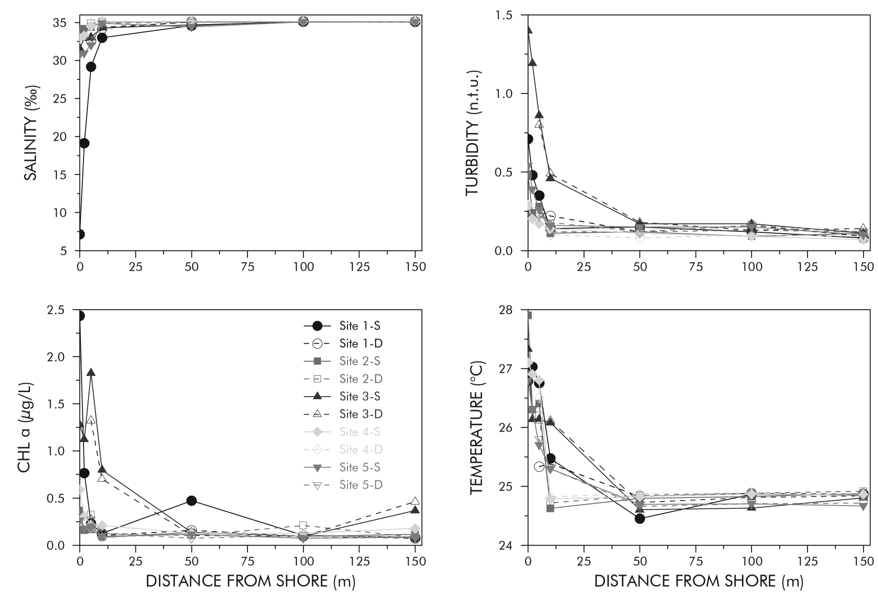

FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on March 6, 2011 as a function of distance from the shoreline offshore of Honua`ula, Wailea, Maui. For site locations, see Figure 1.

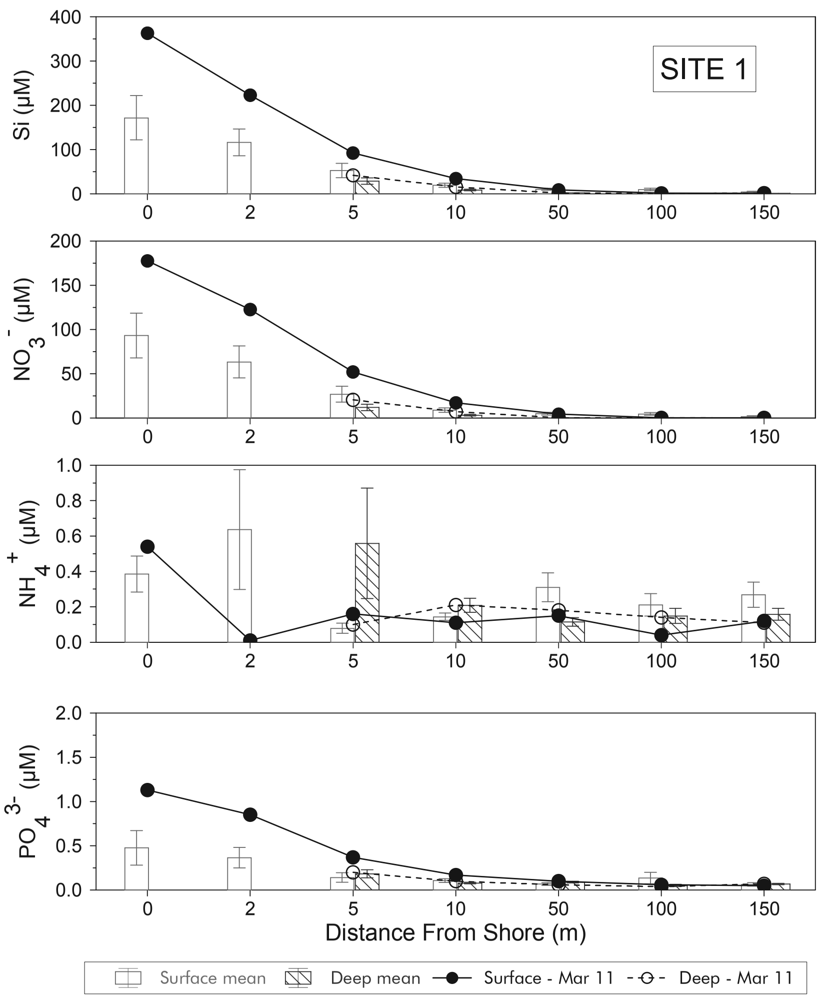

FIGURE 4. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 1, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

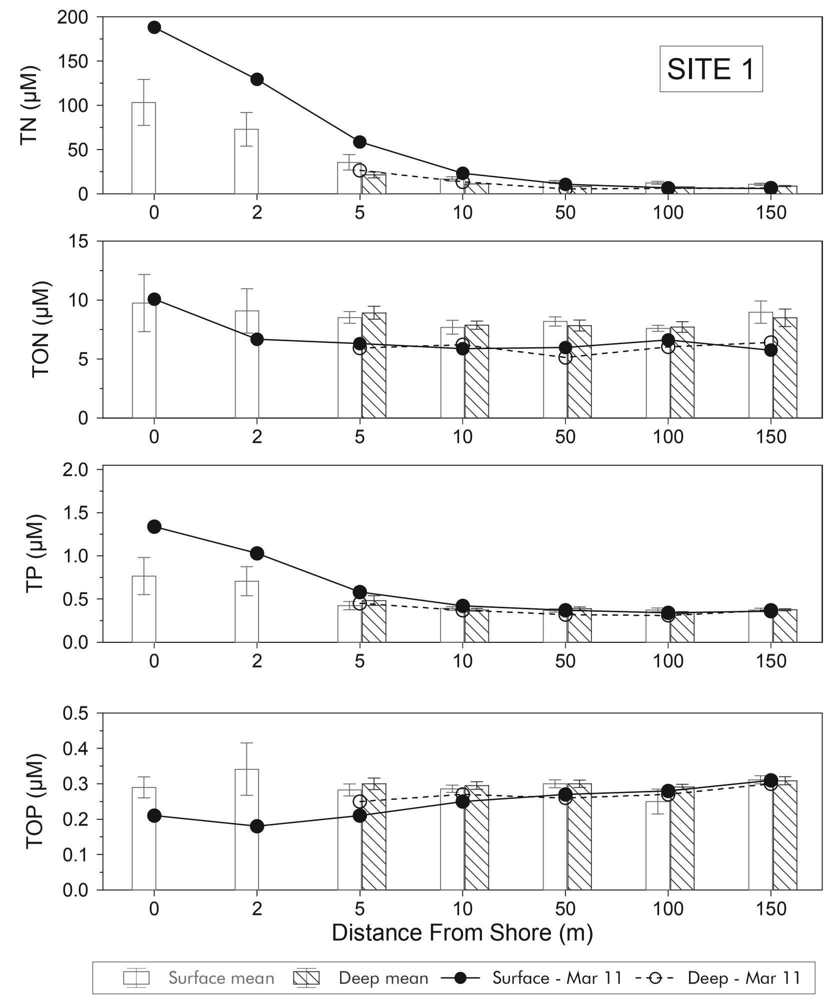

FIGURE 5. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 1, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

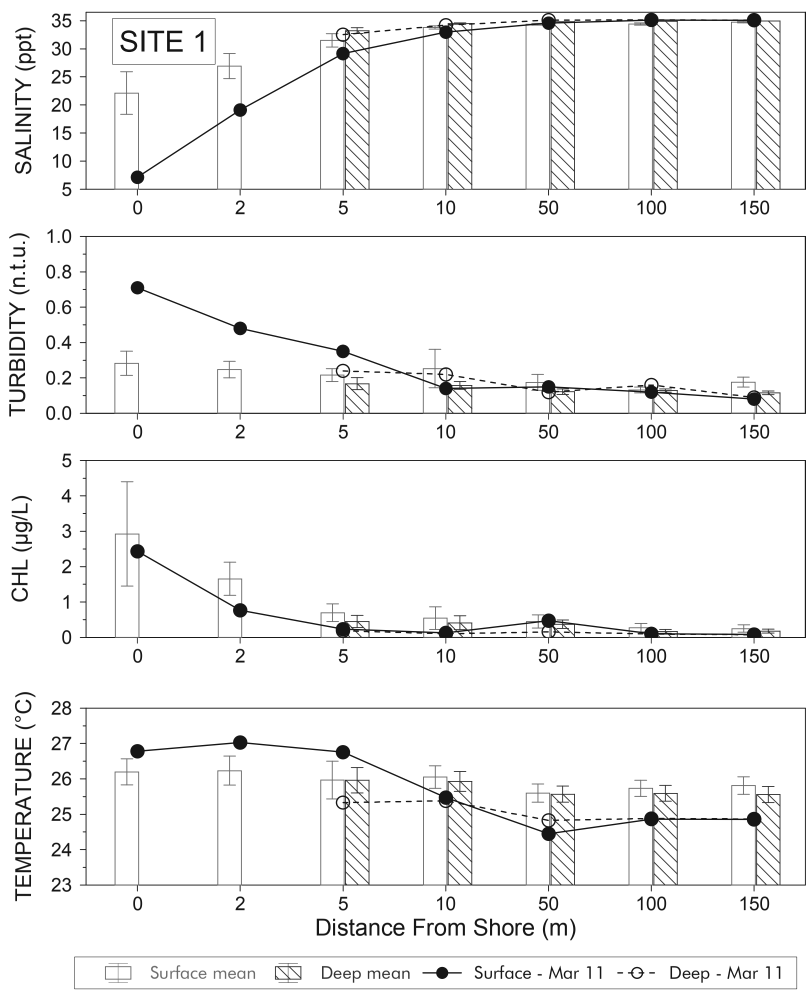

FIGURE 6. Plots of water quality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 1, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

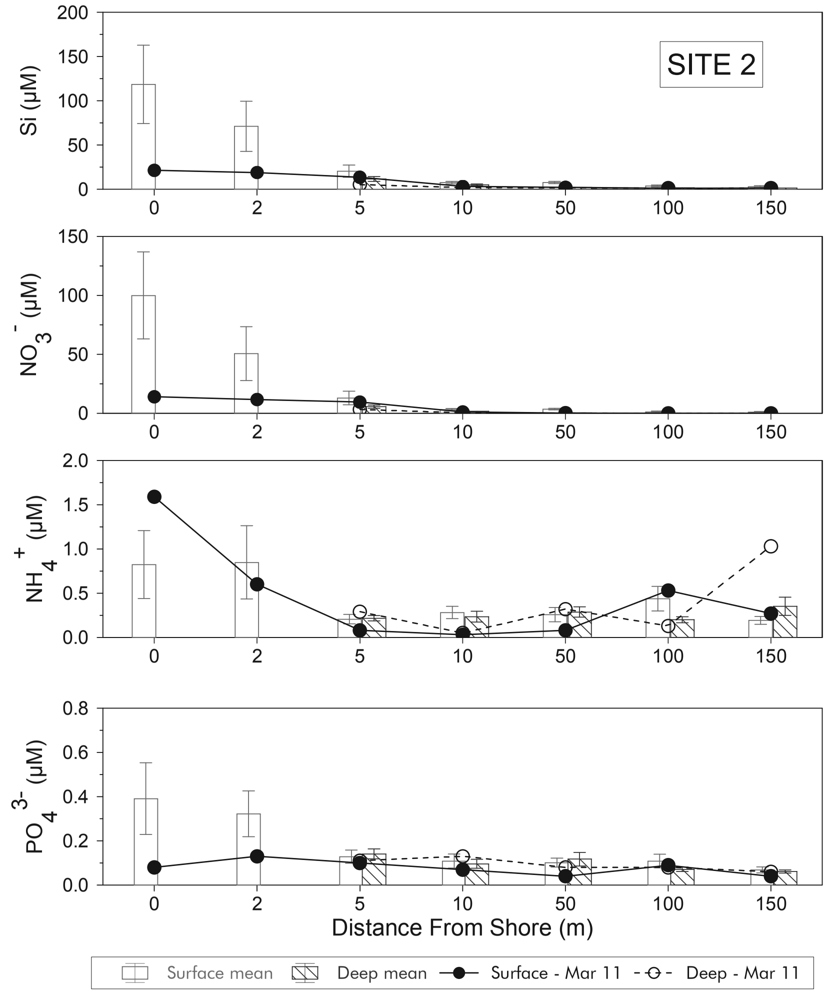

FIGURE 7. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 2, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

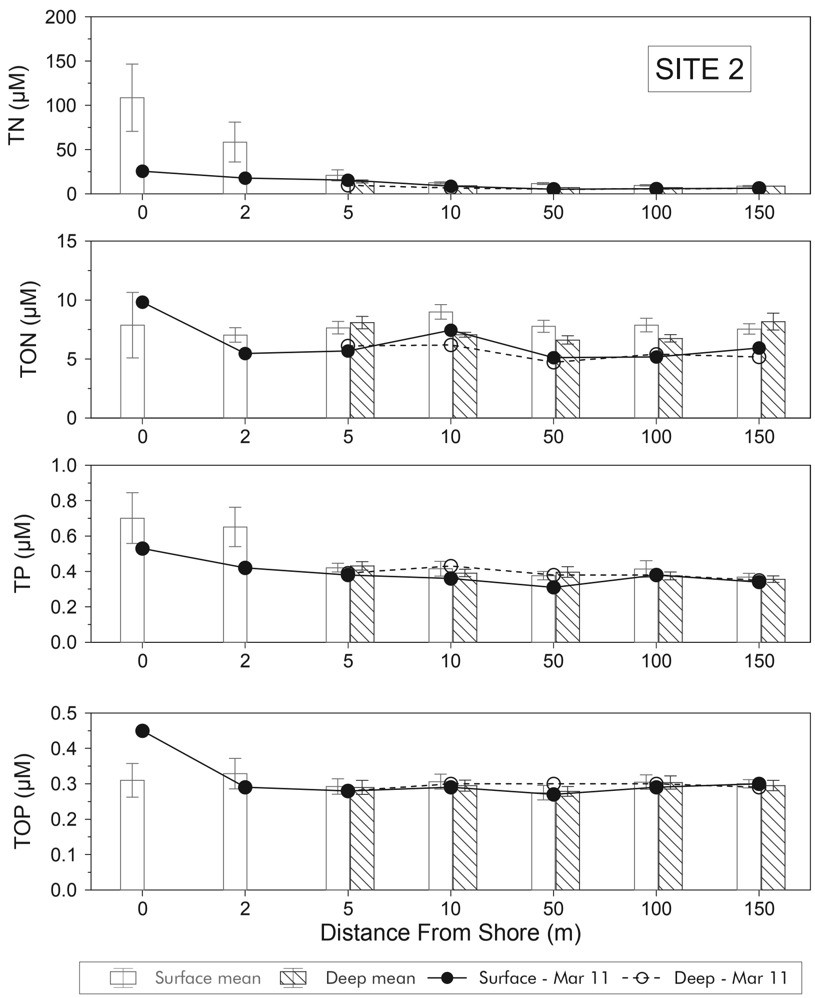

FIGURE 8. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 2, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

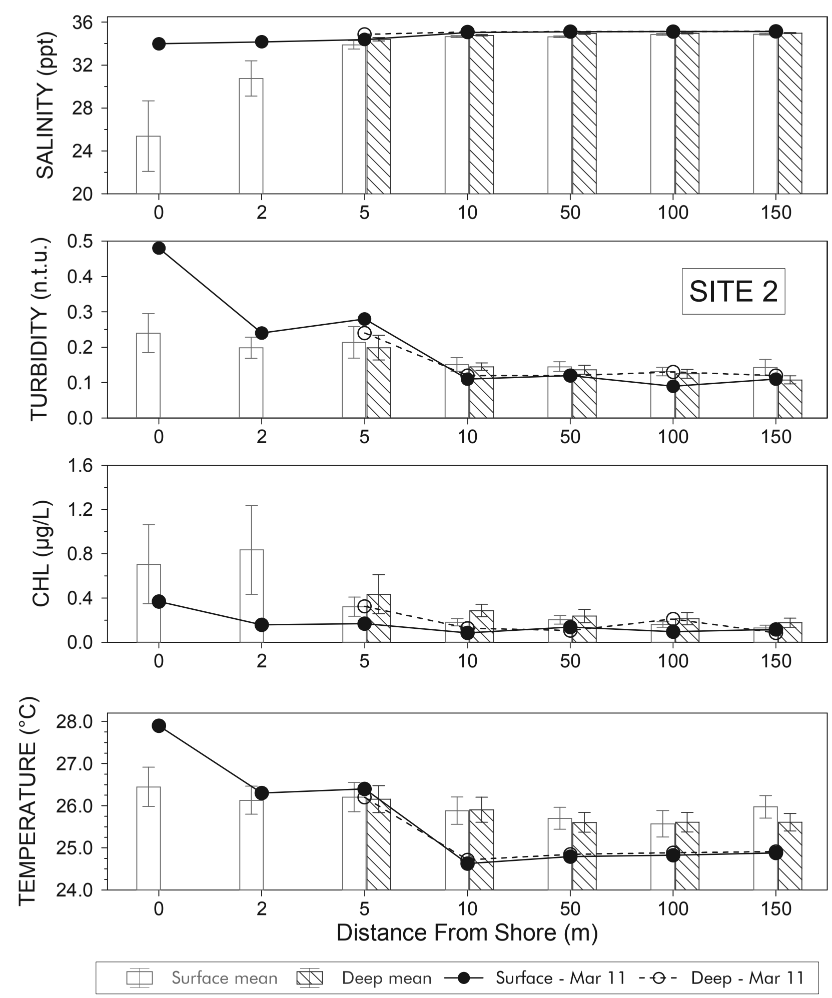

FIGURE 9. Plots of water quality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 2, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

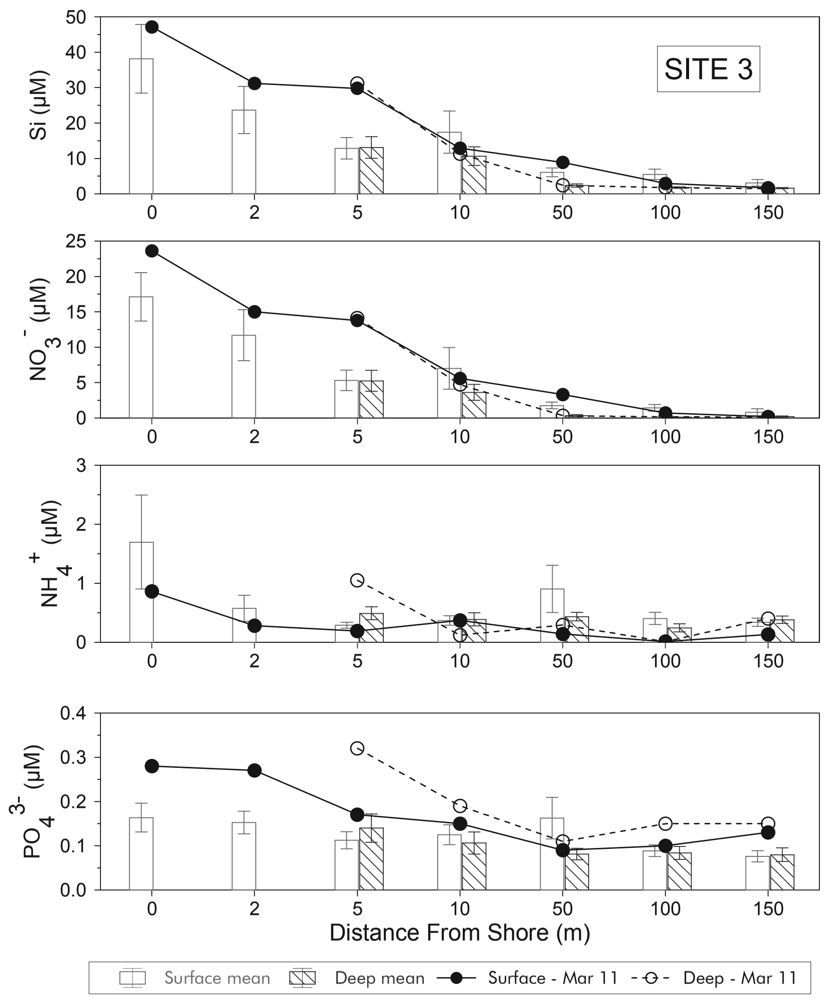

FIGURE 10. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 3, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

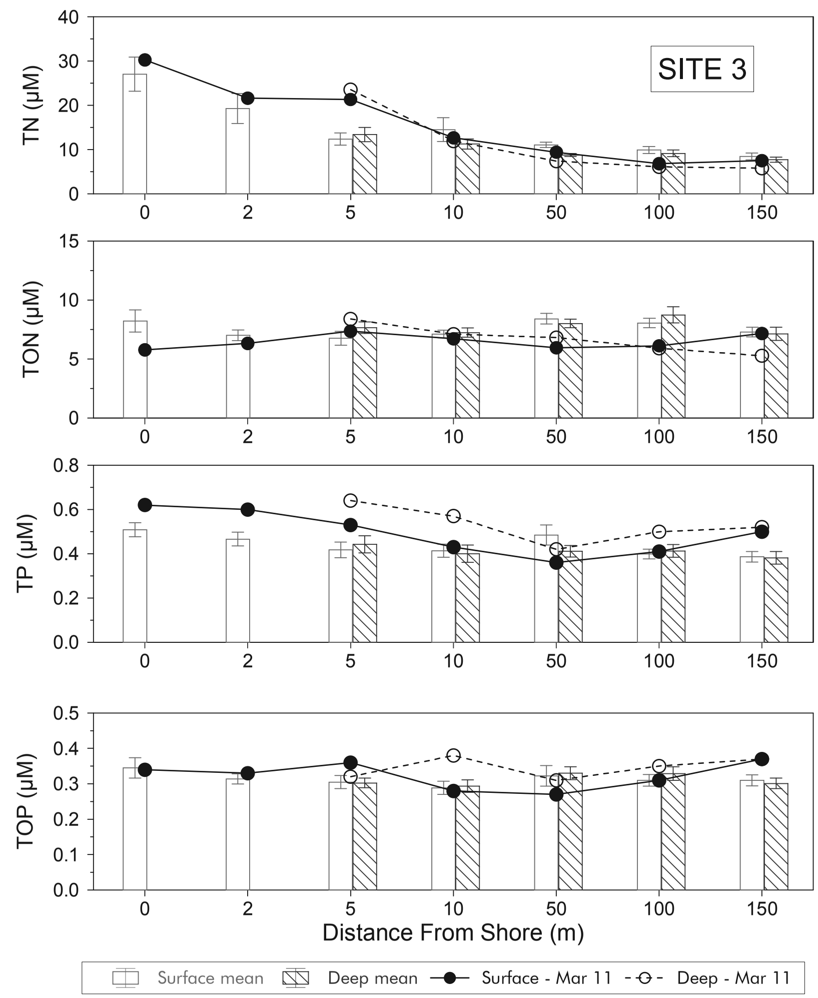

FIGURE 11. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 3, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

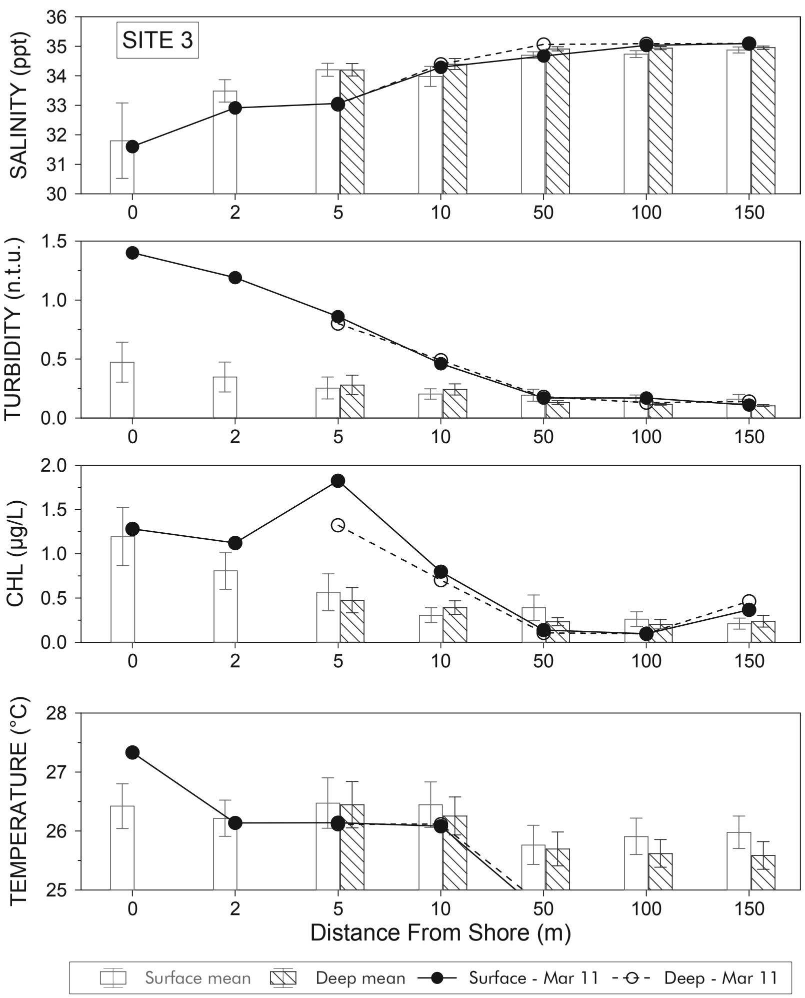

FIGURE 12. Plots of water quality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 3, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

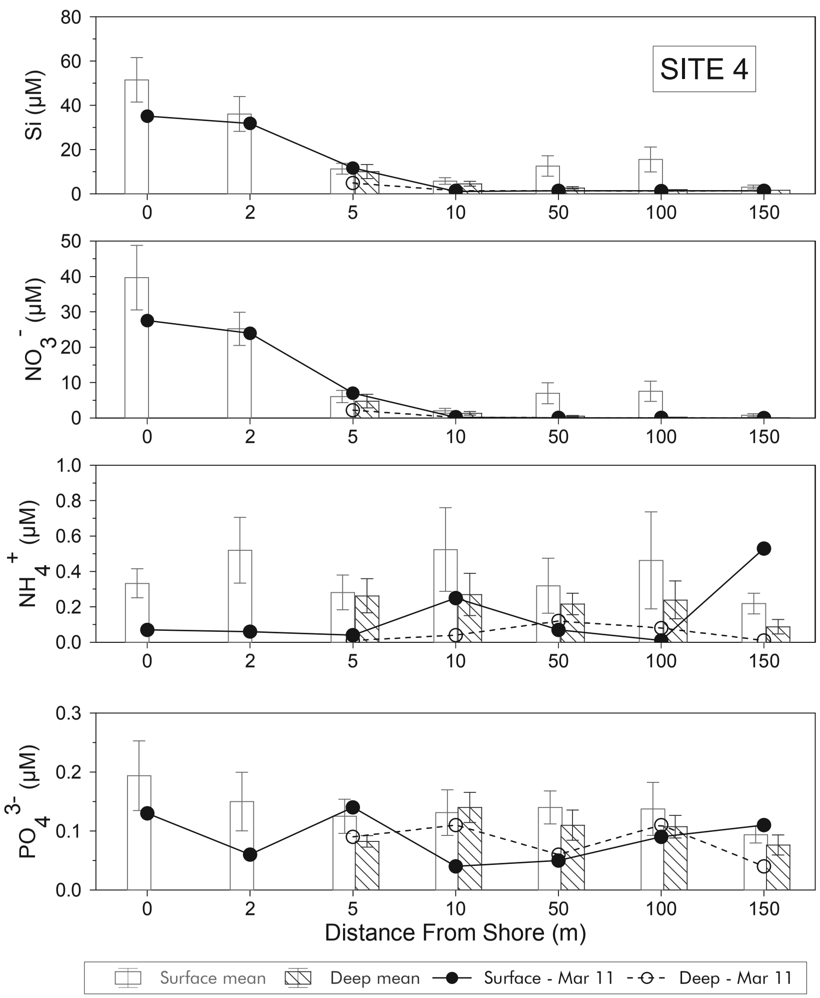

FIGURE 13. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 4, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

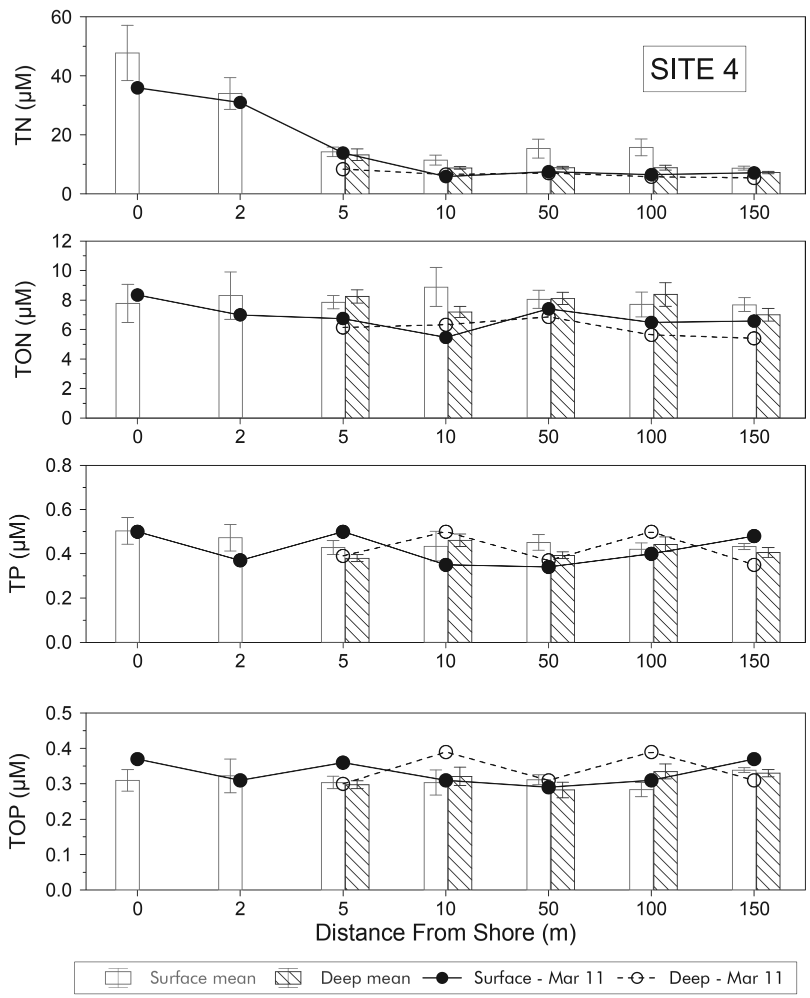

FIGURE 14. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 4, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

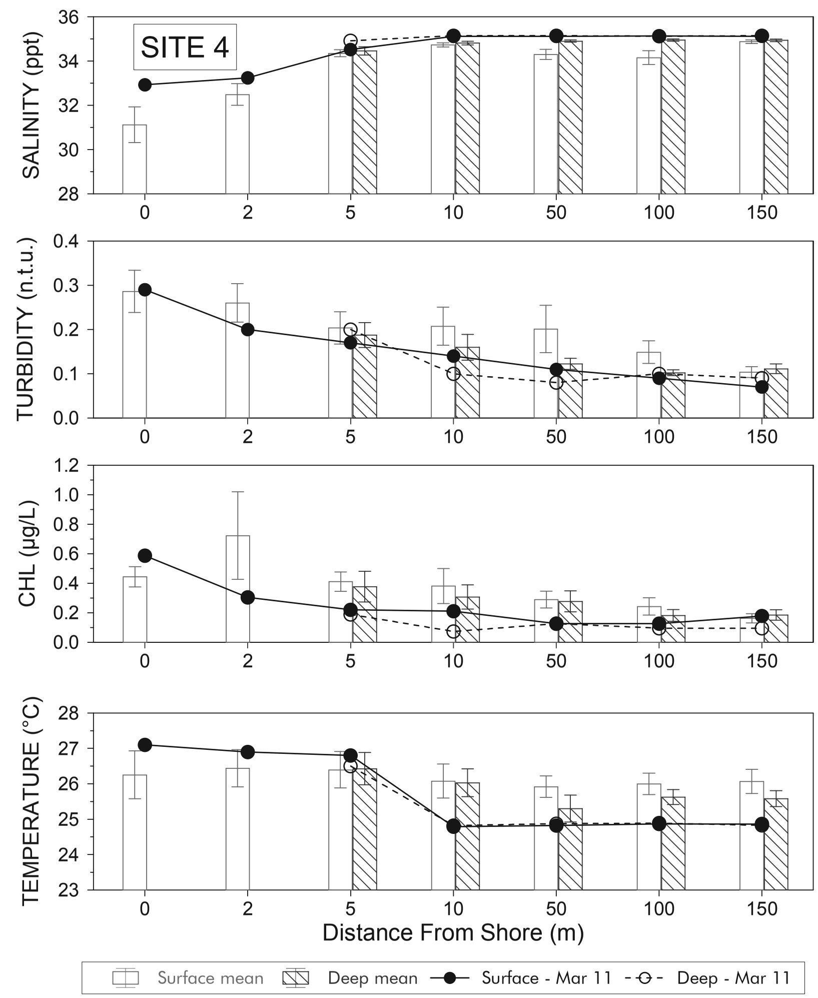

FIGURE 15. Plots of water quality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 4, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

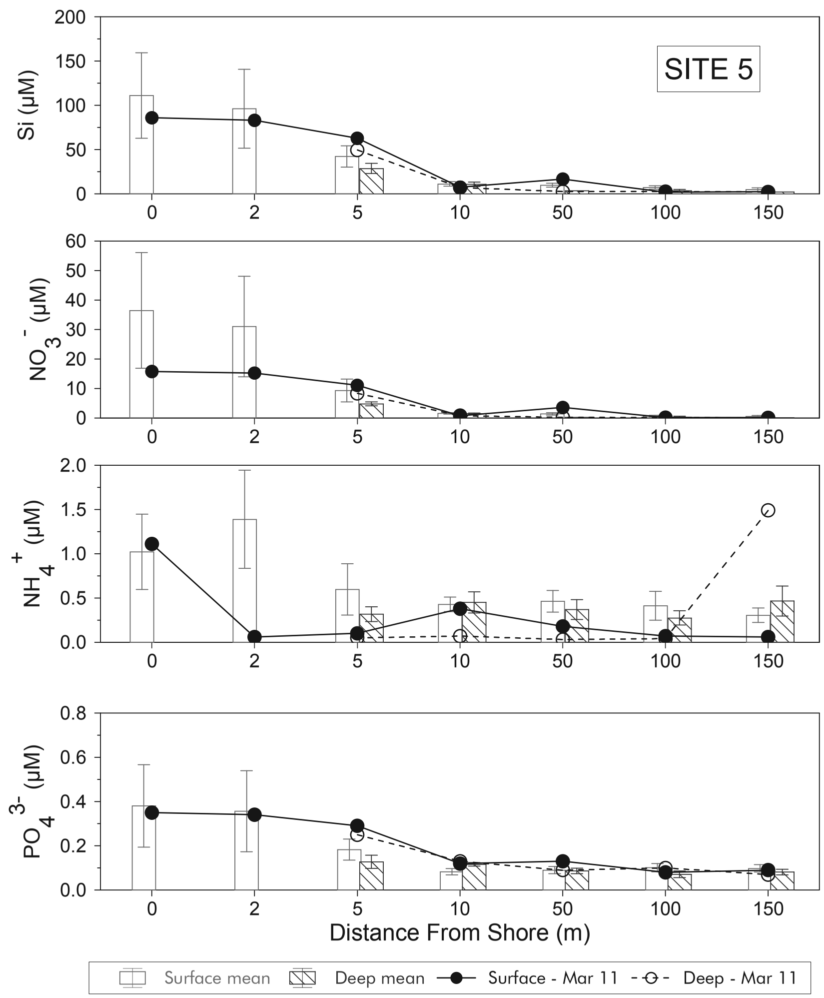

FIGURE 16. Plots of dissolved nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 5, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

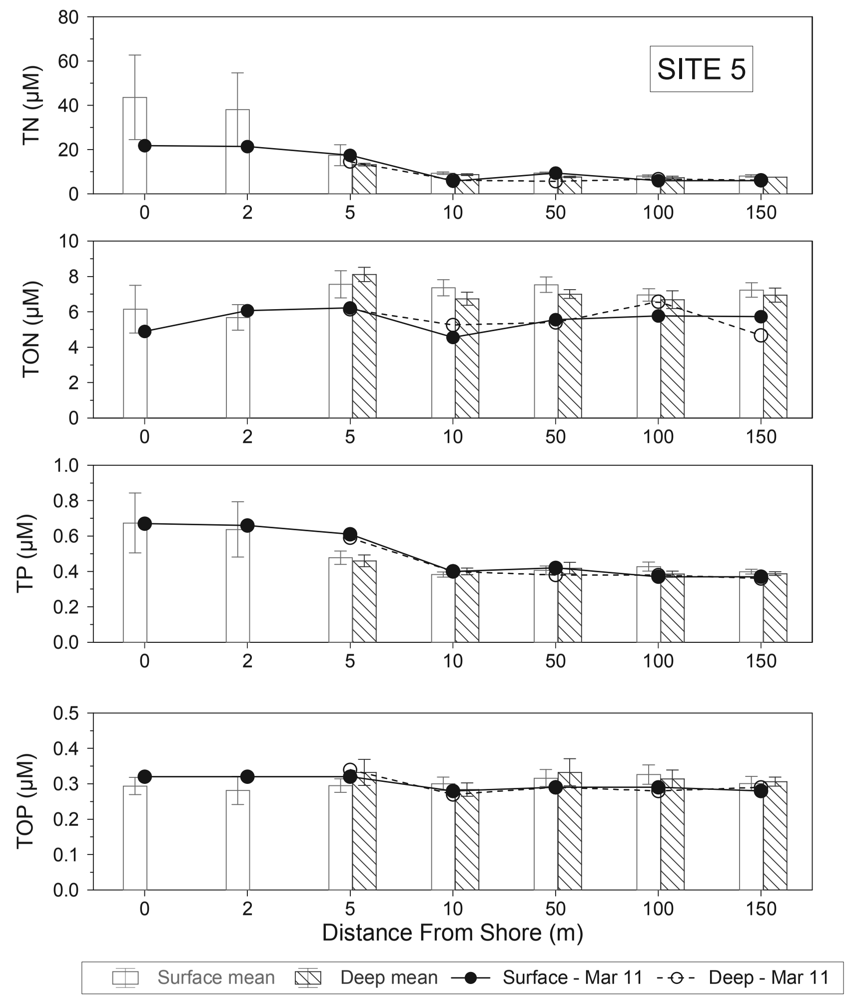

FIGURE 17. Plots of total and organic nutrients measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 5, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

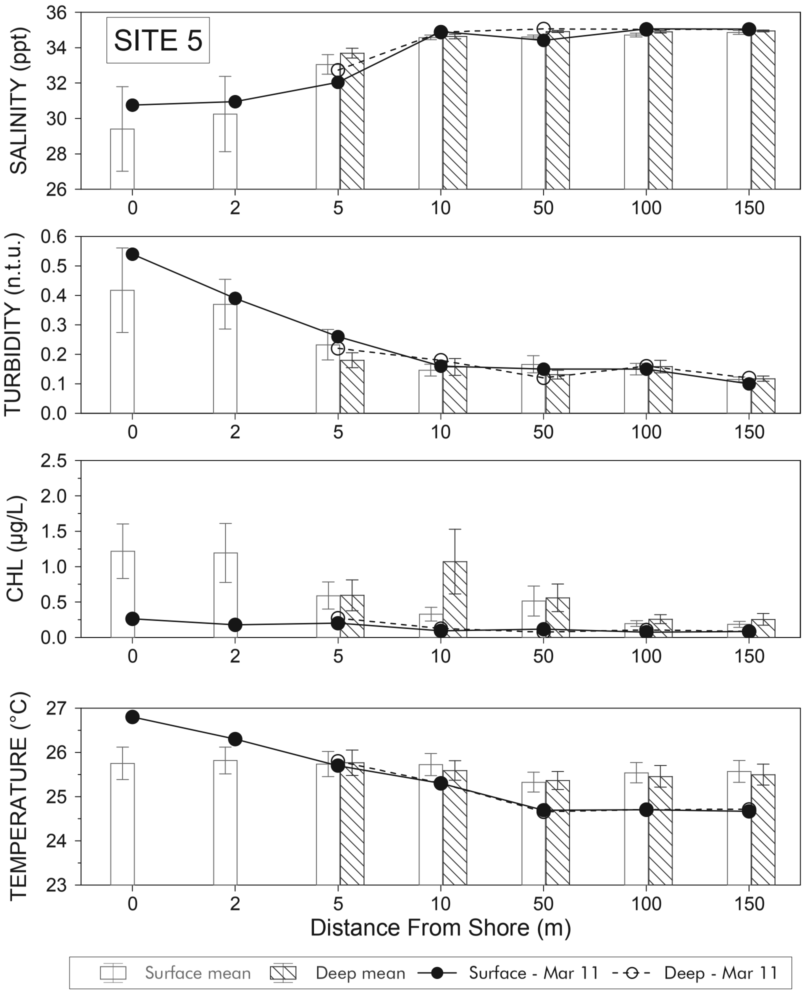

FIGURE 18. Plots of water quality constituents measured in surface and deep water samples as a function of distance from the shoreline at Transect Site 5, offshore of Honua`ula, Wailea, Maui. Data points with connecting lines are from samples collected during the most recent survey. Bar graphs represent mean values at each sampling station for all surveys conducted since June 2005 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

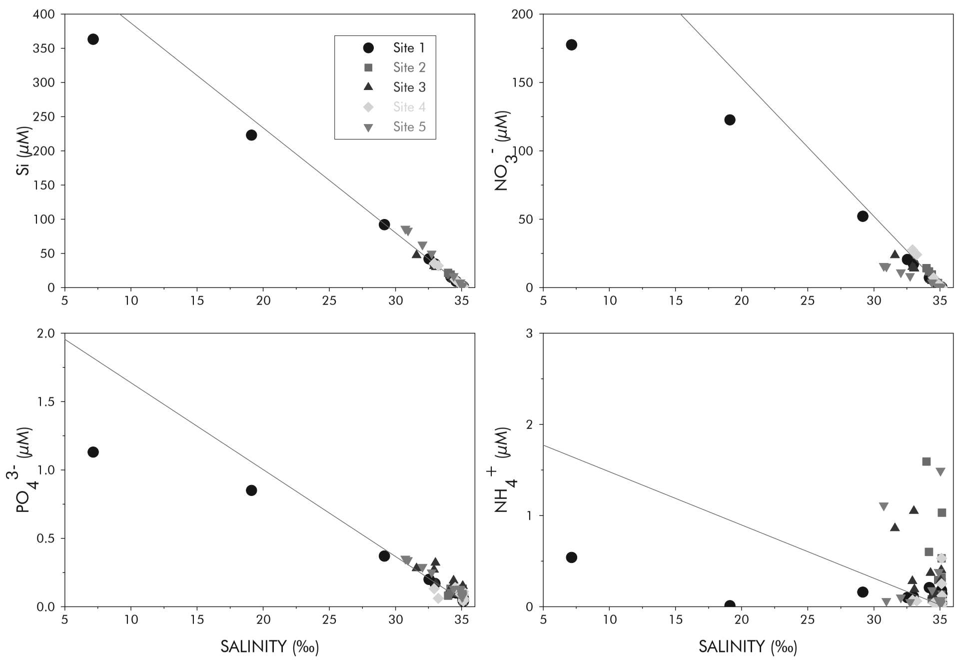

FIGURE 19. Mixing diagram showing concentration of dissolved nutrients from samples collected at five transect sites offshore of the Honua`ula project site in Wailea, Maui on March 6, 2011 as functions of salinity. Straight line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from a golf course irrigation well. For transect site locations, see Figure 1.

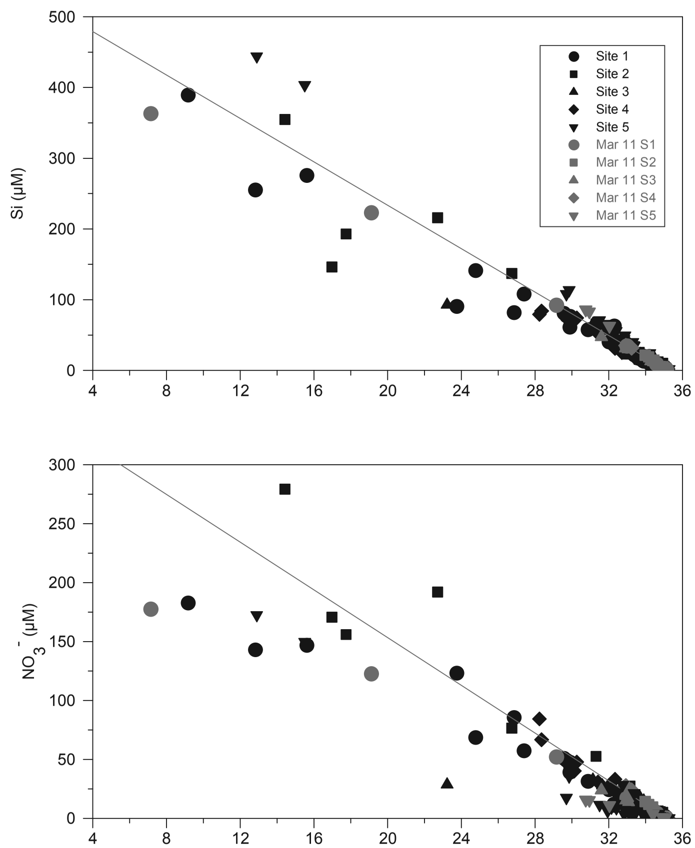

FIGURE 20. Silicate and nitrate, plotted as a function of salinity for surface samples collected since June 2005 at five sites offshore of Honua`ula, Wailea, Maui. Black symbols represent data from surveys conducted between June 2005 and July 2010 (N=7). Red symbols are data from the most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from a golf course irrigation well. For sampling site locations, see Figure 1.

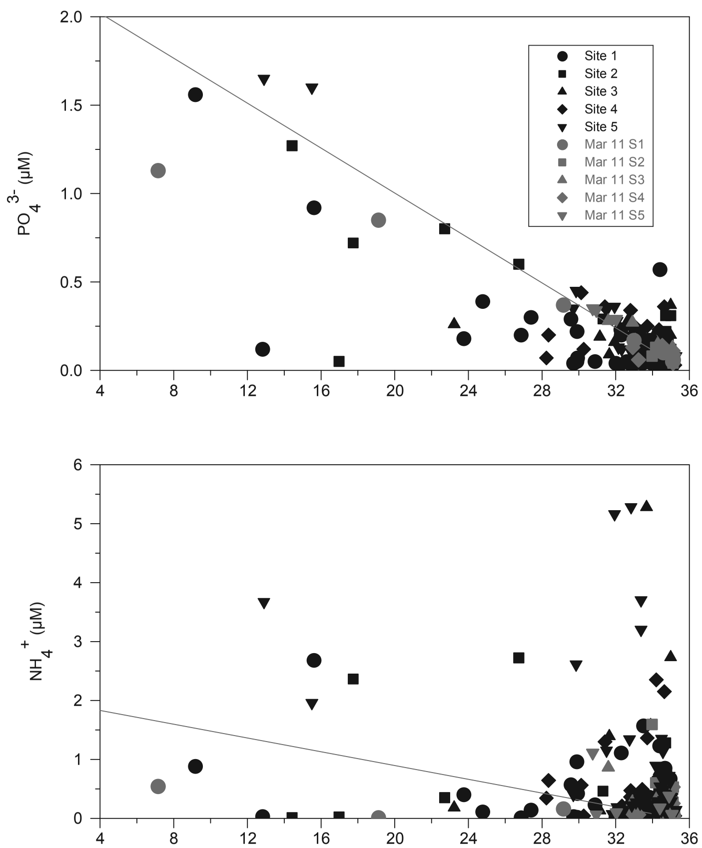

FIGURE 21. Phosphate and ammonium, plotted as a function of salinity for surface samples collected since June 2005 at five sites offshore of Honua`ula, Wailea, Maui. Black symbols represent data from surveys conducted between June 2005 and July 2010 (N=7). Red symbols are data from the most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from a golf course irrigation well. For sampling site locations, see Figure 1.

TABLE 6. Linear regression statistics (y-intercept and slope) of surface concentrations of silica as functions of salinity from five ocean transect sites in the vicinity of Honua'ula collected during monitoring surveys from June 2005 to March 2011. Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes."REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. Surveys were conducted once per year between 2005-2008 and 2010 (N=7), twice per year in 2009 (N=14) and once, to date for 2011 (N=7). For location of transect sites, see Figure 1.

SILICA -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	497.88	3.56	488.73	507.03
2006	539.75	3.21	531.50	548.00
2007	301.46	37.05	206.21	396.70
2008	441.78	21.87	385.57	497.98
2009	410.31	16.55	374.24	446.38
2010	515.27	7.85	495.09	535.45
2011	463.22	8.04	442.56	483.88
REGSLOPE	-1.57	16.55	-44.13	40.98
SITE 2				
2005	448.61	94.10	206.72	690.51
2006	445.83	27.79	374.40	517.26
2007	605.37	2.41	599.18	611.55
2008	736.44	124.97	415.20	1057.68
2009	348.37	26.00	291.71	405.03
2010	708.83	11.33	679.71	737.94
2011	615.32	15.57	575.29	655.35
REGSLOPE	27.47	27.71	-43.76	98.69
SITE 3				
2005	471.10	29.51	395.24	546.97
2006	521.67	9.12	498.22	545.12
2007	264.62	10.69	237.14	292.10
2008	389.25	28.52	315.95	462.55
2009	580.96	11.67	555.53	606.39
2010	467.31	18.09	420.82	513.81
2011	458.52	8.49	436.69	480.36
REGSLOPE	6.07	20.72	-47.21	59.34
SITE 4				
2005	539.62	153.92	143.97	935.28
2006	415.26	8.33	393.86	436.66
2007	388.49	16.11	347.07	429.90
2008	310.16	38.90	210.18	410.15
2009	476.61	535.93	441.76	545.61
2010	471.84	27.13	402.11	541.57
2011	553.16	9.59	528.52	577.81
REGSLOPE	8.64	17.38	-36.05	53.33
SITE 5				
2005	736.03	2.23	730.30	741.75
2006	711.37	7.83	691.25	731.48
2007	712.08	6.64	695.02	729.15
2008	739.31	9.75	714.26	764.36
2009	648.43	51.18	536.92	759.94
2010	673.09	6.27	656.98	689.21
2011	683.29	8.16	662.30	704.27
REGSLOPE	-10.66	5.07	-23.69	2.38

SILICA - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	-14.29	0.11	-14.57	-14.02
2006	-15.51	0.10	-15.76	-15.25
2007	-8.33	1.18	-11.37	-5.29
2008	-12.59	0.66	-14.29	-10.90
2009	-11.42	0.51	-12.53	-10.31
2010	-14.78	0.28	-15.49	-14.06
2011	-13.03	0.27	-13.74	-12.33
REGSLOPE	0.08	0.50	-1.21	1.37
SITE 2				
2005	-12.84	2.72	-19.84	-5.85
2006	-12.76	0.81	-14.83	-10.68
2007	-17.27	0.08	-17.47	-17.07
2008	-21.03	3.60	-30.28	-11.77
2009	-9.71	0.81	-11.47	-7.94
2010	-20.26	0.33	-21.10	-19.41
2011	-17.48	0.45	-18.63	-16.32
REGSLOPE	-0.76	0.81	-2.83	1.31
SITE 3				
2005	-13.49	0.86	-15.69	-11.29
2006	-14.95	0.27	-15.65	-14.26
2007	-7.39	0.32	-8.22	-6.56
2008	-11.04	0.82	-13.14	-8.93
2009	-16.51	0.34	-17.26	-15.77
2010	-13.32	0.53	-14.67	-11.97
2011	-12.99	0.25	-13.64	-12.35
REGSLOPE	-0.16	0.60	-1.71	1.39
SITE 4				
2005	-15.47	4.45	-26.91	-4.04
2006	-11.88	0.24	-12.51	-11.25
2007	-10.93	0.48	-12.17	-9.69
2008	-8.77	1.11	-11.63	-5.90
2009	-13.50	0.81	-15.26	-11.73
2010	-13.45	0.82	-15.55	-11.34
2011	-15.71	0.28	-16.42	-14.99
REGSLOPE	-0.23	0.50	-1.53	1.07
SITE 5				
2005	-21.13	0.07	-21.30	-20.96
2006	-20.28	0.23	-20.87	-19.68
2007	-20.28	0.23	-20.86	-19.70
2008	-21.16	0.29	-21.90	-20.42
2009	-18.42	1.50	-21.68	-15.16
2010	-19.14	0.19	-19.62	-18.66
2011	-19.40	0.24	-20.03	-18.77
REGSLOPE	0.33	0.15	-0.06	0.73

TABLE 8. Linear regression statistics (y-intercept and slope) of surface concentrations of orthophosphate phosphorus as functions of salinity from five ocean transect sites in the vicinity of Honua'ula collected during monitoring surveys from June 2005 to March 2011. Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes."REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. Surveys were conducted once per year between 2005-2008 and 2010 (N=7), twice per year in 2009 (N=14) and once, to date for 2011 (N=7). For location of transect sites, see Figure 1.

PHOSPHATE -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	0.09	0.09	-0.13	0.32
2006	1.19	0.13	0.85	1.53
2007	0.31	0.20	-0.21	0.82
2008	0.04	0.01	0.03	0.06
2009	0.27	0.13	-0.01	0.56
2010	1.80	0.27	1.11	2.50
2011	1.49	0.08	1.29	1.70
REGSLOPE	0.19	0.12	-0.13	0.51
SITE 2				
2005	1.09	1.19	-1.98	4.16
2006	-0.78	2.81	-7.99	6.44
2007	2.08	0.03	2.00	2.16
2008	-0.56	13.34	-34.85	33.73
2009	0.78	0.26	0.21	1.34
2010	1.08	1.88	-3.75	5.92
2011	1.54	0.74	-0.37	3.45
REGSLOPE	27.47	27.71	-43.76	98.69
SITE 3				
2005	1.28	1.92	-3.67	6.22
2006	2.69	0.12	2.38	3.01
2007	0.57	0.11	0.28	0.86
2008	-0.45	4.30	-11.49	10.60
2009	0.58	0.60	-0.73	1.88
2010	1.12	0.91	-1.22	3.45
2011	1.96	0.38	0.99	2.92
REGSLOPE	6.07	20.72	-47.21	59.34
SITE 4				
2005	-2.26	7.50	-21.53	17.02
2006	0.71	1.29	-2.62	4.03
2007	0.12	0.57	-1.35	1.58
2008	-0.79	4.43	-12.18	10.61
2009	2.31	0.63	0.93	3.69
2010	0.65	0.18	0.19	1.12
2011	0.50	0.61	-1.05	2.06
REGSLOPE	8.64	17.38	-36.05	53.33
SITE 5				
2005	1.92	0.67	0.18	3.65
2006	2.33	0.26	1.65	3.01
2007	2.66	0.08	2.46	2.86
2008	2.85	1.24	-0.34	6.04
2009	-0.08	0.32	-0.77	0.61
2010	0.76	0.47	-0.46	1.97
2011	2.23	0.08	2.01	2.44
REGSLOPE	-10.66	5.07	-23.69	2.38

PHOSPHATE - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	0.00	0.00	-0.01	0.01
2006	-0.03	0.00	-0.04	-0.02
2007	-0.01	0.01	-0.02	0.01
2008	0.00	0.00	0.00	0.00
2009	-0.01	0.00	-0.01	0.00
2010	-0.05	0.01	-0.07	-0.02
2011	-0.04	0.00	-0.05	-0.03
REGSLOPE	0.08	0.50	-1.21	1.37
SITE 2				
2005	-0.03	0.03	-0.12	0.06
2006	0.03	0.08	-0.18	0.24
2007	-0.06	0.00	-0.06	-0.05
2008	0.02	0.38	-0.97	1.01
2009	-0.02	0.01	-0.04	0.00
2010	-0.03	0.05	-0.17	0.11
2011	-0.04	0.02	-0.10	0.01
REGSLOPE	-0.76	0.81	-2.83	1.31
SITE 3				
2005	-0.04	0.06	-0.18	0.11
2006	-0.07	0.00	-0.08	-0.06
2007	-0.01	0.00	-0.02	0.00
2008	0.02	0.12	-0.30	0.33
2009	-0.01	0.02	-0.05	0.02
2010	-0.03	0.03	-0.10	0.04
2011	-0.05	0.01	-0.08	-0.02
REGSLOPE	-0.16	0.60	-1.71	1.39
SITE 4				
2005	0.07	0.22	-0.49	0.62
2006	-0.02	0.04	-0.11	0.08
2007	0.00	0.02	-0.04	0.04
2008	0.02	0.13	-0.30	0.35
2009	-0.06	0.02	-0.11	-0.02
2010	-0.02	0.01	-0.03	0.00
2011	-0.01	0.02	-0.06	0.03
REGSLOPE	-0.23	0.50	-1.53	1.07
SITE 5				
2005	-0.05	0.02	-0.10	0.00
2006	-0.06	0.01	-0.08	-0.04
2007	-0.07	0.00	-0.08	-0.07
2008	-0.08	0.04	-0.17	0.01
2009	0.00	0.01	-0.02	0.02
2010	-0.02	0.01	-0.06	0.02
2011	-0.06	0.00	-0.07	-0.05
REGSLOPE	0.33	0.15	-0.06	0.73

TABLE 7. Linear regression statistics (y-intercept and slope) of surface concentrations of nitrate as functions of salinity from five ocean transect sites in the vicinity of Honua'ula collected during monitoring surveys from June 2005 to March 2011. Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. "REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. Surveys were conducted once per year between 2005-2008 and 2010 (N=7), twice per year in 2009 (N=14) and once, to date for 2011 (N=7). For location of transect sites, see Figure 1.

NITRATE -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	317.11	3.22	308.84	325.38
2006	342.14	4.13	331.53	352.76
2007	382.01	8.64	359.80	404.22
2008	279.63	6.14	263.85	295.42
2009	227.71	6.24	214.11	241.31
2010	253.63	4.57	241.88	265.38
2011	233.77	10.13	207.74	259.81
REGSLOPE	-20.76	7.71	-40.58	-0.95
SITE 2				
2005	292.69	62.62	131.73	453.65
2006	368.09	7.37	349.13	387.04
2007	494.07	15.55	454.10	534.04
2008	248.17	183.53	-223.62	719.95
2009	321.60	4.51	311.76	331.43
2010	450.47	21.87	394.24	506.69
2011	432.04	5.14	418.84	445.25
REGSLOPE	27.47	27.71	-43.76	98.69
SITE 3				
2005	306.11	22.88	247.30	364.91
2006	164.55	6.45	147.98	181.11
2007	83.21	1.95	78.20	88.23
2008	124.87	19.93	73.64	176.09
2009	291.51	15.21	258.38	324.65
2010	220.36	6.33	204.08	236.64
2011	234.76	1.49	230.92	238.60
REGSLOPE	6.07	20.72	-47.21	59.34
SITE 4				
2005	437.11	80.65	229.78	644.43
2006	467.97	2.22	462.26	473.68
2007	447.63	6.29	431.45	463.81
2008	243.43	78.23	42.33	444.53
2009	297.19	15.13	264.23	330.15
2010	357.71	2.10	352.32	363.10
2011	441.60	3.85	431.70	451.50
REGSLOPE	8.64	17.38	-36.05	53.33
SITE 5				
2005	123.09	4.56	111.38	134.80
2006	121.10	2.08	115.77	126.44
2007	272.43	1.83	267.72	277.15
2008	63.82	5.48	49.73	77.91
2009	216.23	58.47	88.84	343.63
2010	148.96	16.96	105.35	192.57
2011	126.20	3.06	118.33	134.07
REGSLOPE	X Variable 1	-10.66	0.09	-23.69

NITRATE - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
2005	-9.13	0.10	-9.38	-8.88
2006	-9.85	0.13	-10.18	-9.53
2007	-11.02	0.28	-11.73	-10.31
2008	-8.05	0.19	-8.53	-7.58
2009	-6.48	0.19	-6.90	-6.06
2010	-7.31	0.16	-7.72	-6.89
2011	-6.53	0.35	-7.42	-5.64
REGSLOPE	0.08	0.50	-1.21	1.37
SITE 2				
2005	-8.40	1.81	-13.06	-3.75
2006	-10.59	0.21	-11.14	-10.04
2007	-14.13	0.51	-15.44	-12.81
2008	-7.09	5.29	-20.68	6.51
2009	-9.12	0.14	-9.43	-8.82
2010	-12.93	0.64	-14.56	-11.29
2011	-12.30	0.15	-12.68	-11.92
REGSLOPE	-0.76	0.81	-2.83	1.31
SiTE 3				
2005	-8.83	0.66	-10.53	-7.12
2006	-4.72	0.19	-5.21	-4.23
2007	-2.35	0.06	-2.50	-2.20
2008	-3.56	0.57	-5.03	-2.09
2009	-8.28	0.45	-9.25	-7.30
2010	-6.32	0.18	-6.79	-5.84
2011	-6.68	0.04	-6.79	-6.57
REGSLOPE	-0.16	0.60	-1.71	1.39
SITE 4				
2005	-12.59	2.33	-18.58	-6.60
2006	-13.45	0.07	-13.62	-13.29
2007	-12.88	0.19	-13.36	-12.39
2008	-6.94	2.24	-12.70	-1.17
2009	-8.44	0.45	-9.42	-7.46
2010	-10.26	0.06	-10.42	-10.10
2011	-12.57	0.11	-12.86	-12.29
REGSLOPE	-0.23	0.50	-1.53	1.07
SITE 5				
2005	-3.56	0.14	-3.91	-3.21
2006	-3.46	0.06	-3.62	-3.30
2007	-7.86	0.06	-8.02	-7.70
2008	-1.82	0.16	-2.24	-1.41
2009	-6.15	1.71	-9.88	-2.43
2010	-4.30	0.50	-5.60	-3.00
2011	-3.59	0.09	-3.82	-3.35
REGSLOPE	0.33	0.15	-0.06	0.73

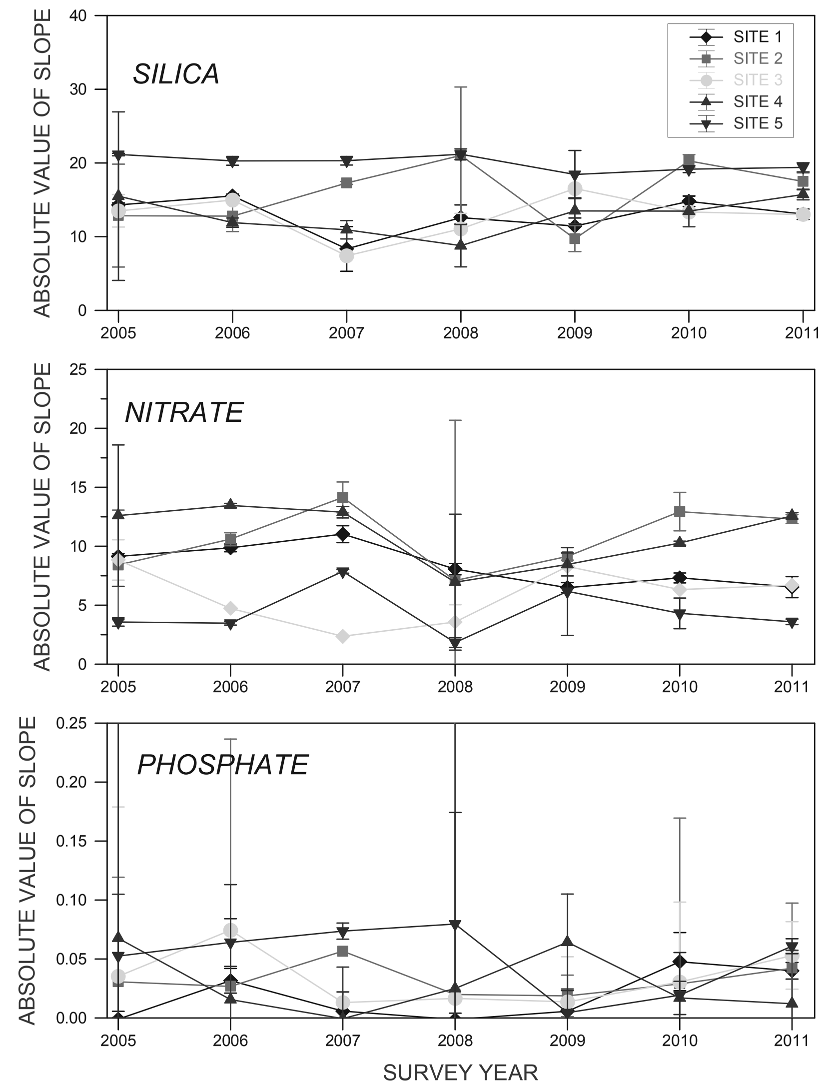

FIGURE 22. Time-course plots of absolute values of slopes of linear regressions of concentrations of silca, nitrate and phosphate as functions of salinity collected annually at each of the transect monitoring stations off of Honua`ula, Wailea, Maui. Error bars are 95% confidence limits. For locations of sampling transect sites, see Figure 1.

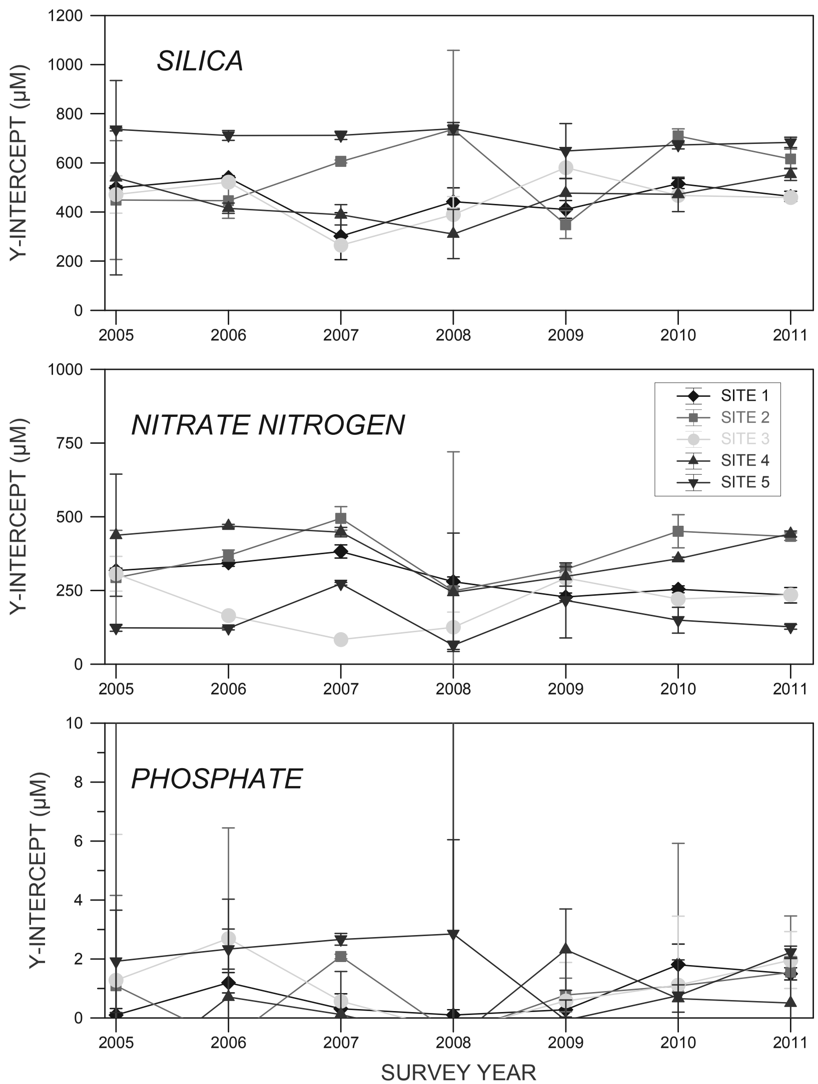

FIGURE 23. Time-course plots of Y-intercepts of linear regressions of concentrations of silca, nitrate and phosphorus as functions of salinity collected annually at each of the transect monitoring stations off of Honua`ula, Wailea, Maui. Error bars are 95% confidence limits. For locations of sampling transect sites, see Figure 1.

Marine Environmental Assessment

ASSESSEMENT OF MARINE COMMUNITY STRUCTURE
HONUA'ULA PROJECT
WAILEA, MAUI

Prepared for:

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INTRODUCTION

The Honua'ula project is situated on the slopes of Haleakala directly mauka of the Wailea Resort in South Maui, Hawaii. The project area is comprised of two parcels totaling 670 acres and is designated Project District 9 in the Kihei/Makena Community Plan (Figure 1). The project area is also zoned Project District 9 in the Maui County code. Current zoning includes provisions for 1,400 homes (including affordable workforce homes in conformance with the County's Residential Workforce Housing Policy (Chapter 2.96, MCC), village mixed uses, a homeowner's golf course, and other recreational amenities as well as acreage for parks, and open space that will be utilized for landscape buffers and drainage ways. The project is immediately above three 18-hole golf courses (Blue, Gold and Emerald) within the southern area of Wailea Resort. The composite Wailea Resort/ Honua'ula encompasses approximately 1.9 mile of coastline. No aspect of the project involves direct alteration of the shoreline or nearshore marine environment. At the time of submission of this report, development of the project EIS and Phase II submittal is in progress. No construction activities associated with the project have commenced.

While all planning and construction activities will place a high priority on maintaining the existing nature of the marine environment, it is nevertheless important to address any potential impacts that may be associated with the planned community. The potential exists, however, for the project to affect the composition and volume of groundwater that flows beneath the property, as well as surface runoff. As all groundwater and runoff that could be affected by the project could potentially reach the ocean, it is recognized that there is potential for effects to the marine environment. As the shoreline downslope from the planned project is a recreational area and is utilized for surfing, swimming, and fishing, evaluating the potential for alterations to water quality and marine life from material input from the community constitutes an important factor in the planning process.

In the interest of addressing these concerns and assuring maintenance of environmental quality, a marine water quality assessment and potential impact analysis of the nearshore areas downslope from Honua'ula are being conducted. The foundation of these assessments are based on a monitoring program that was stipulated as one condition of zoning (No. 20) which states …" *That marine monitoring programs shall be conducted which include monitoring and assessment of coastal water resources (groundwater and surface water) that receive surface water or groundwater discharges from the hydrologic unit where the project is located Monitoring programs shall include both water quality and ecological monitoring."* With respect to ecological monitoring, surveys will be conducted in accordance with the Coral Reef Assessment and Monitoring Program protocols used by the Department of Land and Natural Resources. The initial assessment shall use the full protocol. Subsequent annual assessments can use the Rapid Assessment Techniques. Results shall be reported annually to the Aquatic Resources Division, Department of Land and Natural Resources.

This report describes the results of the initial baseline survey of the nearshore marine communities. Such a characterization of biotic assemblages can provide a basis for estimating alteration of community structure as a result of modifying land uses mauka of the shoreline. This baseline will also serve to identify any specific biotic communities that may be especially susceptible (or resistant), to the potential alterations that may result from the planned development.

An important part of this investigation is to provide an evaluation of the degree of natural stresses (sedimentation, wave scour, freshwater input, etc.) that influence the nearshore marine environment in the area that could be potentially influenced by the proposed project. Typically, water quality and the composition of nearshore marine communities are intimately associated with the magnitude and frequency of these stresses, and any impacts caused by the proposed project may either be mitigated in large part, or amplified, by natural environmental factors. Therefore, evaluating the range of natural stress is a prerequisite for assessing the potential for additional change to the marine environment owing to shoreline modification. It is also important to note that while no work has been initiated for the Honua`ula project, the project site is separated from the ocean by the Wailea Resort, which has been in place for several decades. Hence, the marine communities downslope from the proposed project have been influenced by land uses of the Wailea Resort, and do not represent "pristine" conditions.

Marine community structure can be defined as the abundance, diversity, and distribution of stony and soft corals, motile benthos such as echinoderms, and pelagic species such as reef fish. In the context of time-series surveys, a most useful biological assemblage for direct evaluation of environmental impacts to the offshore marine environment are benthic (bottom-dwelling) communities. Because benthos are generally long-lived, immobile, and can be significantly affected by exogenous input of sediments and other potential pollutants, these organisms must either tolerate the surrounding conditions within the limits of adaptability or die.

As members of the benthos, stony corals are of particular importance in nearshore Hawaiian environments. Corals compose a large portion of the reef biomass and their skeletal structures are vital in providing a complex of habitat space, shelter, and food for other species. Since corals serve in such a keystone function, coral community structure is considered the most "relevant" group in the use of reef community structure as a means of evaluating past and potential impacts associated with land development. For this reason, and because alterations in coral communities are easy to identify, observable change in coral population parameters is a practical and direct method for obtaining the information for determining the effects of stress in the marine environment. In addition, because they comprise a very visible component of the nearshore environment, investigations of reef fish assemblages are presented.

METHODS

All fieldwork was carried out on February 20, 2010 conducted from a 22-foot boat. Biotic structure of benthic (bottom dwelling) communities inhabiting the reef environment was evaluated by establishing a descriptive and quantitative baseline between the shoreline and the 20 meter (m) (~60 foot) depth contour. Initial qualitative reconnaissance surveys were conducted that covered the area off the Honua'ula property from the shoreline out to the limits of coral reef formation. These reconnaissance surveys were useful in making relative comparisons between areas, identifying any unique or unusual biotic resources, and providing a general picture of the physiographic structure and benthic assemblages occurring throughout the region of study.

Following the preliminary survey, two quantitative transect sites were selected offshore of the development area, while a third site (Site 1) was selected as a control within the `Ahihi-Kina'u Natural Area Reserve (Figure 1). This area is a control in the sense that there is no upslope resort or residential community development, as occurs at the subject site. Site 2 was located near the northern property boundary between Polo and Palauea Beaches, while Site 3 was located between Ulua and Wailea Beaches. These areas were deemed to represent the most well developed and richest areas in terms of biotic composition. At each site, transect surveys were conducted, one in each of the dominant reef zones (Figures 1 and 2). Three transects were evaluated at Site 2, and two transects were evaluated at Site 3. Only a single transect was evaluated at Site 1 as the entire reef was essentially uniform. Transects were located beyond the region of wave impact, in areas where benthic biota was common. Each transect was oriented parallel to depth contours so as to bisect a single reef zone. Transects consisted of belt transects 1 m in width, and 10 m in length. Care was taken to place transects in random locations that were not biased toward either peak or low coral cover. In total, six quantitative transects were conducted.

As specified in Condition 20 of conditions of zoning, "the ecological monitoring shall include ecological assessment in accordance with the Coral Reef Assessment and Monitoring Program (CRAMP) protocols used by the Department of Land and Natural Resources. The initial assessment shall use the full protocol. Subsequent annual assessments can use the Rapid Assessment Techniques." In brief, the CRAMP methodology (as described in http://cramp.wcc.hawaii.edu/LT_Montoring_files/lt_methods.htm) employs digital still photography using a camera mounted on an aluminum monopod frame. Twenty non-overlapping high-resolution images 50 x 69 cm in dimension are taken along a 10 m long transect. From the images, percent cover, number of coral species (species richness), coral cover diversity, and non-coral substrate cover are measured. For the present survey, several modifications of the exact CRAMP protocol were employed in order to increase the actual monitoring area of each transect. Higher resolution photographic equipment was employed which allowed images to encompass 100 x 67 cm of reef surface. Thus, over a 10 m transect, 15 non-overlapping images captured 10 m^2 of reef surface compared to 6.9 m^2 on the CRAMP transects. Hence, each transect in the present study contains approximately 30% more information than with the CRAMP protocol. In addition, the CRAMP protocol utilizes a random point count method for evaluating community structure. Composition of reef surface under 50 randomly placed points per quadrat (1,000 points per transect) provides the input for characterization of reef structure. As such, only a very small fraction of the reef surface is actually evaluated, and the probability of missing small or rare components is large. Rather than using a random point count, the present survey utilized an assessment of the entire surface area of photo-quadrats by employing a grid consisting of 10 x 7 cm sections that is overlain on the photographic image. Percent cover within each grid is tabulated to comprise the estimates of benthic cover of the entire photographic quadrat. All photo-quadrats are shown in Appendix A. This method also allows accurate counts of motile macrobenthos (e.g. sea urchins), which is not possible using point counts. In addition to benthic cover, estimates of fish abundance were determined along each transect by a diver visually estimating individuals within a belt 5 m wide, centered on the transect line.

As it is stated in the condition of zoning that subsequent surveys will only require Rapid Assessment Techniques, the CRAMP method involving fixed photo-quadrats to examine trends over time was not appropriate for the present study. An example of results of DAR surveys for Maui conducted using CRAMP methods are shown in Appendix B.

DESCRIPTION OF THE NEARSHORE MARINE ENVIRONMENT

Physical Structure

The main structural feature of the shoreline and nearshore areas off Honua`ula are a series of crescent shaped white sand beaches separated by basaltic rocky headlands that extend up to several hundred feet offshore (Figure 1). Sand plains extend from the beach shorelines continuously to the depth limit of the survey (60 ft). The rocky headlands generally consist of narrow extended fingers of exposed rock with sharply angled edges that form the shorelines of these features. Owing to the vertical shoreline faces, there are essentially no well-defined intertidal tide pools along the shoreline.

The seaward extensions of the rocky headlands that separate the beaches provide the major habitats for marine biota. The intertidal range of the submerged headlands are colonized by bands of the seaweeds *Anhfeltia concinna* and *Ulva fasciata*. The submerged portions of the rock surfaces are lined with various forms of encrusting red algae, and contain numerous urchins of the species *Echinometra matheai, Echinostrephus aciculatus*, and *Colobocentrotus atratus*, as well as numerous juvenile reef fish. As the headlands extend seaward, the top surfaces flatten out into dome-shaped fingers. At the seaward termini, the headlands grade into the sandy bottom, often with a distinct boundary between the rock-rubble platform and the sand bottom, generally at a depth of about 25-30 feet. The exception to this pattern of composition occurred of the `Ahihi-Kina`u Natural Area Reserve. In this area, the shoreline area is comprised of a rocky platform with intermittent cobble beaches, and the offshore reef is comprised primarily of a flat limestone pavement interspersed with sand patches.

Biotic Community Structure

The coral reef communities that occur on the hard-bottom areas off the Wailea/Honua'ula properties consist of abundant and diverse assemblages of common Hawaiian marine life. The predominant taxon of macrobenthos (bottom-dwellers) throughout the reef zones are Scleractinian (reef-building) corals. Tables 1 and 2 show results of benthic photo-quadrat transecting. Table 1 shows tabulated data for each quadrat on each transect, while Table 2

shows the summary transect data, including coral, and non-coral benthic cover, coral species number and diversity. Coral cover on individual transects ranged from 1.6% on the mid-depth transect at Site 2 to 68% coral cover on the deep transect at Site 3. Over the entire transected area, coral cover average 24.4% of the benthic surface. The most abundant coral species was *Porites lobata* (lobe coral) which comprised 83% of coral cover and 20% of bottom cover. The second most abundant coral was *Porites compressa* (finger coral) which comprised 20% of coral cover and about 5% of bottom cover. Other common corals observed were *Pocillopora meandrina* (cauliflower coral) (11% coral cover, 3% bottom cover). Two species of Montipora [*M. capitata* (rice coral) and *M. patula* (sandpaper rice coral] comprised about 3% of coral cover and 1% of bottom cover. Other species encountered on transects included *Pavona varians* (corrugated coral), *Pavona duerdeni* (Porkchop coral) and *Porites brighami* (Brigham's coral).

The most conspicuous aspect of the surveyed reefs is that the richest communities in terms of both species number and bottom cover occur on the rocky outcrops that are elevated above the sand bottom. This is likely in response to lessened stress from abrasion from sand scour during periods when wave action is sufficient to resuspend sand off the bottom. At Survey Site 3, the basaltic extension the rock headland was relatively narrow and steep-sided, while at Site 2 the basalt finger was wider and flatter. Coral cover was greatest on the sloping sides of the rock fingers, with total coral cover in the range of 50-75% of bottom cover (68% on transect 3-2). At Site 2, total coral cover on the top of the finger reef was approximately 28% of bottom cover. In both of these "finger reefs" 6-7 species of corals were encountered, with coral cover diversity ranging from 0.75 to 0.87.

In addition to substantial coral cover, the top of the finger was also occupied by abundant slate-pencil sea urchins (*Heterocentrotus mammilatus*) (Figure 3, Table 3). Of note is that throughout the rocky finger reefs, there were no observations of any species of frondose macro-algae. This observation is of interest as extensive growth of several species of macro-algae in several shoreline areas of Maui have been the subject of considerable concern, particularly with respect to interactions between algal abundance and human activities.

At the seaward end of the rock outcrop fingers, coral abundance is reduced considerably, with the reef consisting primarily of a rock-rubble surface that ends at the juncture of the sand flats (Figure 4). Coral cover on transect 2-2, located at the base of a finger was 1.6% of bottom cover, by far the lowest total cover of any transect, although this area had the highest coral cover diversity (1.08). While no macro-algae were observed in this zone, most of the rock/rubble bottom was covered with a thin veneer of micro-algal turf. Numerous boulders at the base of the finger outcrop were colonized by numerous small colonies of *Pocillopora meandrina* (cauliflower coral) (Figure 5). This coral has been recognized as a "pioneering" species, in that it is often the first to colonize newly cleared substrata. In addition, it also has "determinate" growth, in that colonies grow to a certain size, or age, and then die. As a result, colonies of this species never reach a size larger than approximately one foot in diameter. Such a growth form does not occur for the other major genera found on Hawaiian reefs (e.g., *Porites*) which has an "indeterminate" growth form where colony life span is are not limited by either size or age. The significance of the abundant small colonies of *P. meandrina* (cauliflower coral) at the deeper regions of Site 2 may be that it is indication that a new year class is taking hold, or that recolonization is beginning in an area where corals were removed by some factor. In either case, the occurrence of abundant recruiting colonies indicates that the present conditions are suitable for coral growth.

The physical structure of the reef at Site 3 is slightly different than at Site 2 in that on the latter the top of the outcrop is flatter and wider, while on the former it is relatively narrow and steep-sided. Coral cover, consisting of the same common species listed above, was someone greater on the flat reef of Site 3, with nearly complete coverage of the rocky substratum (Figures 6 and 7).

The deeper seaward extension of the rocky headland at Site 2 was also different than at Site 3. While a relatively barren rock/rubble shelf occurred at the terminus of the reef at Site 2, corals, particularly mats of the branching finger coral *Porites compressa* (finger coral) extended to the sand floor at Site 3 (Figure 8). Numerous large coral-covered boulders also extended onto the sand flats at the seaward end of the reef at Site 3.

Reef structure and composition at the control site off of `Ahihi-Kina`u differed than off of the Wailea area. As mentioned above, the shoreline at `Ahihi-Kina`u is not composed of the distinct cusp beaches separated by rocky headlands which extend a substantial distance offshore. Rather the bottom in this area consists primarily of a solid limestone pavement with interspersed pockets of sand. Scattered throughout the pavement are areas where corals are concentrated into patches between areas of essentially barren bottom. The predominant growth form of coral in this region is large helmet-shaped head of *Porites lobata* (lobe coral), some of which extend up to several feet off the pavement (Figure 9). The highly valued edible algae *Asparagopsis taxiformis* (limu kohu) was abundant throughout the survey area, although no other abundant algae were observed (Figure 9)

Other than corals, the dominant group of macroinvertebrates inhabiting the reef surface off the Honua'ula study sites is sea urchins. The most common urchins are the small species that bore into the rock surface (*Echinometra matheai*, *Echinostrephus aciculatus*) which occurred in all reef zones. The larger species, including the collector urchin *Tripneustes gratilla* (collector urchin) and *Heterocentrotus mammillatus* (slate-pencil urchin) were also abundant on the tops and sides of the rocky finger reefs. Table 3 shows abundance of sea urchins encountered on transect. Total urchin abundance ranged from 31 (T1-1) to 64 (T3-2). The most common urchin encountered was *Tripneustes gratilla* with a total of 112 individuals counted, with a peak number of 47 individuals on transect 3-2. On the other hand, sea cucumbers (Holothurians) or starfish (Asteroidea) were not commonly observed during the survey. No crown-of-thorns starfish (*Acanthaster planci*) were observed feeding on coral colonies, nor were there observations of recently bleached coral skeletons as a result of Acanthaster predation. The green conical-shaped sponge *Iotrocha protea* was observed on the sandy flats at the seaward ends of the reefs. The only commonly occurring non-cryptic mollusk was the oyster *Pinctata* spp.

While frondose benthic algae were conspicuously absent on the survey reefs, encrusting red calcareous algae (*Porolithon* spp., *Peysonellia rubra, Hydrolithon* spp.) were abundant of rocky surfaces throughout the study area. These algae were abundant on bared limestone surfaces, and on the nonliving parts of coral colonies.

The design of the reef survey was such that no cryptic organisms or species living within interstitial spaces of the reef surface were enumerated. Since this is the habitat of the majority of mollusks and crustacea, detailed species counts were not included in the transecting scheme.

Reef fish community structure was largely determined by the topography and composition of reef structure. Fish were most abundant on the edges of the rocky outcrops and in areas of highest relief. Fish were abundant, but were small in size. Table 4 shows results of fish counts on transects. A total of 566 fish were encountered, while the three most abundant species were the damselfish *Chromis agilis* (Agile chromis), the brown surgeonfish *Acanthurus nigrofuscus*, saddleback wrasse *Thallosoma duperrey*. Overall, fish community structure at Honua`ula is fairly typical of the assemblages found in undisturbed Hawaiian reef environments. However, the lack of abundance of food fish indicates that the area has been subjected to moderate amounts of fishing pressure.

Several species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly along the South Maui Coast, and turtles are frequently observed on beaches throughout the area. The endangered hawksbill turtle (*Eretmochelys imbricata*) is also known to occur in the study area, with hatching grounds nearly at Maalaea. One green sea turtle, approximately 50 cm in carapace length, was observed during the surveys.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) winter in the Hawaiian Islands from December to April, and were commonly observed off the survey sites. The Hawaiian Monk Seal, (*Monachus schauinslandi)*, is an endangered earless seal that is endemic to the waters off of the Hawaiian Islands. Monk seals commonly haul out of the water onto sandy beaches to rest. Hence, while there is no greater potential for haul out to the beaches fronting the Honua`ula site than any other area, there is a probability that seals will haul out on these beaches. No individuals were observed on the beach or in the water during the course of the present survey. As there are no plans for any modification of the shoreline, and with established of the shoreline preservation area, there are no physical factors that will result in modification of seal behavior. The major factor that could affect seal behavior is interaction with humans. Typically when seals haul out, authorized Federal or State agencies may establish a safety zone by placement of temporary fencing and signs indicating proper treatment of the animals. At present, the shoreline below Honua`ula is heavily used for recreational purposes, which is not likely to change. Any additional activity by people using the beach area as a result of the project will not qualitatively change usage of the shoreline by humans. Hence, the best management protocol to ensure the absence of negative effects to seals is establishment of a protocol to notify the appropriate authorities as soon as possible to establish buffer zones with appropriate signage.

CONCLUSIONS

As with all Hawaiian nearshore reef communities, biotic composition of the nearshore marine environment downslope from the proposed Honua'ula project is primarily a response to natural factors, including suitable surfaces for settlement, and protection from destructive storm waves (Dollar 1982, Dollar and Tribble 1993, Fletcher et al. 2008, Grigg 1998). Off Honua'ula, these factors are manifested with rich coral reef assemblages that occupy hard bottom, primarily on submerged extensions of rocky headlands that occur between sandy shorelines. The rocky headlands primarily provide a solid surface for coral settlement that is elevated above the level where wave-resuspended sand scour can limit coral growth. In

TABLE 1. Results of analysis of benthic photo-quadrad photographs on six transects off of Honua`ula project site, Wailea Maui. Each transect consisted of 15 quadrats each covering 0.67 square meters for a total area of 10 square meters. For locations of transect sites, see Figures 1 and 2.

TRANSECT 1-1 (24 ft)

SPECIES	QUADRAT															SPECIES
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MEAN
Montipora capitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Montipora patula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Pavona duedeni	1	1	0	3	0	1	0	0	0	0	0	0	0	0	1	**0.5**
Pavona varians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Porites brighami	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Porites compressa	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	**0.7**
Porites lobata	0	0	10	15	10	4	65	5	5	45	90	65	30	20	2	**24.4**
Pocillopora meandrina	0	0	0	3	1	0	0	0	0	0	0	0	3	0	1	**0.5**
Zoanthus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
TOTAL CORAL	1	1	10	31	11	5	65	5	5	45	90	65	33	20	4	**26.1**
Macroalgae	15	10	10	1	8	5	1	2	0	0	0	0	2	0	1	**3.7**
Turf algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Sand	15	10	5	0	25	0	15	0	0	0	5	0	0	20	0	**6.3**
Limestone	0	0	5	0	0	40	18	0	20	0	5	15	30	0	0	**8.9**
Dead Coral Colony	0	0	0	0	0	0	0	10	0	10	0	0	0	0	0	**1.3**
Crust. Calc. Algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Rubble	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.3**
Turf-bound sediment	69	74	69	67	55	49	0	83	74	45	0	20	35	60	94	**52.9**
macro-invertebrate	0	0	1	1	1	1	1	0	1	0	0	0	0	0	1	**0.5**

TRANSECT 2-3 (34 ft.)

SPECIES	QUADRAT															SPECIES
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MEAN
Montipora capitata	0	0	0	1	0	0	1	3	0	1	1	0	0	0	1	**0.5**
Montipora patula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Pavona duedeni	1	0	1	0	1	1	0	0	0	0	1	1	0	0	0	**0.4**
Pavona varians	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**0.1**
Porites brighami	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Porites compressa	2	0	2	0	1	0	0	0	0	1	0	0	0	0	0	**0.4**
Porites lobata	5	15	50	40	25	13	25	15	18	9	19	4	15	5	10	**17.9**
Pocillopora meandrina	4	7	0	5	1	1	5	2	2	13	10	0	2	0	4	**3.7**
Zoanthus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
TOTAL CORAL	13	27	53	46	28	15	31	20	20	25	31	5	17	5	15	**23.4**
Macroalgae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Turf algae	10	0	0	5	5	0	0	0	0	0	10	0	15	0	0	**3.0**
Sand	0	0	5	0	0	0	0	0	0	0	0	10	0	0	0	**1.0**
Limestone	75	23	34	39	55	0	58	50	55	25	33	43	32	0	80	**40.1**
Dead Coral Colony	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Crust. Calc. Algae	0	0	0	0	0	0	0	0	0	5	20	0	0	0	0	**1.7**
Rubble	0	50	5	5	10	0	10	25	20	35	5	40	35	0	0	**16.0**
Turf-bound sediment	0	0	0	0	0	84	0	0	0	0	0	0	0	93	0	**11.8**
macro-invertebrate	2	0	3	5	2	1	1	5	5	10	1	2	1	2	5	**3.0**

TRANSECT 2-1 (18ft.)

SPECIES	QUADRAT															SPECIES
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MEAN
Montipora capitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Montipora patula	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	**0.3**
Pavona duedeni	0	0	0	1	0	0	0	0	0	0	0	1	2	1	0	**0.3**
Pavona varians	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**0.1**
Porites brighami	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Porites compressa	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	**0.1**
Porites lobata	12	65	1	30	4	15	10	20	3	25	20	2	21	5	35	**17.9**
Pocillopora meandrina	13	0	2	0	2	8	7	4	20	4	8	25	7	17	20	**9.1**
Zoanthus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
TOTAL CORAL	25	65	3	31	6	25	17	24	23	32	30	29	30	23	55	**27.9**
Macroalgae	0	0	0	0	0	0	5	0	0	0	0	0	0	20	10	**2.3**
Turf algae	60	19	35	30	20	25	20	15	20	15	10	10	10	15	5	**20.6**
Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Limestone	14	5	25	34	52	38	36	49	46	31	27	38	32	15	5	**29.8**
Dead Coral Colony	0	10	0	0	0	0	0	0	0	0	0	0	0	0	5	**1.0**
Crust. Calc. Algae	0	0	0	0	10	10	20	10	10	20	30	20	25	25	15	**13.0**
Rubble	0	0	0	5	10	0	0	0	0	0	0	0	0	0	0	**1.0**
Turf-bound sediment	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	**2.3**
macro-invertebrate	1	1	2	0	2	2	2	2	1	2	3	3	3	2	5	**2.1**

TRANSECT 3-1 (22 ft.)

SPECIES	QUADRAT															SPECIES
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MEAN
Montipora capitata	0	0	1	2	0	0	0	0	0	0	2	0	0	0	0	**0.3**
Montipora patula	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.1**
Pavona duedeni	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	**0.1**
Pavona varians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Porites brighami	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Porites compressa	0	1	2	0	0	0	0	2	0	0	0	3	5	0	2	**1.0**
Porites lobata	20	20	15	31	23	35	24	10	20	30	35	30	25	37	30	**25.7**
Pocillopora meandrina	0	1	0	2	1	0	1	2	1	0	3	0	2	3	3	**1.3**
Zoanthus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
TOTAL CORAL	21	23	18	36	25	36	25	14	21	30	40	33	32	40	35	**28.6**
Macroalgae	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	**0.2**
Turf algae	10	42	0	0	59	57	58	50	67	60	35	36	48	55	40	**41.1**
Sand	20	0	10	15	10	0	5	5	10	0	5	1	1	0	0	**5.5**
Limestone	0	5	0	0	0	0	0	11	0	5	0	0	0	0	20	**2.7**
Dead Coral Colony	5	0	0	5	0	5	5	0	0	5	10	5	10	0	0	**3.3**
Crust. Calc. Algae	0	0	0	0	5	0	0	0	0	0	10	15	5	2	0	**2.5**
Rubble	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	**1.0**
Turf-bound sediment	44	30	71	44	0	0	0	0	0	0	0	0	0	0	0	**12.6**
macro-invertebrate	0	0	1	0	1	2	7	5	2	0	0	10	4	0	5	**2.5**

TRANSECT 2-2 (28 ft.)

SPECIES	QUADRAT															SPECIES
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MEAN
Montipora capitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Montipora patula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Pavona duedeni	0	1	0	0	0	1	1	1	1	0	1	0	0	1	1	**0.5**
Pavona varians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Porites brighami	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Porites compressa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Porites lobata	0	1	1	0	0	0	1	0	0	0	0	0	0	1	2	**0.4**
Pocillopora meandrina	1	2	1	0	0	0	3	0	0	0	1	0	1	0	1	**0.7**
Zoanthus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
TOTAL CORAL	1	4	2	0	0	1	5	1	1	0	2	0	1	2	4	**1.6**
Macroalgae	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	**0.3**
Turf algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Sand	0	5	0	0	10	0	5	0	0	0	0	0	0	0	5	**1.7**
Limestone	10	10	0	0	0	5	5	0	0	0	0	0	0	10	0	**2.7**
Dead Coral Colony	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Crust. Calc. Algae	0	0	0	0	0	0	0	0	0	0	15	0	2	10	0	**1.8**
Rubble	0	20	15	0	20	40	30	10	15	25	15	20	20	35	30	**19.7**
Turf-bound sediment	89	59	83	100	70	53	53	89	80	75	67	79	73	33	61	**70.9**
macro-invertebrate	0	2	0	0	0	1	2	0	0	0	1	1	4	10	0	**1.4**

TRANSECT 3-2 (27 ft.)

SPECIES	QUADRAT															SPECIES
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MEAN
Montipora capitata	22	0	0	0	0	0	0	0	0	0	0	2	1	4	1	**2.0**
Montipora patula	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	**0.4**
Pavona duedeni	0	0	0	5	0	0	2	0	0	0	0	0	0	0	0	**0.5**
Pavona varians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Porites brighami	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	**0.3**
Porites compressa	32	35	32	37	21	3	0	17	26	22	29	53	22	35	38	**26.8**
Porites lobata	18	35	60	55	51	18	26	48	43	44	32	27	20	34	35	**36.4**
Pocillopora meandrina	0	0	2	0	0	0	2	0	0	0	10	0	0	5	0	**1.3**
Zoanthus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
TOTAL CORAL	75	70	94	97	72	21	34	65	69	66	71	82	46	78	74	**67.6**
Macroalgae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Turf algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Limestone	21	23	6	3	24	72	60	25	24	27	25	16	50	20	25	**28.1**
Dead Coral Colony	3	5	0	0	0	0	0	5	4	0	0	0	0	0	0	**1.1**
Crust. Calc. Algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Rubble	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
Turf-bound sediment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**
macro-invertebrate	1	2	0	0	4	7	6	5	3	7	4	2	4	2	1	**3.2**

addition, the rugosity created by the basalt extensions provides more suitable shelter for reef fish than open, flat reef surfaces. Results of the present assessment do no reveal any substantial effects to marine community structure from human activities along the shoreline (with the possible exception of overfishing). Aggregations of nuisance algae do not occur in the subject area.

Implementation of the proposed Honua`ula project will not involve alteration of the shoreline, or offshore environments in any manner. In fact, the project is separated from the shoreline by the existing Wailea Resort. All shoreline areas fronting the project site are presently heavily used for recreational purposes by visitors and residents with little apparent effect to benthic reef communities. While the Honua'ula project may result in some increases in user numbers, it is not likely that uses of the shoreline areas will change with the project in place. Considerations of the changes to water chemistry as a result of alteration of groundwater flow and composition will not qualitatively or quantitatively change the existing character of the marine environment to an extent that will alter biotic community structure (see Reports by Tom Nance Water Resources Engineering, and Marine Research Consultants). In summary, the proposed project does not appear to present the potential for alteration of the offshore environments. None of the proposed development activities has the potential to induce large changes in physico-chemical properties that could affect biotic community structure.

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TABLE 2. Summary of coral species percent cover, non-coral substrata cover, and coral community statistics on transects

CORAL SPECIES	TRANSECT					
	1-1	2-1	2-2	2-3	3-1	3-2
Montipora capitata	0.0	0.0	0.0	0.5	0.3	2.0
Montipora patula	0.0	0.3	0.0	0.0	0.1	0.4
Pavona duedeni	0.5	0.3	0.5	0.4	0.1	0.5
Pavona varians	0.0	0.1	0.0	0.1	0.0	0.0
Porites brighami	0.0	0.0	0.0	0.0	0.0	0.3
Porites compressa	0.7	0.1	0.0	0.4	1.0	26.8
Porites lobata	24.4	17.9	0.4	17.9	25.7	36.4
Pocillopora meandrina	0.5	9.1	0.7	3.7	1.3	1.3
TOTAL CORAL COVER	26.1	27.9	1.6	23.4	28.5	67.6
NUMBER OF SPECIES	4	6	3	6	6	7
CORAL COVER DIVERSITY	0.31	0.80	1.08	0.75	0.73	0.87
NON-CORAL SUBSTRATA						
Macroalgae	3.7	2.3	0.3	0.0	0.2	0.0
Turf algae	0.0	20.6	0.0	3.0	41.1	0.0
Sand	6.3	0.0	1.7	1.0	5.5	0.0
Limestone	8.9	29.8	2.7	40.1	2.7	28.1
Dead Coral Colony	1.3	1.0	0.0	0.0	3.3	1.1
Crust. Calc. Algae	0.0	13.0	1.8	1.7	2.5	0.0
Rubble	0.3	1.0	19.7	16.0	1.0	0.0
Turf-bound sediment	52.9	2.3	70.9	11.8	12.6	0.0
macro-invertebrate	0.5	2.1	1.4	3.0	2.5	3.2

TABLE 3. Sea Urchin abundance on benthic transects off the Honua'ula Project site on south Maui. For locations of transects, see Figure 1.

SEA URCHIN SPECIES	TRANSECT NO.					
	1	2	3	4	5	6
Echinometra matheai	27	12	14	13	8	9
Heterocentrotus mammillatus		5		4	2	2
Tripneustes gratilla		23	13	22	7	47
Echinothrix diadema		6	2	13	14	3
Echinostrephus aciculatus	4	5	6	7	11	3
TOTAL URCHIN COUNT	31	51	35	59	42	64

TABLE 4. Fish species encountered on transects off of Honua`ula, Wailea Maui. For locations of transects, see Figure 1.

Fish Species	TRANSECT T 1-1	T 2-1	T 2-2	T 2-3	T 3-1	T 3-2
Butterflyfishes						
Chaetodon lunula	1					
C. multicinctus						6
C. ornatissimus				2		1
C. quadrimaculatus					2	
Forcipiger flavissimus				2		
C. miliaris			2	2		
Zebrasoma. flavescens						8
Damselfishes						
Chromis hanui						10
C. agilis	25		10	10		
C. vanderbilti					14	
Plectoglyphidodon johnstonianu	3			2	7	9
Stegastes fasciolatus	1	1	2	1	12	21
Plectolyphidodon imparipennis	2				1	
Filefishes						
Cantherhines. sandwichiensis					2	
Goatfishes						
Parupeneus bifasciatus	1	6	10	4	3	5
P.multifasciatus						4
Hawkfishes						
Paracirrhites arcatus	1			4		2
P. forsteri						1
Parrotfishes						
Chlorurus sordidus				1		1
Scarus psittacus		7			1	
Triggerfishes						
Rhinecanthus rectangulus		1	1			
Pufferfishes						
Canthigaster amboinensis					2	
Arothron meleagris	2					
A. hispidus			1			

FIGURE 4. Continued

Fish Species	TRANSECT T 1-1	T 2-1	T 2-2	T 2-3	T 3-1	T 3-2
Surgeonfishes						
Acanthurus nigrofuscus	20	33	9	15	73	28
A. olivaceus			2			
Ctenochaetus. strigosus					3	16
Naso lituratus				1		
N. brevirostris		3	20	8		
Triggerfishes						
Melichthys vidua			2	1		4
Sufflamen bursa				1		3
Wrasses						
Thallosoma duperrey	11	7	2	6	21	6
Coris gaimard	1					1
Gomphosus varius		1				
Halicoeres ornatissimus	8	1	1		1	
Macropharyngodon geoffroy					1	
Pseudochrilinus evanidus						3
P. tetrataenia				2		
Stethojulis balteata				1	4	
Trumpetfish						
Aulostomus chinensis		1			2	
Angelfish						
Centropyge potteri						1
Moorish Idol						
Zanclus cornutus					1	1
Mackerel Scad						
Decapterus macarellus			20			
Green Sea Turtle						
Chelonia mydas		1		1		
Moray eel						
Gymnothorax meleagris				1		
TOTAL FISH	76	62	82	65	150	131

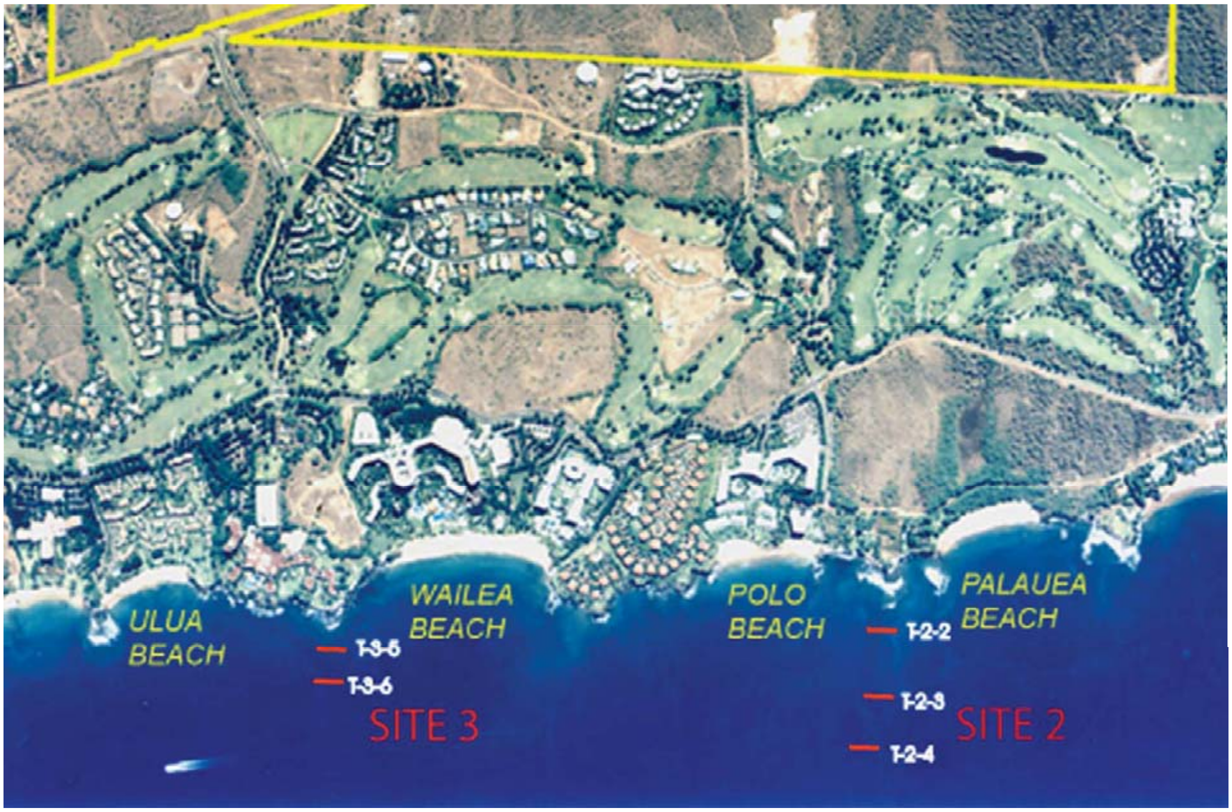


FIGURE 2. Aerial photograph of shoreline of Wailea are of south Maui showing seaward boundary of Honua`ula project site (yellow line). Also shown are site and transect locations for reef community structure biotic assessment. Site 1 and transect T-1-1 are located off the `Ahihi-Kina`u Natural Area Reserve, approximately 4 km south of the Honua`ula project site.

FIGURE 1. Aerial photograph of Wailea Maui coastline showing locations of beaches downslope from Wailea Golf Couses and Honua`ula project site (outlined in yellow). Locations of representative marine biota sampling sites are shown as red ovals. Site 1, which is considered a control station, is located within the `Ahihi-Kina`u Natural Area Reserve, approximately 4 km south of the Honua`ula project site.

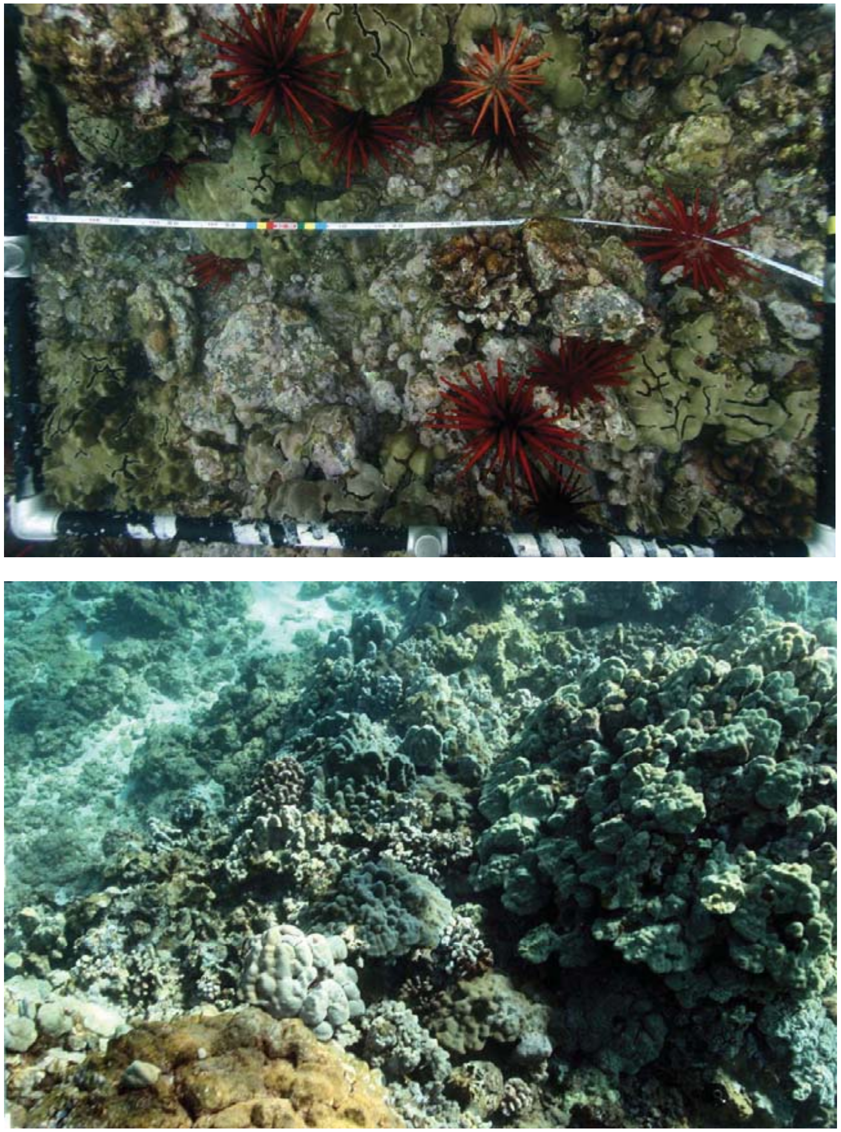


FIGURE 3. Typical views of reef on rocky outcrop at Survey Site 2 between Palauea and Polo Beaches downslope from the Honua`ula project site. Upper photo shows photo-quadrat used for quantifying reef community structure. Red slate-pencil sea urchins (*Heterocentrotus mammilatus*) were common throughout the survey area.

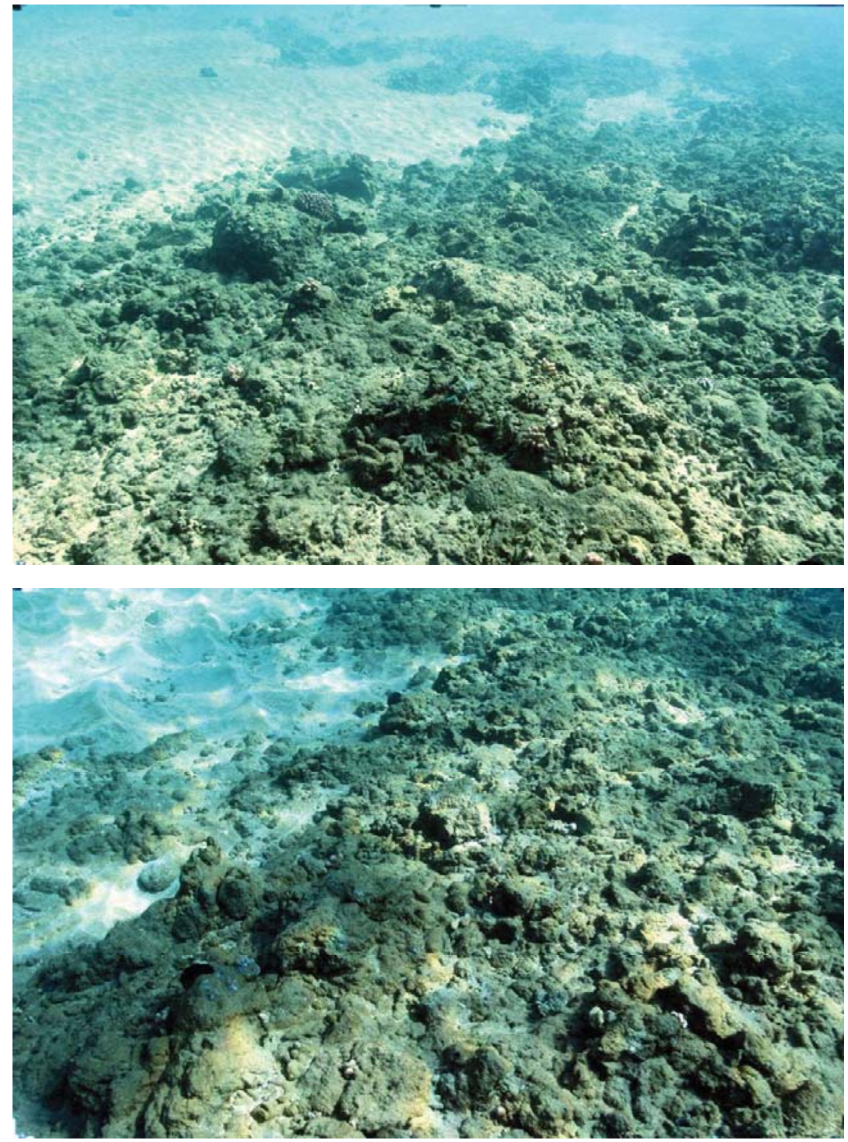


FIGURE 4. Seaward edge of reef at juncture of sand flats and seaward extension of rock headlands off Survey Site 2 between Polo and Palauea Beaches. Note lack of corals or algae on limestone reef surface. Water depth is approximately 25 feet.

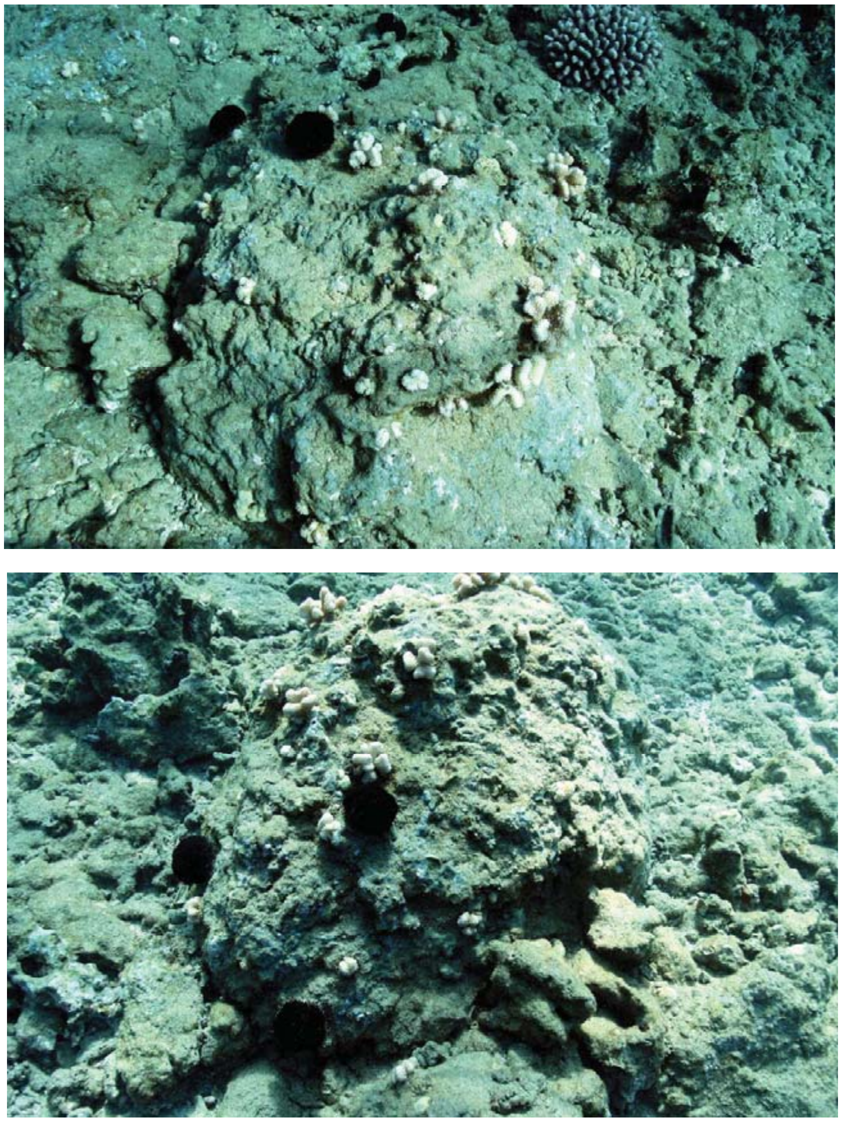


FIGURE 5. Boulders at base of reef at Survey Site 2 settled by numerous small colonies of cauliflower coral *Pocillopora meandrina*. Water depth is approximately 25 feet.

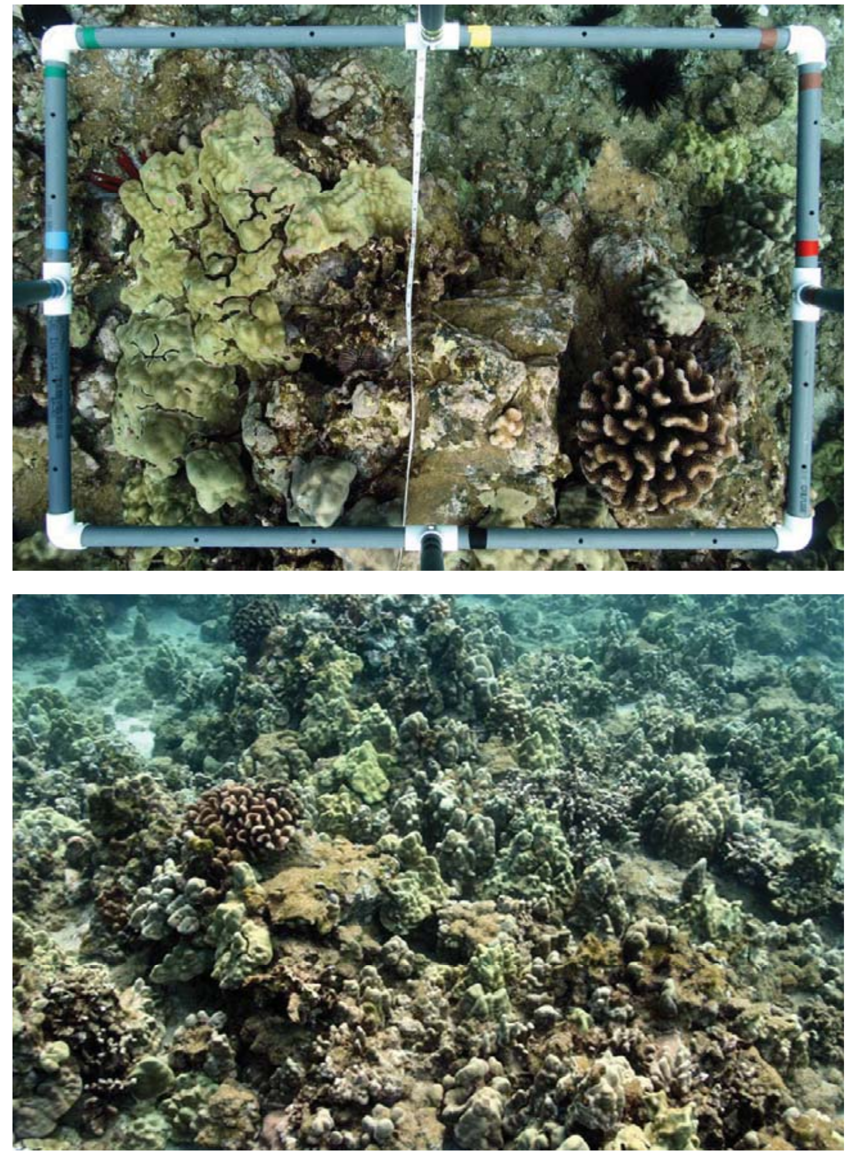


FIGURE 6. Typical vies of reef surface on top of rocky outcrop at Site 3 between Ulua and Wailea beaches. Upper photo shows typical photo-quadrat used for determining quantitative estimates of coral abundance. Water depth is approximately 12 feet.

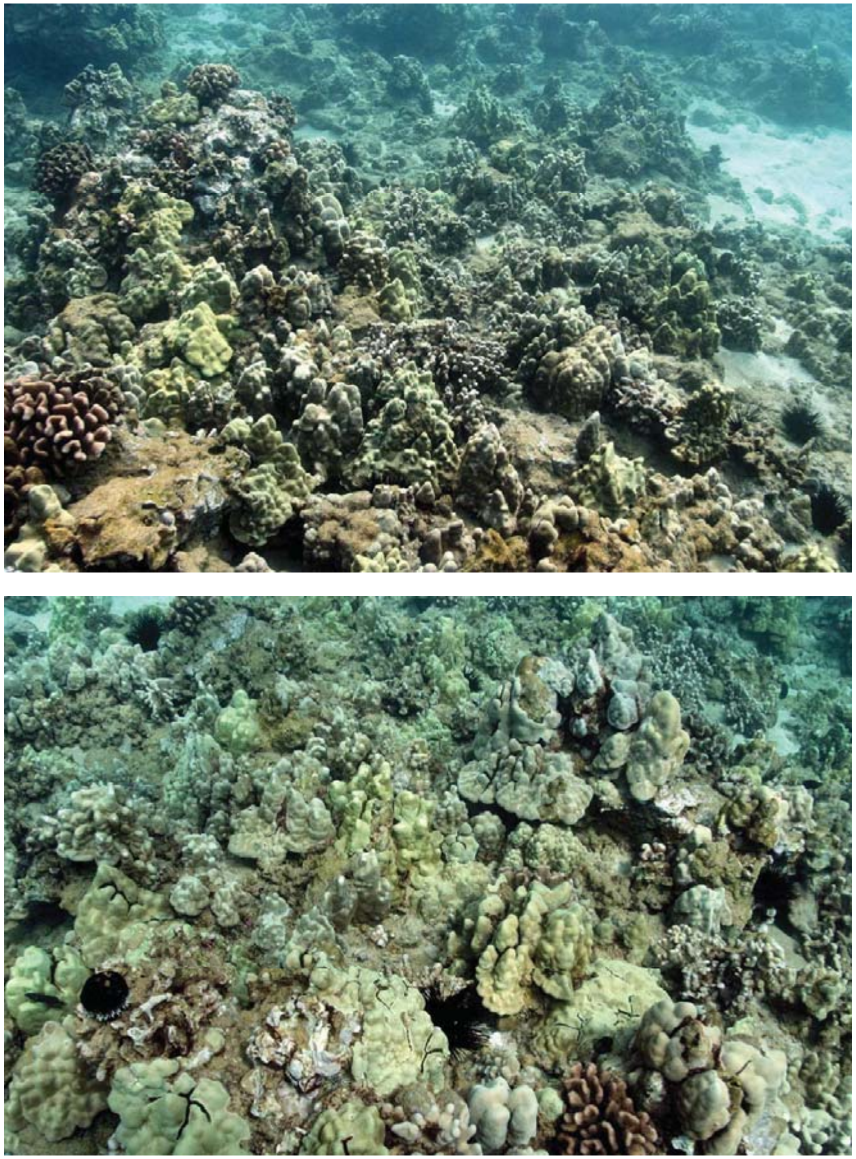


FIGURE 7. Surface of reef on extension of rocky headland at Survey Site 3 between Wailea and Ulua Beaches. Dominant coral in both photos is lobe coral *Porites lobata*. Water depth is approximately 15 feet.

FIGURE 8. Outer boundaries of reef at Survey Site 3 between Ulua and Wailea Beaches. Boundaries between hard bottom colonized by high densities of coral and sandy bottom are clearly seen in both top and bottom photos. Water depth is approximately 30 feet.

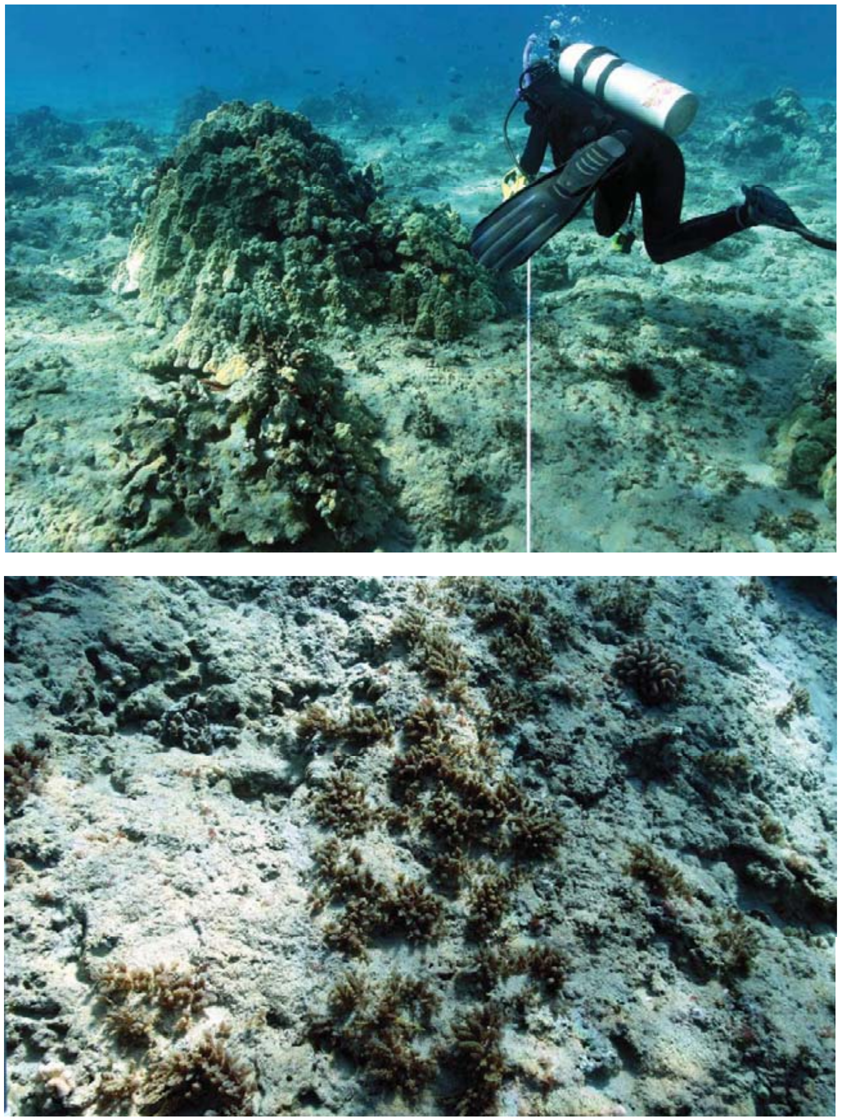
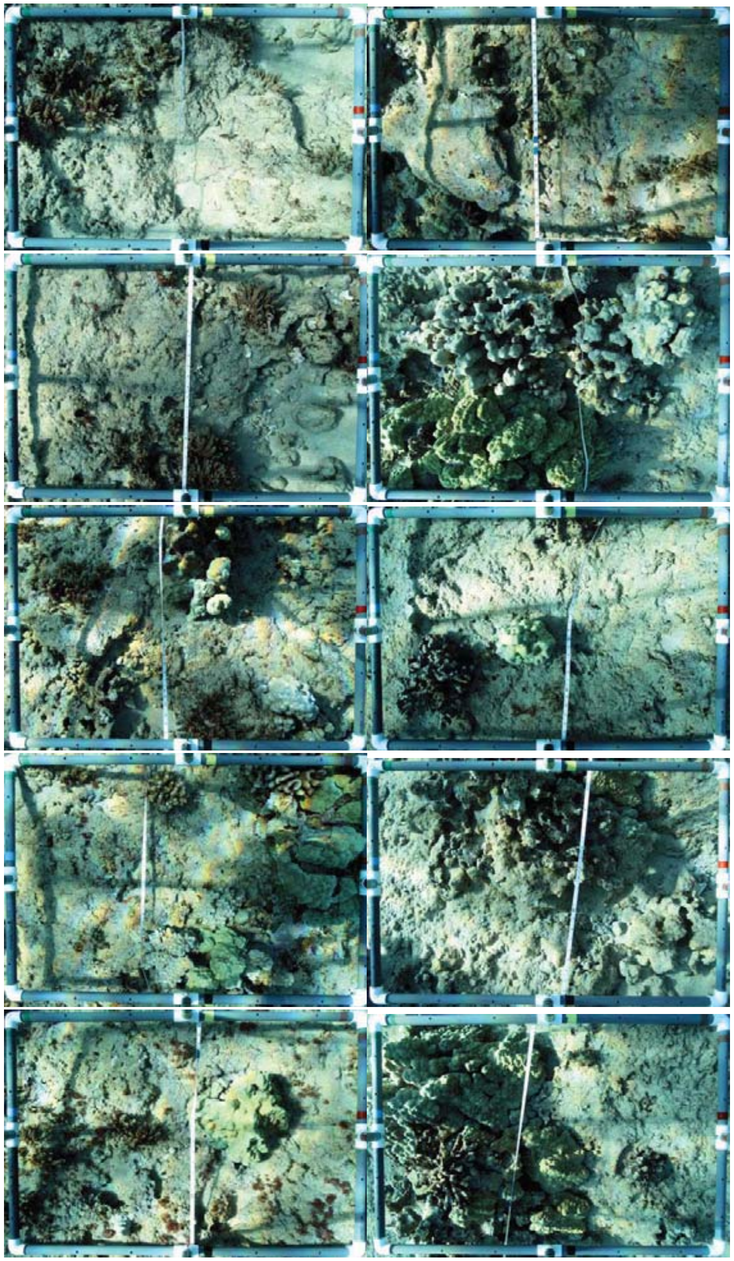


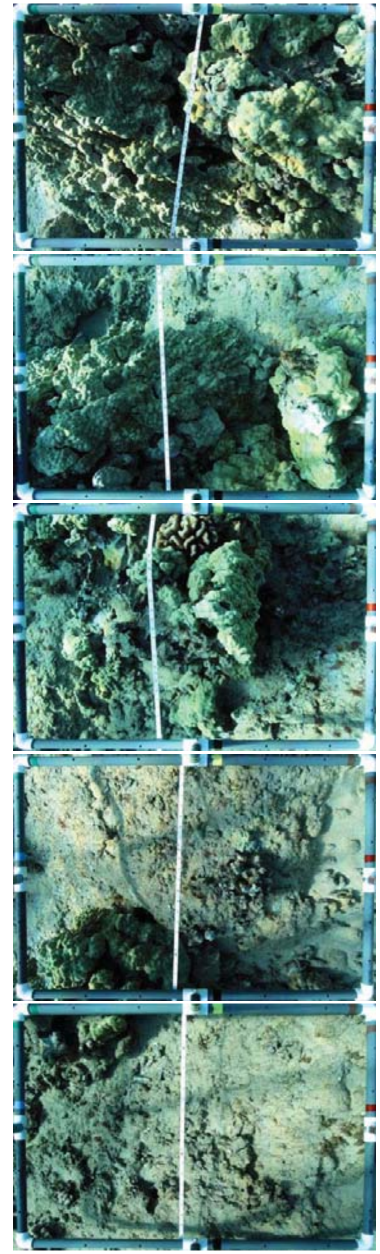
FIGURE 9. Typical reef platform off `Ahihi-Kina`u Natural Area Reserve characterized by large dome-shaped colonies of lobe coral *Porites lobata* (top). Dense patches of the edible seaweed limu kohu *Asparagopsis taxiformis* (bottom) occurred throughout this area, but was not observed on the reefs offshore of Honua`ula/Wailea.

APPENDIX A

Photo-quadrats
Survey transects off of Honua`ula Maui
February 2010



HONUA'ULA BENTHIC MONITORING – FEB. 2010 TRANSECT 1-1 QUADRADS 1-10.



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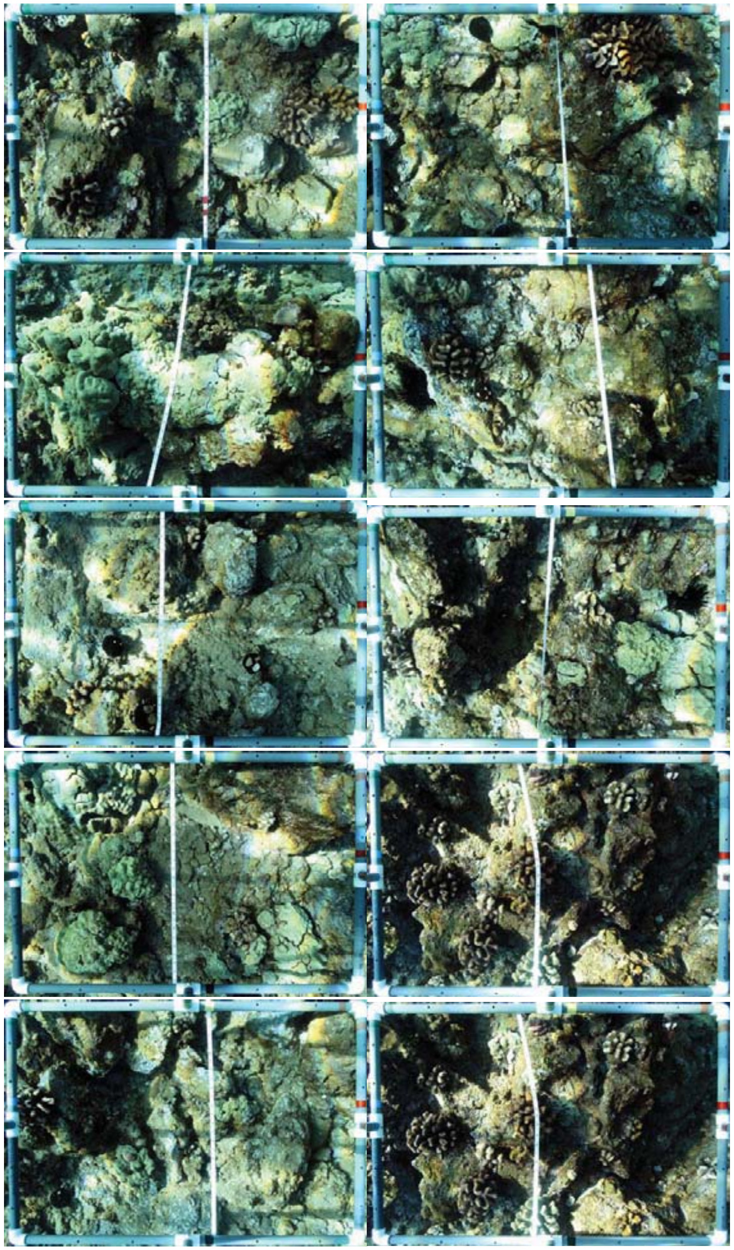
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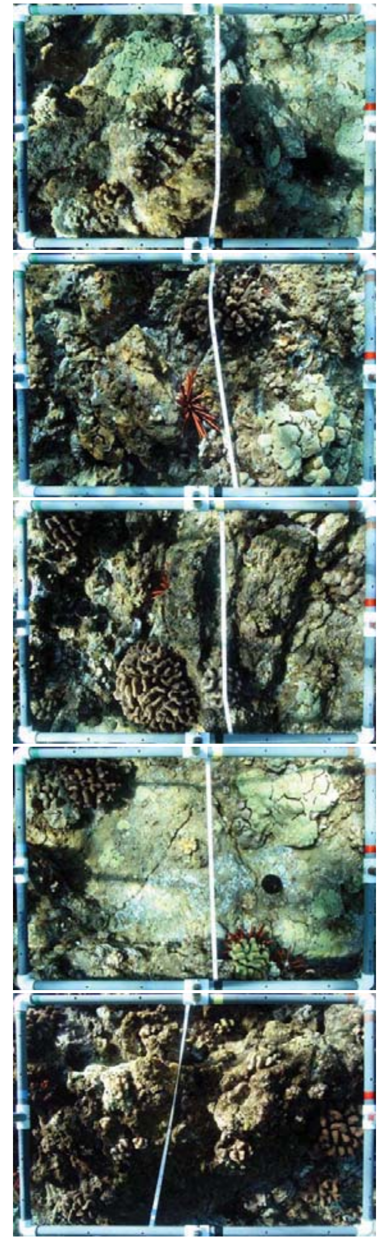
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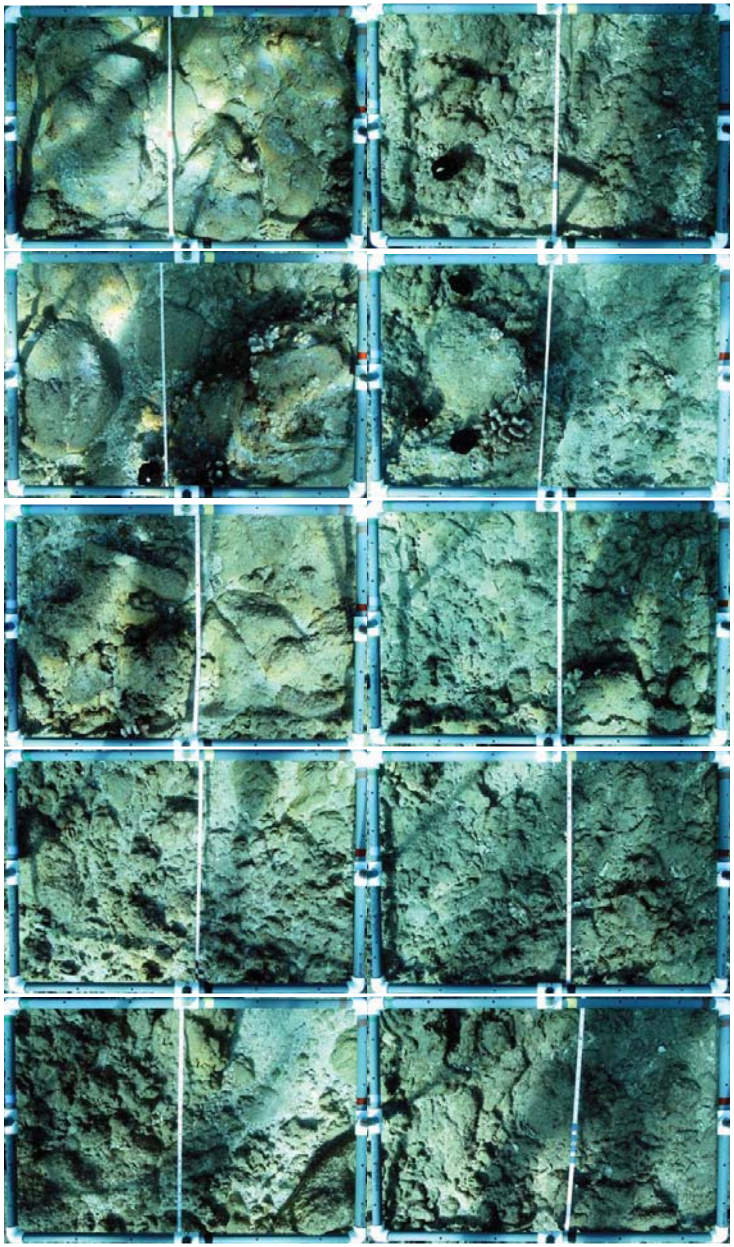

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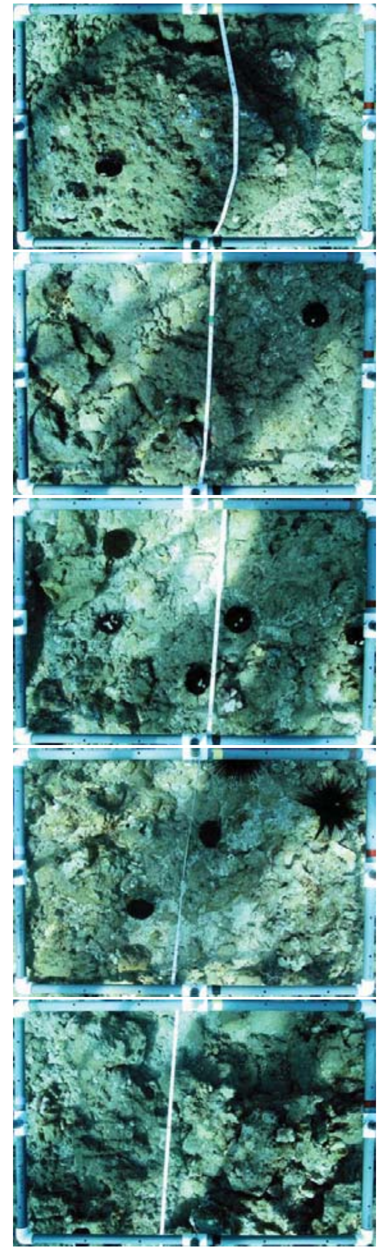

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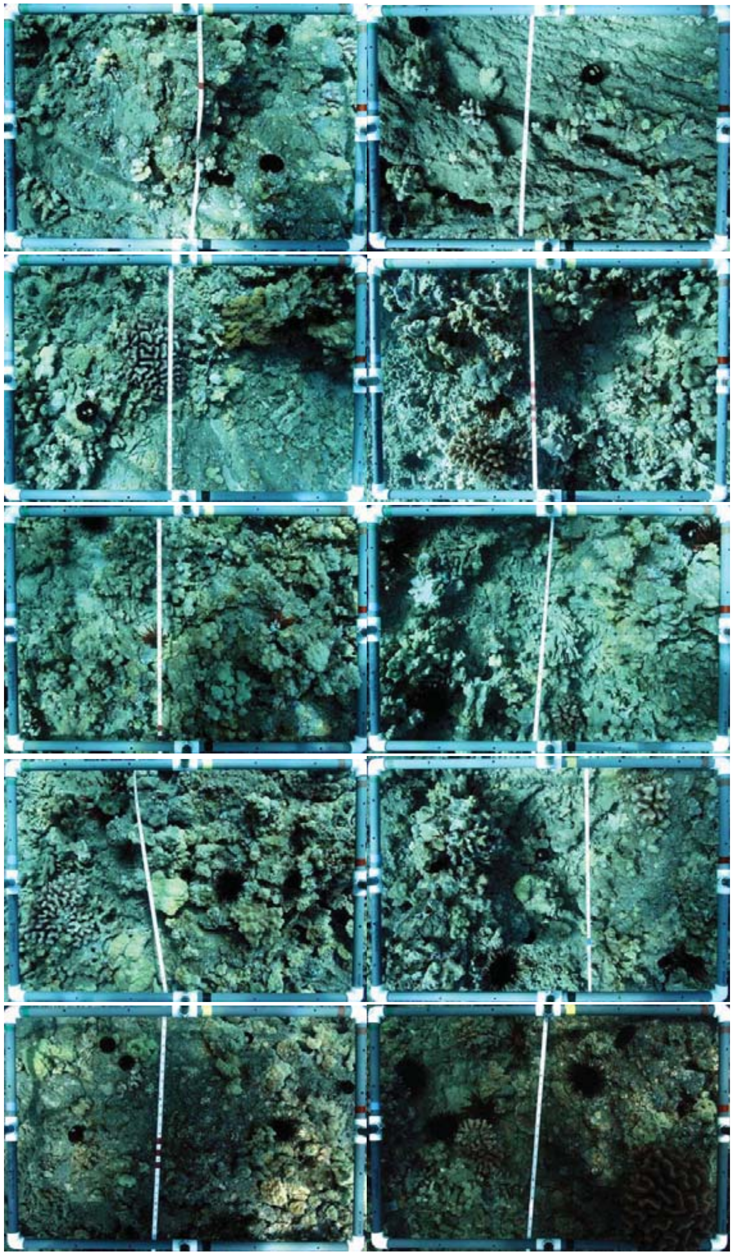

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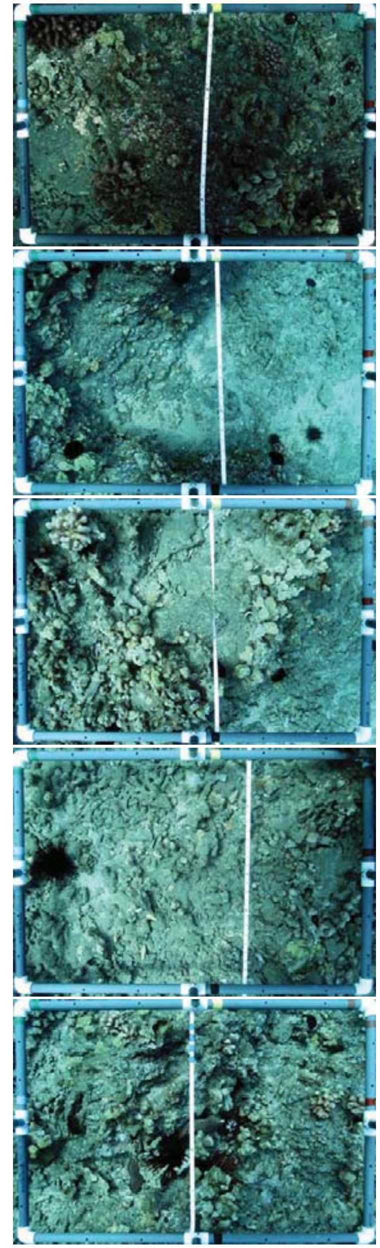

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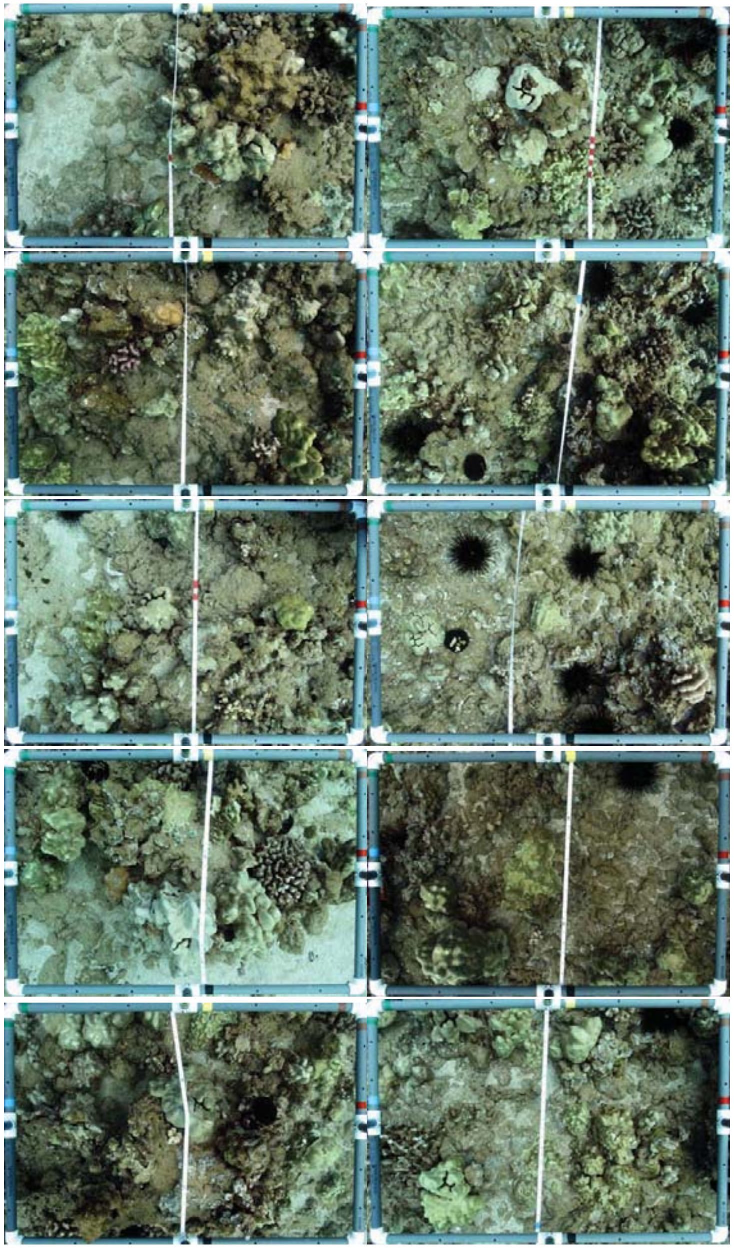

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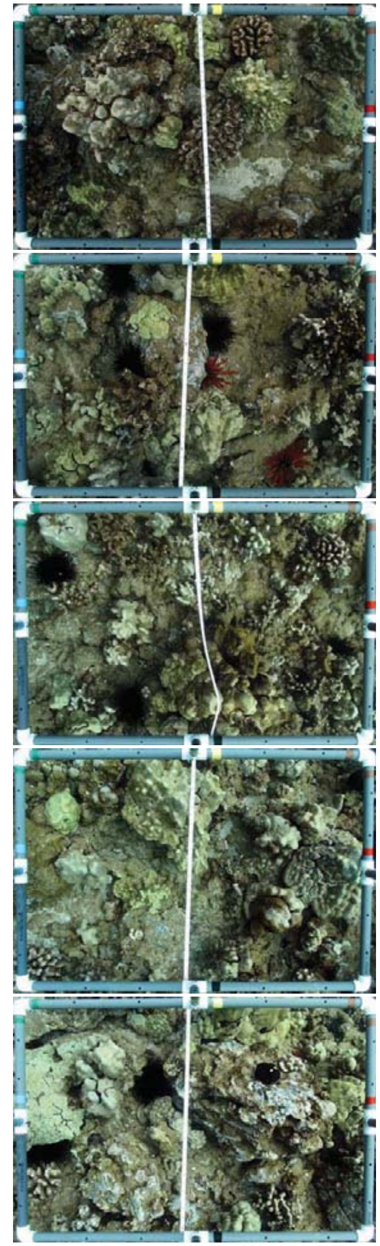

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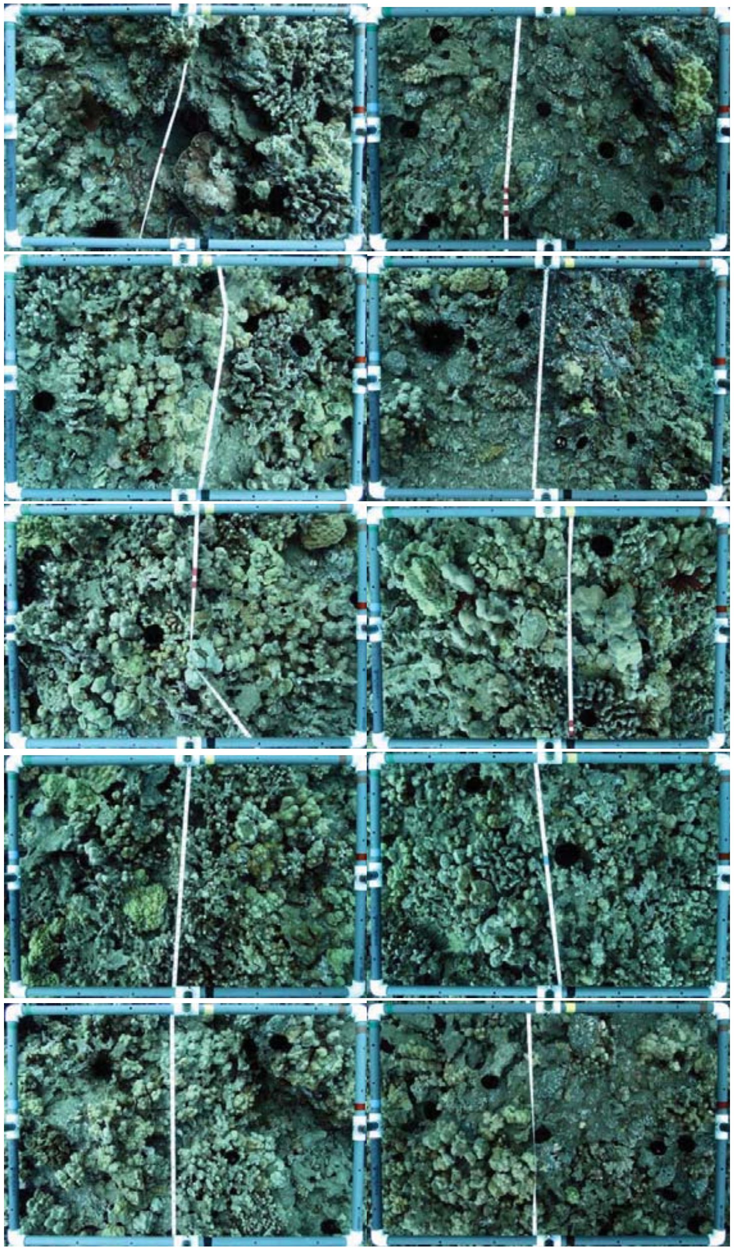

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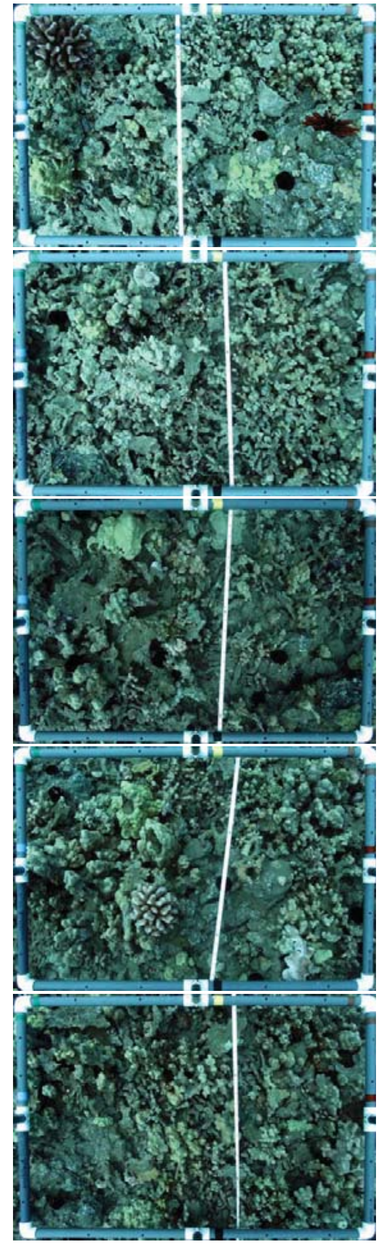


HONUA'ULA BENTHIC MONITORING – FEB. 2010 TRANSECT 3-2 QUADRADS 11-15.

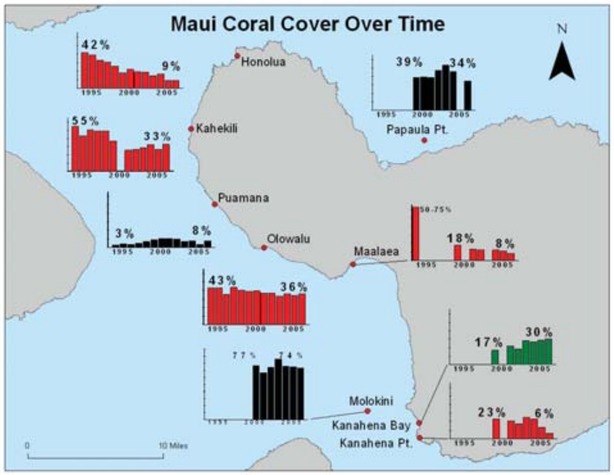
Status of Maui's Coral Reefs

In 1999, The Hawaii Division of Aquatic Resources (DAR) in partnership with the Coral Reef Assessment and Monitoring Program began annual surveys of coral condition at 9 reef areas in Maui County (see map ?). The 4 West Maui stations had been previously monitored by the Pacific Whale Foundation since 1994. Those long-term monitoring programs provide an opportunity to assess the status and trends of Maui's coral reefs over the last 7 to 13 years.

Coral Status and Trends:

- Coral cover in 2006 ranged from 74% at Molokini to <10% at 4 sites: Honolua (9%), Puamana (8%), Maalaea (8%), and Kanahena Pt (6%).
- Coral cover increased at only 1 reef (Kanahena Bay, 17% to 30%), remained stable (<5% change), at 3 reefs (Molokini, Papaula Point, and Puamana), and declined at 5 reefs, most dramatically at Honolua (42% to 9%) and at Kahekili (55% to 33%).
- Mean coral cover of the 9 reefs declined from 35% when sites were first surveyed (1994 for West Maui, 1999 elsewhere) to 27% in 2006. Thus, nearly ¼ of all living coral was lost over that period.

Given the strong likelihood that several of the sites were already somewhat degraded when monitoring began, recent trends almost certainly underestimate declines over longer timeframes. For example, coral cover at the Maalaea site declined from 18% to 8% between 1999 and 2006, but a 1993 Fish & Wildlife Service study estimated coral cover there as being between 50% and 75%.



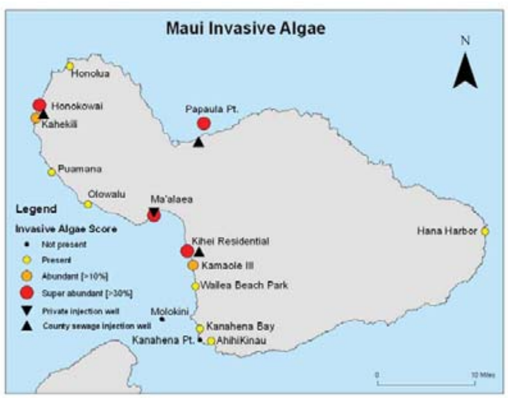
Trends in coral cover at 9 long-term monitoring stations. **Red** indicates >5% decline over monitoring period, **green** indicates >5% increase, **black** = no change (<5%)

The causes of coral reef decline around Maui are complex and vary among locations, but there are strong indications that human impacts have been very important. Notably, cover has declined at several West Maui sites: Honolua Bay, Kahekili, shallow reefs of Olowalu, and at Maalaea, where anthropogenic impacts from shoreline development and human use are likely greatest. Conversely, sites which have experienced increases or sustained high coral cover are remote or offshore (Kanahena Bay and Molokini). The one observed decline on a relatively remote reef (at Kanahena Point since 2004) was due to a local outbreak of the coral-eating crown-of-thorns starfish.

The Growing Problem of Invasive Algae

A significant and growing concern is the increasing overgrowth of reefs by invasive seaweeds, particularly *Acanthophora spicifera*, *Hypnea musciformis and Ulva* spp.. Shallow reefs in Kihei and Maalaea are now almost totally overgrown by those species and *A. spicifera* has become much more abundant in recent years at other locations including Honokowai/Kahekili and Papaula Point. Algal blooms are indicative of a loss of balance between factors which promote algal growth (e.g. nutrient availability) and those which control algal abundance (e.g. grazing). It is likely that both high nutrients & low grazing have been important:

- Studies by researchers from University of Hawaii (UH, next page), together with the evident correspondence between reefs with severe algal blooms and coastal areas with high human population density (see ?), strongly suggest that elevated nutrients from wastewater or fertilizers are fueling accelerated algal growth.
- Reefs with abundant herbivorous fishes, such as those in the Honolua and Molokini MLCDs, have little or no invasive algae present, whereas reefs with depleted herbivore populations (e.g. Maalaea) are severely overgrown by algae.



Distribution of invasive algae around Maui: 'present' means invasive species found only in low abundance & in limited habitats, 'abundant' indicates cover of 10-30% on extensive portions of reef; 'super-abundant' means >30% algal cover in multiple reef zones

Appendix E

Botanical Surveys

Botanical Survey – Honuaʻula

BOTANICAL SURVEY OF HONUA'ULA (WAILEA 670), KĪHEI, MAUI

PREPARED FOR

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August 2008
Updated January 2010

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1.0 INTRODUCTION

1.1 Objectives

SWCA Environmental Consultants (SWCA) was tasked to conduct a botanical survey within the 271 ha (670 ac) Honua'ula (Wailea 670) Property (hereinafter referred to as the 'Property') in Kīhei, Maui. The objectives of the survey were to: 1) describe the vegetation on the Property; 2) document all the plant species found on the Property; and 3) identify and map the location(s) of native plants. This report documents the results of the botanical survey, offers conservation management recommendations, and provides mitigation alternatives to address the Phase I project district zoning conditions promulgated by the Maui County Council. The survey also supports the Environmental Impact Statement (EIS) being prepared for the project by PBR Hawaii, Inc. in accordance with Chapter 343 Hawaii Revised Statutes (HRS). A companion document addressing wildlife and plant-related wildlife issues was prepared by SWCA and is submitted under separate cover (SWCA 2009a). Further documentation will detail the conservation and stewardship plan for the Native Plant Preservation Area and an animal management plan as required by the Maui County Council (SWCA 2009b).

Botanical surveys conducted in support of EIS and environmental assessments (EA) under HRS Chapter 343 are typically qualitative descriptions of vegetation and lists of species observed during brief pedestrian surveys. They are characteristically limited to a single survey rather than repeated seasonal assessments, and rarely the result of rigorous, quantitative research. In the past, greater emphasis was placed upon individual species than the ecosystems in which they occurred. To better address concerns raised by the Maui County Council and members of the public over the presence of native plants within the southern portion of the Property, SWCA set out to conduct a thorough quantitative assessment of site vegetation in order to obtain the best possible understanding of vegetation types and plant species present within the Property.

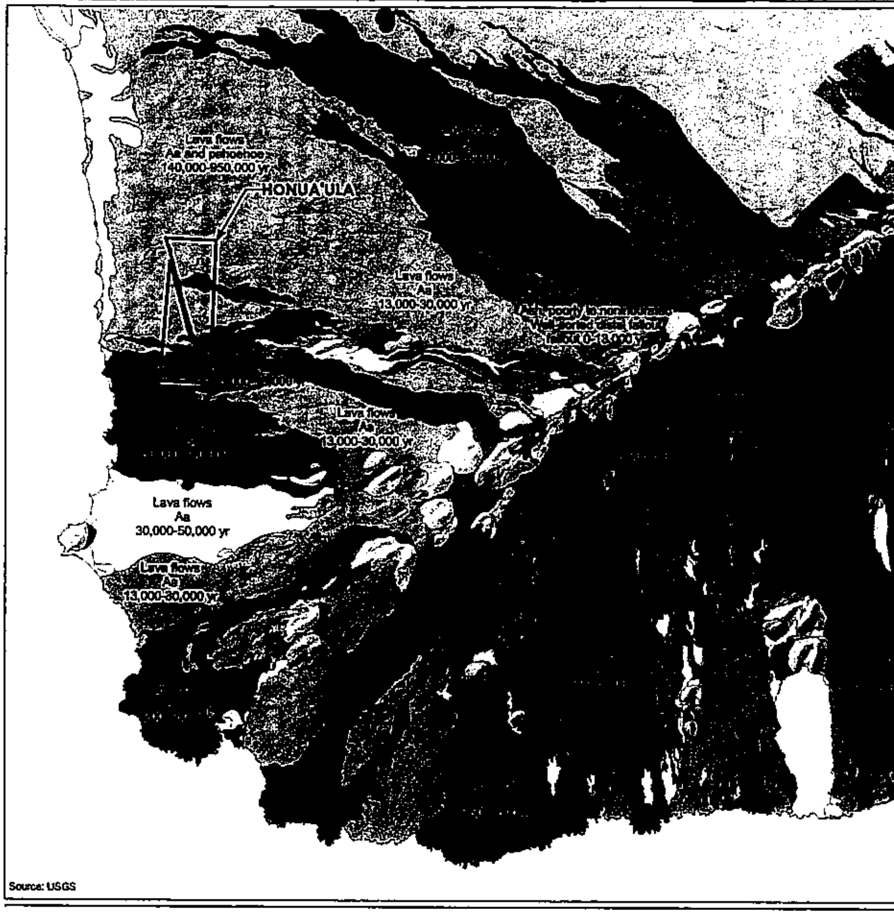
1.2 Project Summary

Honua'ula is a planned mixed-residential community encompassing a rectangular area of 271 ha (670 ac) east of, and adjacent to, the existing Wailea Resort in Kīhei, Maui. It is bounded by the Maui Meadows subdivision to the north, the Makena golf course to the south, the Wailea golf course to the west, and the 'Ulupalakua Ranch to the east (Figure 1). An EIS was first published for the development (then known as Wailea 670) in 1988 (PBR Hawaii 1988). Project district zoning was approved for the entire 271 ha in 1993, and approximately 170 ha (420 ac) was approved for golf course development and accessory uses. The following year, the State Land Use Commission issued a decision and order on urban land use designation. Since 1988, the project has had several owners.

After six years of project revisions by the present owner to accommodate community concerns, the Maui County Council approved Phase I conditional Project District Zoning for 271 ha allowing for residential, limited commercial, golf course, and open space zoning. With this approval, the Maui County Council issued several conditions regarding the conservation of natural resources. Their conditions included the creation of a Native Plant Preservation Area and stewardship plan for the propagation of native dry land forest plants within the Property. The conservation and stewardship plan (SWCA 2009b) incorporates findings, conclusions, and recommendations of this report and a sister report prepared by SWCA on the wildlife resources of the Property.

1.3 Physical Setting

Approximately 200 ha (495 ac) of land in the northern three-quarters of the Honua'ula Property within the Paeahu ahupua'a consists of older lava flows of the Kula Volcanic Series (Figure 2). Older Kula lavas range in age from 140,000 to 950,000 years old, while younger Kula lavas in the central portion of the parcel may be between 13,000 and 30,000 years old (USGS). Weathering of lavas led to the formation of a thin layer of soil over the northern portion. About 70 ha (173 ac) of younger Hana Volcanic Series flows within the Palauea ahupua'a make up the southern quarter of the Property. The southern lava flows are estimated to be between 5,000 and 13,000 years old (Figure 2) and have not undergone extensive weathering.



Legend

- Project Boundary

Geology

- Qa, Alluvium
- Qbd, Beach deposits
- Qdy, Younger dune deposits
- Qhn, Hana Volcanics
- Qhn0, Hana Volcanics
- Qhn1, Hana Volcanics
- Qhn2, Hana Volcanics
- Qhn2v, Hana Volcanics
- Qhn3, Hana Volcanics
- Qhn6, Hana Volcanics
- Qhne, Hana Volcanics
- Qhnt, Hana Volcanics
- Qhnv0, Hana Volcanics
- Qhnv1, Hana Volcanics
- Qhnv2, Hana Volcanics
- Qhnv3, Hana Volcanics
- Qhnv4, Hana Volcanics
- Qhnv5, Hana Volcanics
- Qhnv6, Hana Volcanics
- Qkui, Kula Volcanics
- Qkul, Kula Volcanics
- Qkul?, Kula Volcanics
- Qkuls, Kula Volcanics
- Qkuv, Kula Volcanics
- Qkuv?, Kula Volcanics
- Qls, Landslide deposits
- Qtc, Talus and colluvium

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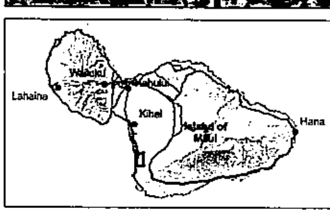
Figure 2
Geology Map



Legend

- Honua'ula Project Boundary
- TMK Parcels

Aerial Source: Microsoft 2009
Boundary and Parcel Source: PBR Hawaii

Figure 1
Aerial Photograph

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This area is characterized by an extremely rough surface composed of broken 'a'ā lava blocks called clinker with little or no soil accumulation (PBR Hawaii 1988). The terrain slopes gently at about 12% in an east to west direction across the Property. Steeply sloping ridges and gulches dissect the parcel, particularly in the north. The soils and lavas covering the Property, and the drainage gulches that run across the land, strongly influence the nature of the vegetation that grows there.

1.4 Literature Review

At one time, Rock (1913) suggested that lowland dry and mesic forests in Hawai'i had more native tree species than any other area in the state. Since then, however, native lowland dry forests have been degraded by non-native herbivores and invaded by alien shrubs and grasses (Wagner, et al. 1999). True native dry forests are acknowledged to be the rarest native plant community within the main Hawaiian Islands (Bruegmann 1996) and the nation (Noss and Peters 1995). Bruegmann (1996) estimated that over 90 percent of Hawai'i's native dry forest habitats have been severely fragmented and degraded. Williams (1990) and Cabin et al. (2000a, 2000b) summarized the causative factors of this loss citing pre-contact fire and deforestation, non-native ungulate grazing, alien species invasions, and conversion of forests for agricultural, urban, and military uses.

During the Second World War, the military used lands in Kīhei for training and maneuvers (P. Erdman, Ulupalakua Ranch, pers. comm.). Activities within and adjacent to the Property included a Navy Underwater Demolition Team (UDT) training base at Kamaole, an Army camp at Makena, and amphibious assault training exercises by the Marine Corps. Jeep roads were bulldozed inland and cross-country movement by armored vehicles and troops were conducted. Following 1945, the area was returned to open pasture. Periodic bulldozing of the highway easement connecting Kīhei to 'Ulupalakua by the State of Hawai'i, grazing pressure from axis deer (*Axis axis*) and feral goats (*Capra hircus*), and unauthorized *kiawe* (*Prosopis pallida*) logging have caused further disturbance to the area.

Char and Linney (1988) conducted the first botanical survey within the Property area. They observed 132 plant species in three distinct vegetation types: *kiawe* (*Prosopis pallida*)/buffelgrass (*Cenchrus ciliaris*) pasturelands, gully vegetation, and scrub vegetation. Twenty-one of the 132 plant species they observed are native to Hawai'i. The remaining 111 are non-native species. They found no threatened or endangered plant species within the Property. However, they identified one candidate species, *'āwikiwiki* (*Canavalia pubescens*), and several uncommon native species on the site including *nehe* (*Lipochaeta rockii*), *'ānunu* vine (*Sicyos hispidus*), *maiapilo* (*Capparis sandwichiana*), and *kolomona* (*Senna gaudichaudii*). Char and Linney (1988) recommended that a small area in the southwestern corner of the Property where they found *'āwikiwiki* (*C. pubescens*) and representatives of other uncommon native plants be left intact. However, sometime prior to 1996, unknown persons bulldozed the area and the plants were lost.

The *nehe* plants (*Lipochaeta rockii*) reported from the Property have a distinct leaf shape (A.C. Medeiros, USGS, pers. comm.); however, the current Manual of Flowering Plants of Hawaii (Wagner et al. 1999) did not find sufficient scientific evidence to recognize it as a distinct variety or subspecies. Herbst (Bishop Museum, pers. comm.) suggested that it might easily hybridize with other plants of the same species.

Recently, Altenberg (2007) drew attention to the southern portion of the Property which he claimed to be among the best examples of a remnant native lowland dry forest remaining on Maui. He suggested that Honua'ula "contains most of the 3rd largest contiguous area of *wiliwili* (*Erythrina sandwicensis*) habitat on Maui, approximately 110 acres in the southern 1/6 of the property" (Altenberg 2007). Altenberg recommended that an area of approximately 45 ha (110 ac) be preserved for its ecological significance. He found 20 native plant species (including 12 endemic species) concentrated in the southern one third of the Property. Four of the native species he observed - *pua kala* (*Argemone glauca*), *alena* (*Boerhavia herbstii*), *'akoko* (*Chamaecyse celastroides* var. *lorifolia*), and *'ānunu* (*Sicyos pachycarpus*) - had not been reported by Char and Linney (1988) or Char (1993, 2004). Char and Linney (1988) and Char (1993, 2004) reported five species within the Property that were not found by Altenberg (2007): maidenhair fern (*Adiantum capillus-veneris*), *pellaea* (*Pellaea ternifolia*), *kakonakona* (*Panicum torridum*), *Solanum americanum* (*popolo*) and *alena* (*Boerhavia repens*).

Gagne and Cuddihy (1999) noted that native dry forest communities occur on all of the main islands at 300-1,500 m (984-4,921 ft) in elevation, especially on leeward aspects or in the rain shadows of mountains. Precipitation is between 500-2,000 mm (17-79 in) annually, and is usually concentrated between November and March. Gagne and Cuddihy (1999) noted that lowland dry forests usually "grade into lowland dry grasslands or shrub lands below 300 m elevation..." The semi-arid Honua'ula Property lies between 90-245 m (295-804 ft) elevation, and is estimated to receive about 300 mm (12 in) of precipitation annually. Hence, the southern portion of the Property may be described more accurately as a highly disturbed, remnant native coastal dry shrubland (sensu Gagne and Cuddihy 1999) in which *wiliwili* (*Erythrina sandwicensis*) has become a common inhabitant. Medeiros (USGS, pers. comm.) suggested that mature *wiliwili* (*Erythrina sandwicensis*) trees may be found throughout southeastern Maui, often in abundance and greater densities than those encountered in the Property. Altenberg (2007) identified eight *wiliwili* (*E. sandwicensis*) forests in southeast Maui including Kanaio, Pu'u o Kali, Honua'ula / Wailea 670, Makena, La Perouse, Kaupo, Lualailua, and Waikapu.

The recent US Geological Survey GAP Analysis Program (Figure 3) maps classified landcover within the Property as largely "XT: open kiawe forest and shrubland (alien grasses)", "Y: uncharacterized open-sparse vegetation", with small patches of "XG: alien grassland" and "XT: alien forest". Price et al. (2007) recently developed methods using bioclimatic data to map habitat quality for and range of two widespread plant species including *wiliwili* (*Erythrina sandwicensis*) and two rare plant species throughout the Hawaiian Islands. The area encompassed by the Property appears on these maps as 'medium' to 'low' habitat quality for *wiliwili* (*E. sandwicensis*) (Price et al. 2007). However, numerous areas in southeastern Maui located between Pu'u Ola'i and Kaupo outside the Property did appear as having 'high' habitat characteristics on the maps prepared by Price et al (2007).

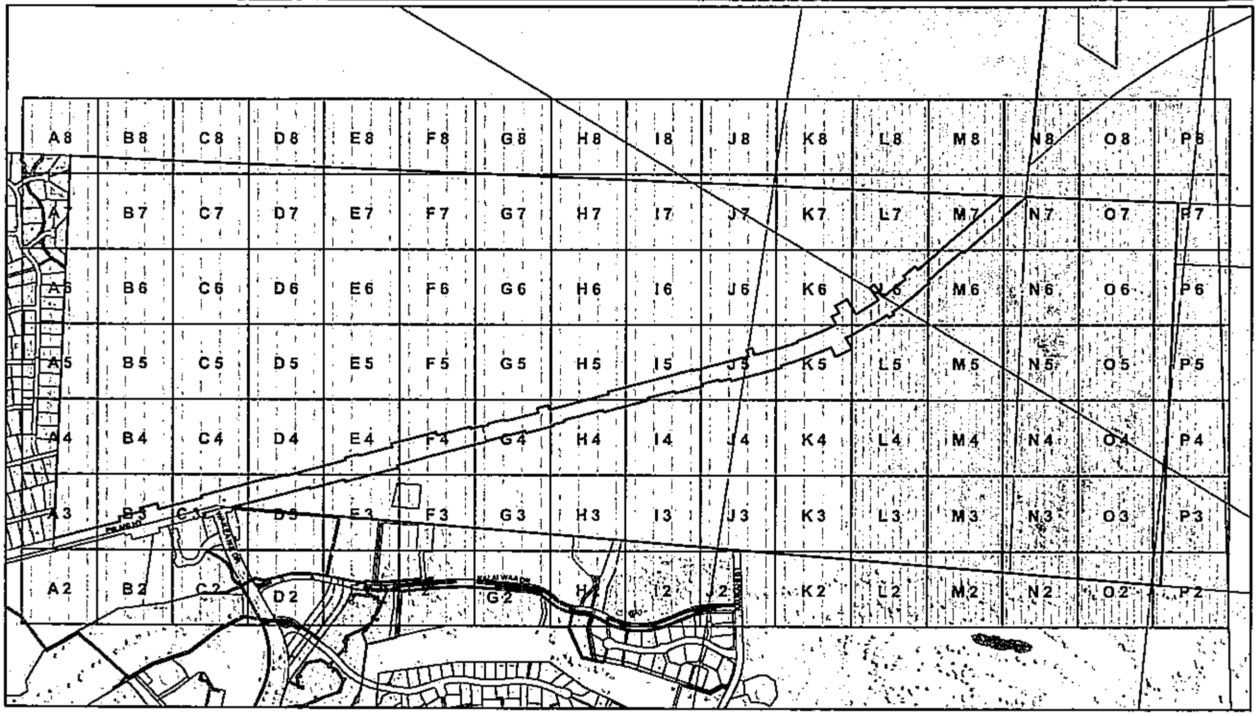
2.0 METHODS

Spatially explicit information on the composition and structure of plant communities within the Property is needed to meet the survey objectives, especially if data are to be used to make conservation, management and long-term monitoring and ecological research recommendations for the Property. However, the relatively small Property and the nature of the understory vegetation prevent the effective application of remote sensing technologies typically used in vegetation mapping. Therefore, SWCA botanists developed a sampling method to meet all three study objectives. High resolution field sampling techniques were designed based upon previous reconnaissance surveys conducted by SWCA, cooperating government, and other scientists on March 6-8, 13-15, 24-26, 2006; January 4-5, February 24-26, and October 18, 2007.

2.1 Field Surveys

A modified one-dimensional line transect method of plot-less sampling (Barbour et al. 1987) was employed by SWCA botanists across the entire Property. Linear transects were established at regular 20 m (65.6 ft) intervals across the remnant mixed *kiawe-wiliwili* shrubland in the southern portion of the Property, and at regular 50 m (164 ft) intervals across the entire northern portion of the Property (Figure 4). Transects in the northern portion of the Property were placed 50 m apart because, compared to the southern rugged 'a'ā lava flow with scrub vegetation, the northern 200 ha (495 acres) of Property is open pastureland and is known to harbor fewer native plant species (Char and Linney, 1988 and Altenberg 2007). The advantages of plot-less sampling are: 1) a sample plot does not need to be established, saving time; and 2) elimination of subjective error associated with the sample plot boundaries. This method also allowed us to sweep the entire project site to record more native plants than would have been found through sample plots and/or quadrats.

Transects were pre-established on an 800 x 1200 m (0.5 x 0.75 mi) map-overlay with ARC GIS software developed by Environmental Science Research Insititute (ESRI), and pre-loaded into Trimble GeoXT (Pocket PC) Global Positioning System (GPS) units with Terrasync 2.4 GPS software. Field surveys for this study were conducted within the southern 70 ha (173 acres) of scrub vegetation on March 8-10, 2008 and March 29-31, 2008, by botanists Shahin Ansari, Ph.D., Maya LeGrande, M.S., Ane Bakutis, M.S., Hina Kneuble, M.S., Talia Portner, B.S., Tiffany Thair, (M.S. candidate), and GIS Analyst Ryan Taira, B.A.



Legend

Transects

Parcels

Project Boundary

200 Meter Grid

Figure 4
Grid and Transects Map

0 250 500 1,000 ft

0 50 100 200 M

N

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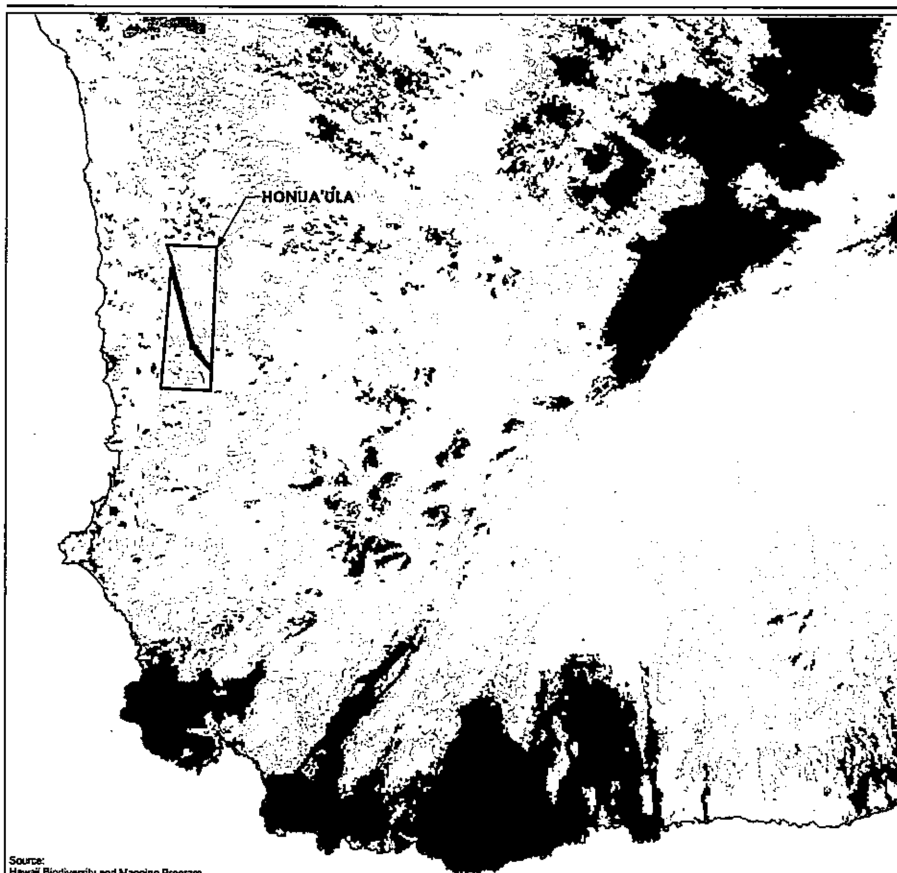
Parcel and Boundary Source: PBR Hawaii



Legend

Project Boundary

Landcover

- NG: Deschampsia Grassland
- NS: Bog Vegetation
- NS: Native Dry Cliff Vegetation
- NS: Native Shrubland (alien grasses)
- NS: Native Shrubland / Sparse Ohia (native shrubs)
- NS: Native Wet Cliff Vegetation
- NS: Uluhe Shrubland
- NT: Closed Hala Forest
- NT: Closed Koa-Ohia Forest (native shrubs)
- NT: Closed Koa-Ohia Forest (uluhe)
- NT: Closed Ohia Forest (native shrubs)
- NT: Closed Ohia Forest (uluhe)
- NT: Ohia Forest (native shrubs and uluhe)
- NT: Open Koa-Ohia Forest (native shrubs)
- NT: Open Ohia Forest (native shrubs)
- NT: Open Ohia Forest (uluhe)
- Undefined
- W: Water
- X Agriculture
- X: High Intensity Developed
- X: Low Intensity Developed
- XG: Alien Grassland
- XG: Kikuyu Grass Grassland / Pasture
- XS: Alien Shrubland
- XS: Alien Shrubs and Grasses
- XT: Alien Forest
- XT: Closed Kiawe - Koa Haole Forest and Shrubland
- XT: Kiawe Forest and Shrubland
- XT: Open Kiawe Forest and Shrubland (alien grasses)
- Y: Uncharacterized Forest
- Y: Uncharacterized Open-Sparse Vegetation
- Y: Uncharacterized Shrubland
- Z: Very Sparse Vegetation to Unvegetated

N

0 0.5 1 2 Km

0 0.5 1 2 Mi

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Source:
Hawaii Biodiversity and Mapping Program
Center for Conservation Research and Training (CCRT)
University of Hawaii

Figure 3
HI-GAP Landcover

The northern portion of the Property was surveyed by the team on May 27- 29, 2008. Three two-person teams concurrently walked abreast along adjacent transects. Each team was responsible for locating and mapping native plants 10 m (33 ft) on either side of each transect. At each plant feature, 10 to 15 data points were collected and averaged to produce a single GPS point. GPS data was collected along transects using Wide Area Augmentation System (WAAS) for real time differential GPS (DGPS). At the end of each transect, the botanists moved to adjacent transects to continue their search until all transects were surveyed. Mapping was conducted at an approximate rate of 0.4 km/ hr (0.25 miles/ hr). Surveys commenced at the southeastern corner of the Property (grid P8) and proceeded to the south-west corner (grid P2; Figure 4). The entire length of each transect was surveyed, totaling 78,500 m (48.7 mi) across the Property.

A single GPS point was collected at the center of each discrete patch of vines, herbaceous and small shrub species. Herbs, shrubs, and vines less than 15 cm (6 inch) tall that were not flowering or fruiting were considered seedlings. For each patch, the botanists documented the phenology, number of individuals (seedlings and adults), aerial diameter of the patch (m), presence/ absence of signs of herbivory (such as chewed leaves or stems, scraping of the leaf surface), damage (broken off branches) and/or disease (wilting, yellowing of the whole or part of the plant). If patches were very large (> 5 m^2 or 54 ft^2), a GPS point was collected every 5 m^2. Where multiple *wiliwili* trees (*E. sandwicensis*) were found with overlapping canopies, a single GPS point was collected at the approximate center of the grove of trees. Botanists also noted the aerial canopy diameter and the number of seedlings/ juveniles and adult plants within a grove. Large tree species with trunks less than 15 cm (6 inch) in diameter were regarded as juveniles.

Hoary abutilon (*Abutilon incanum*), *koali awahia* (*Ipomoea indica*), *'ilima* (*Sida fallax*), *popolo* (*Solanum americanum*), *'ilie'e* (*Plumbago zeylanica*), *alena* (*Boerhavia* spp.), and *'uhaloa* (*Waltheria indica*) were abundant and widespread indigenous (versus endemic) species common throughout the southern 'a'ā lava flow. Therefore, individuals of these species were not mapped. This is consistent with the methods of Altenberg (2007).

2.2 Mapping and Data Analysis

GPS field data was post-processed with GPS Pathfinder Office software and used to differentially correct to a Continuously Operating Reference Station (CORS). Most features were accurate to sub-meter precision. Data was exported in ESRI ArcGIS to shape file format in NAD 83 (Cors 96) UTM Zone 4 meters using WGS 84 to NAD 83_4 transformation. ESRI ArcView 9.2 software was used for digital mapping.

To better visualize the distribution of native plant species, a graduated circle map was created showing the distribution of all species based on the number of plants mapped at each location (GPS point). Circles of different color represent different species, the size of the circle reflects the number of individuals mapped at each location and assigned to one of six count classes; 1-5, 6-10, 11-15, 16-25, 26-60, and 61-110 individuals. While the graduated circle map is informative, a more effective way to find the greatest concentration of the native plant resources is to map the densities of each species.

Vegetation density maps were created using kernel density which is based on the quadratic kernel function described in Silverman (1986). The 26 native species known to occur in the Property were arranged in order of their relative importance by the project botanists and only the top eight endemic and indigenous plant species that are uncommon within the Property and elsewhere in the State were included in the GIS density analysis (Table 1). Density of these selected eight native plant species was evaluated as a means of identifying suitable boundaries for a Native Plant Preservation Area within a portion of the Property based upon their greatest concentration.

Using the ArcView GIS Spatial Analyst extension, SWCA converted species count classes of the eight species to density (number of species/acre) classes. These resulting density maps allow comparison of native plants on the same spatial scale. However, density maps for these species varied greatly from 0-57 plants per acre for *wiliwili* (*Erythrina sandwicensis*) to 0-1 plant per acre for *'āwikiwiki* (*Canavalia pubescens*). Therefore, the maps were further standardized by reclassifying the densities for the species to a common scale where nine (9) represented the highest density for each species and one (1) represented lowest. The reclassified density maps

were then overlaid with a percent weight assigned to each. Each species was assigned a different weight by the project botanists based on their relative botanical importance throughout the State and Property (Table 2). The density maps and the overlay analysis were developed using 100 m (328 ft) resolution to define specific and contiguous preservation areas that protect the greatest concentration of rare native plant species within the Property.

Table 1. Native plants reported from the Property arranged in order of their relative importance by project botanists. *Group 1 = endemic (E) and indigenous (I) plants uncommon within the Property as well as elsewhere in the State, and/or of significance to life stages of the endangered Blackburn sphinx moth (Manduca blackburni); Group 2 = relatively common endemic species throughout Hawai'i, Group 3 = relatively common native (indigenous) species throughout Hawai'i.*

Species	Status	Hawaiian Name	Family
GROUP 1			
Lipochaeta rockii	E	*nehe*	Asteraceae
Canavalia pubescens	E	*paunu*	Fabaceae
Erythrina sandwicensis	E	*wiliwili*	Fabaceae
Capparis sandwichiana	E	*maiapilo*	Capparaceae
Senna gaudichaudii	I	*kolomona*	Fabaceae
Sicyos hispidus	E	*'ānunu*	Cucurbitaceae
Sicyos pachycarpus	E	*'ānunu*	Cucurbitaceae
Chamaesyce celastroides var. *lorifolia**	E	*'akoko*	Euphorbiaceae
Argemone glauca	E	*pua kala*	Papaveraceae
GROUP 2			
Myoporum sandwicense	E	*naio*	Myoporaceae
Panicum torridum	E	*kakonakona*	Poaceae
Heteropogon contortus	E	*pili*	Poaceae
Ipomoea tuboides	E	*ipomea*	Convolvulaceae
Boerhavia herbstii	E	*alena*	Nyctaginaceae
Doryopteris decipiens	E	*'iwa'iwa*	Adiantaceae
Plumbago zeylanica	E	*'ilie'e*	Plumbaginaceae
GROUP 3			
Dodonaea viscosa	I	*'a'ali'i*	Sapindaceae
Sida fallax	I	*'ilima*	Malvaceae
Boerhavia spp.**	I	*alena*	Nyctaginaceae
Abutilon incanum	I	hoary abutilon	Malvaceae
Ipomoea indica	I	*koali awahia*	Convolvulaceae
Waltheria indica	I	*'uhaloa*	Sterculiaceae
Pellaea ternifolia	I	*pellaea*	Adiantaceae
Adiantum capillus-veneris	I	maidenhair fern	Pteridaceae
Solanum americanum	I	*popolo*	Solanaceae

** A single stunted akoko was found within the Property in 2006; however, the plant was found to be dead in the late summer of 2007, and was not found at all during the 2008 surveys. Therefore, it is not considered in further plant density analysis for the purpose of defining boundaries of the native plant preserve.*
*** Two indigenous species of Boerhavia (repens and acutifolia) were reported within the Property during the SWCA surveys. Char and Linney (1988) and Char (1993, 2004) also found B. repens within the Property.*

2.3 Regional Assessment of *Wiliwili* Abundance

A low-altitude qualitative aerial survey of southeast Maui was conducted by biologists Robert Kinzie, Ph.D., John Ford, M.S., and GIS Analyst Ryan Taira, B.A. on July 11, 2008 to identify and photograph other areas where *wiliwili* (*Erythrina sandvicensis*) is common. During summer months, *wiliwili* (*E. sandwicensis*) trees drop their leaves and are easy to identify from the air. The aerial survey began at Kahului International Airport and extended along the Kīhei coast over undeveloped lands between 300-450 m (980-1500 ft) elevation toward the southeast to Lualailua, at altitudes ranging from 15-150 m (50-500 ft) above ground level (AGL).

Still photos and videos of *wiliwili* (*E. sandwicensis*) were collected with a SONY DCR-SR100 digital video camera with a Carl Zeiss® Vario-Sonnar® T lens. Still photos were also taken with a Pentax Optio W30 digital camera with a Pentax 6.3mm lens. *Wiliwili* (*E. sandwicensis*) trees within the Pu'u O Kali Preserve, Honua'ula, adjacent 'Ulupalakua Ranch and Makena Resort lands, Makena State Park, lands east of Pu'u Olai, Ahihi-Kinau, Kanaio, and Lualailua were photographed.

Table 2. Percent weight assigned for the eight species selected for density analysis; *based on their relative botanical importance throughout the State and the Honua'ula Project site.*

Species	Common Name	Percent Weight
Lipochaeta rockii (E)	*nehe*	16
Canavalia pubescens (E)	*paunu*	15
Erythrina sandwicensis (E)	*wiliwili*	14
Capparis sandwichiana (E)	*maiapilo*	13
Senna gaudichaudii (I)	*kolomona*	12
Sicyos hispidus (E)	*'ānunu*	11
Sicyos pachycarpus (E)	*'ānunu*	10
Argemone glauca (E)	*pua kala*	9

3.0 RESULTS

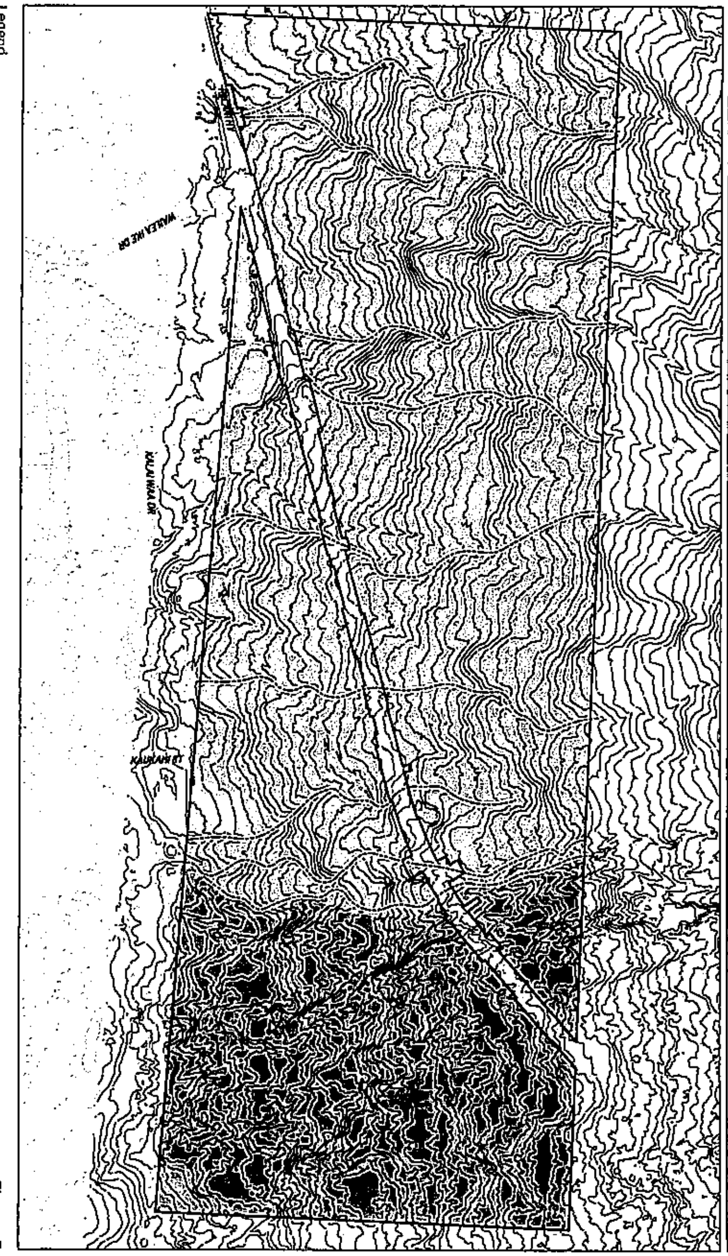
A complete list of all plants found within the site is provided in Appendix A. *Portulaca* sp. nov. was reported by Char and Linney (1988); however, it is not included in Appendix A because the species level was never determined and no known collections were made by Char and Linney (1988). All the native plant species described from the Property are known to occur elsewhere on Maui and the main Hawaiian Islands. Only the unique leaf form of Rock's *nehe* (*Lipochaeta rockii*) appears to be limited to the Property. Table 3 illustrates the occurrence of adult and seedling native plants within the Property.

Table 3. A comparison of the number of native plants and seedlings observed within the entire Honua'ula Property and the remnant mixed kiawe-wiliwili shrubland in the southern portion of the Property. *Prop = entire Honua'ula Property, KW = kiawe-wiliwili shrubland.*

Species (Hawaiian name)	Number of Points		Number of Seedlings		Number of Adults		Total Numbers Observed	
	KW	Prop	KW	Prop	KW	Prop	KW	Prop
Argemone glauca (pua kala)	26	26	247	247	165	165	412	412
Canavalia pubescens ('āwikiwiki)	5	5	0	0	5	5	5	5
Capparis sandwichiana (maiapilo)	311	312	14	14	548	549	562	563
Dodonea viscosa ('a'ali'i)	7	7	0	0	16	16	16	16
Doryopteris decipiens ('iwa'iwa)	2	14	0	2	7	52	7	54
Erythrina sandwicensis (wiliwili)	546	569	334	341	2105	2137	2439	2478
Heteropogon contortus (pili)	0	66	0	384	0	1109	0	1493
Ipomoea tuboides (ipomea)	5	5	0	0	5	5	5	5
Lipochaeta rockii (nehe)	24	24	56	56	45	45	101	101
Myoporum sandwicense (naio)	17	17	0	0	21	21	21	21
Senna gaudichaudii (kolomona)	28	32	1	5	36	38	37	43
Sicyos hispidus ('ānunu)	48	49	5	5	107	108	112	113
Sicyos pachycarpus ('ānunu)	101	102	313	313	289	290	602	603

3.1 Vegetation

Similar to the vegetation categories described by Char and Linney (1988), SWCA found three distinct vegetation types within the Property (see Figure 5). Each of these is described in the following paragraphs. Figure 6 illustrates the percent of introduced and native plants reported from each of the three predominant vegetation types.



Legend
Project Boundary
Vegetation Types
Kiawe-buffel Grass Grassland
Kiawe-wiliwili Shrubland
Gulch Vegetation

Boundary Source: PBR Hawaii
Aerial Source: Microsoft 2009

N
0 250 500 1,000 ft
0 50 100 200 M

Figure 5
Vegetation Types

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3.1.1 *Kiawe*-Buffelgrass Grassland

About 75% of the northern portion of the project parcel is characterized by an extensive grassland comprised primarily of *kiawe* (*Prosopis pallida*) and buffelgrass (*Cenchrus ciliaris*). There is scattered evidence that trespassers may be logging *kiawe* (*P. pallida*) trees for charcoal in this area. Guinea grass (*Urochloa maxima*), natal redtop (*Rhynchelytrum repens*), and sour grass (*Digitaria insularis*) are also scattered throughout the northern portion of the Property. Other plants found here include the invasive *koa haole* (*Leucaena leucocephala*), lantana (*Lantana camara*), partridge pea (*Chamaecrista nictitans*) and cow pea (*Macroptilium lathyroides*).

The area has been disturbed throughout by numerous jeep trails and unrestricted grazing by axis deer. Some open areas that appeared to be heavily grazed were devoid of buffelgrass (*Cenchrus ciliaris*), but contained the native shrubs *'ilima* (*Sida fallax*) and hoary abutilon (*Abutilon incanum*), and the introduced golden crown beard (*Verbesina encelioides*).

3.1.2 Gulch Vegetation

The vast expanse of *kiawe*-buffelgrass in the northern three quarters of the Property is bisected from east to west by several gulches that carry flood waters to the sea (Figure 5). These intermittent gulches vary in depth and are characterized by patches of exposed bedrock. The gulches are shaded by their steep walls providing relatively cool and moist conditions. Three species of ferns including maidenhair fern (*Adiantum capillus-veneris*), sword fern (*Nephrolepis multiflora*), and the endemic *'iwa'iwa* fern (*Doryopteris decipiens*) were found in the shaded rocky outcrops and crevices within the gulches. Native *Pili* grass (*Heteropogon contortus*) was found in more open and sunny locations. Other species found within the gulches include tree tobacco (*Nicotiana glauca*), *wiliwili* (*Erythrina sandwicensis*), lantana (*Lantana camara*), partridge pea (*Chamaecrista nictitans*), golden crownbeard (*Verbesina encelioides*), *'ilima* (*Sida fallax*), hoary abutilon (*Abutilon incanum*), *koa haole* (*Leucaena leucocephala*), indigo (*Indigofera suffruticosa*), *'uhaloa* (*Waltheria indica*) and lion's ear (*Leonotis nepetifolia*).

3.1.3 Mixed *Kiawe-Wiliwili* Shrubland

Remnant mixed *kiawe-wiliwili* shrubland was limited to the southern 'a'ā lava flow in the southern quarter of Property (Figure 5). Scattered groves of large-stature *wiliwili* (*Erythrina sandwicensis*) and *kiawe* trees co-dominated the upper story. Native shrubs, such as *'ilima* (*Sida fallax*) and *maiapilo* (*Capparis sandwichiana*), and the native vine *'ānunu* (*Sicyos pachycarpus*), were represented in the understory. Introduced shrubs, introduced grasses, and introduced vines and herbaceous species dominated the ground vegetation. Lantana (*Lantana camara*), found throughout the mixed *kiawe-wiliwili* shrubland, showed signs of dieback. Although abundant, the guinea grass (*Urochloa maxima*) found on the site was grazed to stubble, probably by axis deer.

3.2 Endangered, Threatened, and Candidate Endangered Species of Plants

No Federal or State of Hawai'i listed threatened, or endangered plant species were found in the Property. Over a period of time, Altenberg (2007) collected roughly 15 GPS points for *'āwikiwiki* vines (*Canavalia pubescens*) within the *kiawe-wiliwili* shrubland during his hikes across the Honua'ula parcel. It is unknown how many of his GPS points represent duplicate occurrences of the same plant. The U.S. Fish and Wildlife Service (2009) reported "a few individuals at Palauea-Keahou" [including the Property] based upon information received from Altenburg (2007) and Hank Oppenheimer (Plant Extinction Prevention Program, pers. comm.). During this study, the project botanists found only five (5) individual *'āwikiwiki* (*C. pubescens*) plants on the Property. All *'āwikiwiki* (*C. pubescens*) were flowering and fruiting at the time of the survey; however, no seedlings were detected. The plants appeared to be healthy with no signs of damage or disease.

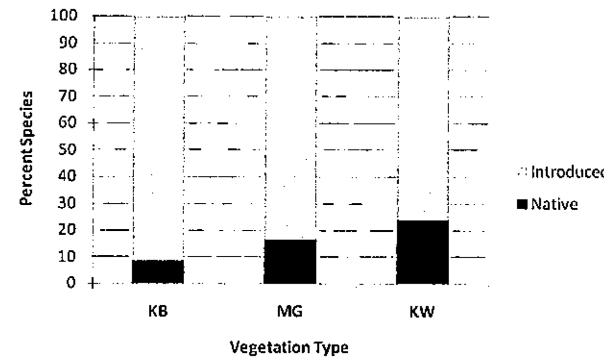


Figure 6. *Percent of native and introduced plant species found in each of the three predominant vegetation types within the Property.* *Data is pooled across all plant species (n= 146) observed by Char and Linney (1988), Altenberg (2007) and SWCA (this study). KB = Kiawe-buffelgrass grassland (n= 105, 9 natives and 96 introduced), MG = mixed gulch vegetation (n= 66, 11 natives and 55 introduced), KW = kiawe-wiliwili shrubland (n= 106, 26 natives and 80 introduced).*

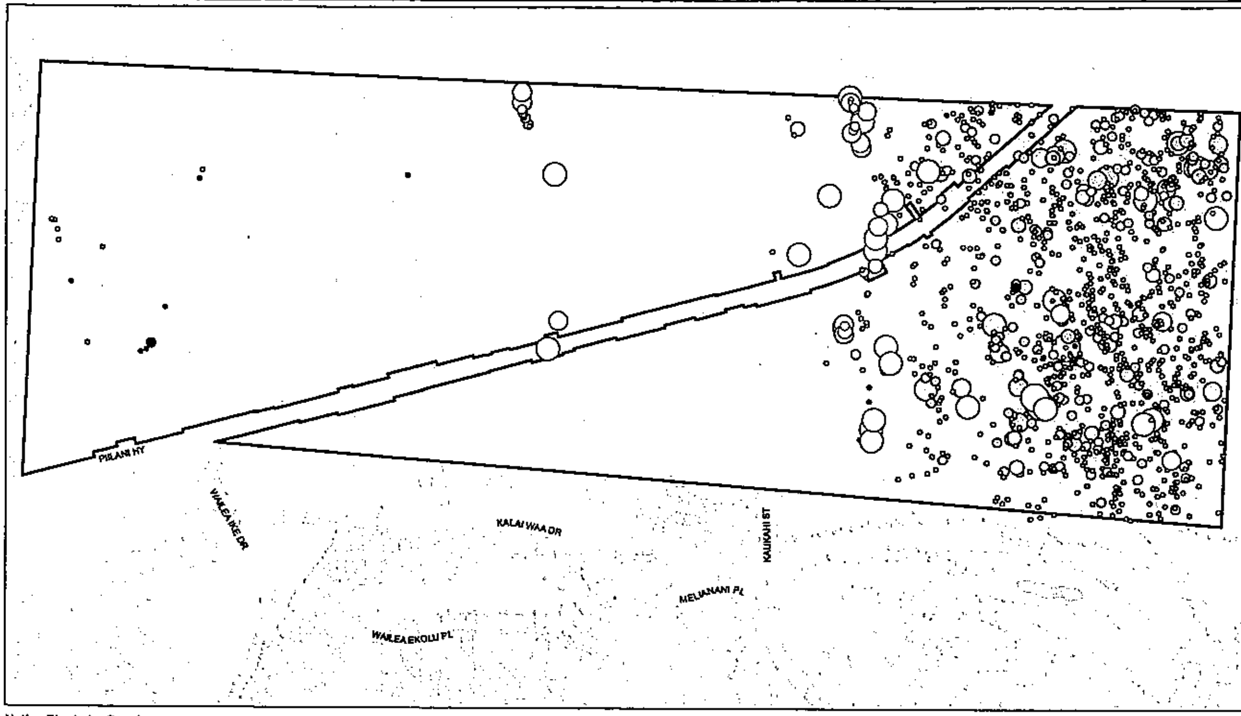
3.3 Distribution and Abundance of Native Plant Species

In all, 146 plant species have been identified within the Property, 26 of which are native, 14 of these endemic. The remaining 120 plant species are introduced non-native species. Of the 26 native species reported in previous surveys (Char and Linney 1988, Altenberg 2007), we found 21 during this study. We did not observe *Panicum torridum*, *Boerhavia herbstii*, *Adiantum capillus-veneris*, *Chamaesyce celastroides* and *Pallaea ternifolia* during our surveys. Figure 7 illustrates the location of native plants within the Property, and Figure 8 illustrates the distribution of native plant species within the Property by count.

As previously mentioned, hoary abutilon (*Abutilon incanum*), *koali awahia* (*Ipomoea indica*), *'ilima* (*Sida fallax*), *popolo* (*Solanum americanum*), *'ilie'e* (*Plumbago zeylanica*), *alena* (*Boerhavia* spp.), and *'uhaloa* (*Waltheria indica*) were abundant and widespread throughout the *kiawe-wiliwili* shrubland, and therefore were not mapped since it was not feasible to collect GPS data for each individual plant. Aside from these species and *'āwikiwiki* (*Canavalia pubescens*), which is discussed above and at length in Section 4.0, descriptions of the remaining native plants found on the Property appear below. Individual fact sheets, including photographs and distribution maps, of the native plants mapped by SWCA are found in Appendix B in alphabetical order by species name.

SWCA botanists found 412 *pua kala* (*Argemone glauca*) in 26 locations within the Property, all of which were limited to the southern 'a'ā portion of the Property (Table 3, Figure 8). Most clusters averaged 16 individuals, most of which were seedlings (60%). Clusters ranged from one to 39 m^2 with the average being 4 m^2 (n= 26 clusters). The majority of clusters occurred in the southwestern portion of the *kiawe-wiliwili* shrubland, usually in relatively open, sunny locations of the lava flow. All plants of this species we observed were flowering at the time of the surveys.

Maiapilo (*Capparis sandwichiana*) is a common shrub throughout the understory of the remnant mixed *kiawe-wiliwili* shrubland. We found 563 *maiapilo* during the survey and all but one individual was located in the southern 'a'ā portion of the Property (Table 3, Figure 8). Most clusters ranged from one to five individuals; 11 were larger, consisting of six to 10 individuals.



Native Plants by Species

- *Argemone glauca*
- *Canavalia pubescens*
- *Capparis sandwichiana*
- *Doryopteris decipiens*
- *Dodonea viscosa*
- *Erythrina sandwicensis*
- *Heteropogon contortus*
- *Ipomoea tuboides*
- *Lipochaeta rockii*
- *Myoporum sandwicense*
- *Senna gaudichaudii*
- *Sicyos hispidus*
- *Sicyos pachycarpus*

Native Plants by Count Classes

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 25
- 26 - 60
- 61 - 110

Plant Source: Native Plants were mapped with GPS
Boundary Source: PBR Hawaii
Aerial Source: Microsoft 2009

Figure 8
Native Plant Count Classes

0 250 500 1,000 ft
0 50 100 200 M

N

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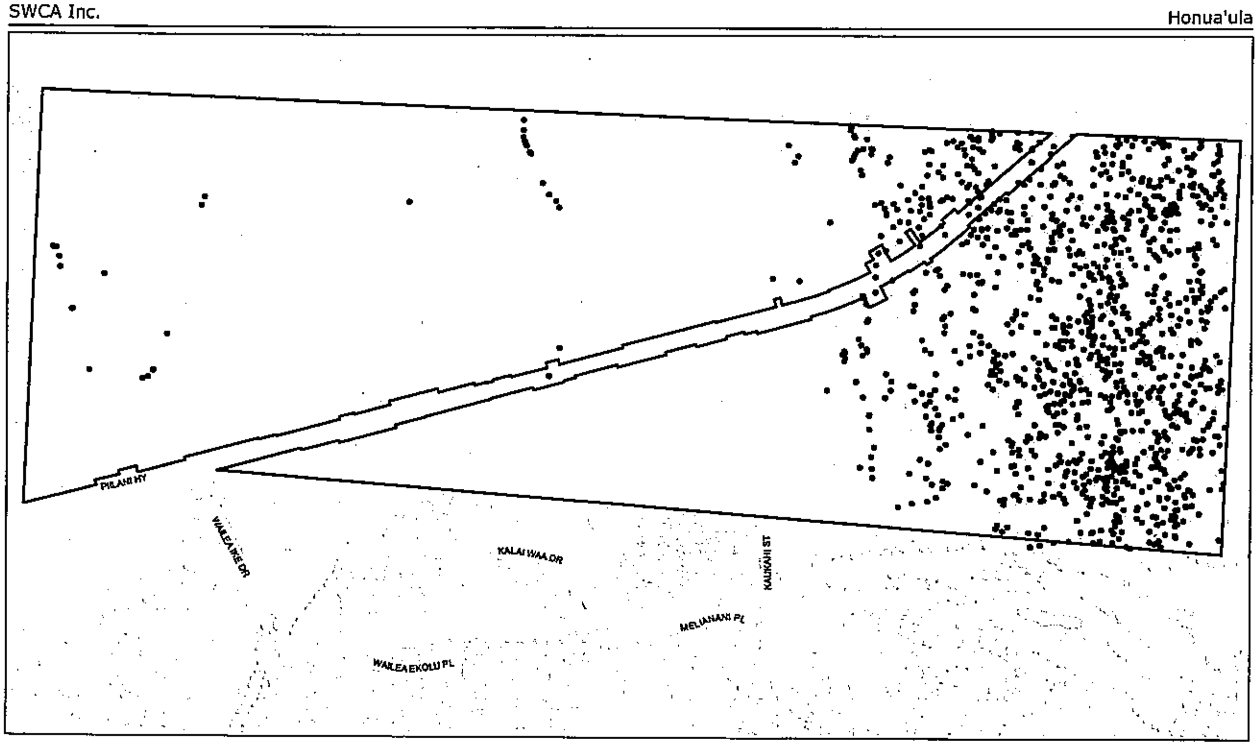

Legend

- Project Boundary
- Native Plant Points

Figure 7
Native Plant Occurrences

0 250 500 1,000 ft
0 50 100 200 M

N

Native Plant Source: Trimble GeoXT GPS
Boundary Source: PBR Hawaii
Aerial Source: Microsoft 2009

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These large clusters were found primarily in the southern portion of the *kiawe-wiliwili* shrubland. The aerial cover of the largest cluster was 531 m^2, others ranged from one to 314 m^2 (average cover of 17 m^2). Several *maiapilo* clusters were flowering and fruiting, but the frequency of seedlings was low (2.5%). About 20% of the plants showed mild to heavy signs of insect herbivory where the epidermis (upper layer of the leaves) appeared to be scraped away.

We observed 16 *'a'ali'i* (*Dodonaea viscosa*) shrubs in seven locations, all limited to the southwestern corner of the *kiawe-wiliwili* shrubland (Figure 8). Six of the seven locations had one to four individuals while the largest cluster was comprised of six individuals. Average cover of *'a'ali'i* was about 26 m^2 where the aerial cover of two clusters were 79 m^2 each and the remaining five ranged from one to 20 m^2. One plant was observed fruiting and no seedlings were observed in the vicinity of the adult shrubs. All plants were healthy with no detectable signs of damage, disease, or herbivory.

Fifty-four *'iwa'iwa* (*Doryopteris decipiens*) ferns were distributed at about 14 locations within the Property (Figure 8). Of these, only seven individuals were found within the *kiawe-wiliwili* shrubland; the others occurred in the drainage gulches within the northern portion of the Property. The number of individuals within a cluster ranged from one to 16, the majority of which were adults (96%). Some plants showed signs of dehydration; most plants in the largest cluster (16 individuals) were very dry. Aerial cover of the largest cluster was approximately 7 m^2 while the others ranged from one to 3 m^2.

Wiliwili (*Erythrina sandwicensis*) was the most common native tree species in the southern 'a'ā lava flow (Table 3, Figure 8). We mapped 2,476 individuals distributed throughout the Property. The majority (2439 individuals) were limited to the *kiawe-wiliwili* shrubland in groves of various sizes. The largest groves (>15 individuals) tended to be located in the eastern portion of the *kiawe-wiliwili* shrubland. The number of adult *wiliwili* (*E. sandwicensis*) trees was greater (86%) than seedlings and juveniles (Table 3). Most *wiliwili* trees showed some form of damage, primarily from the Erythrina gall wasp (*Quadristichus erythrinae* Kim) and the seed eating bruchid beetle (*Specularius impressithorax* Pic). Additional information on the *wiliwili* (*E. sandwicensis*) within the Property can be found in Table 4.

Table 4. Number of wiliwili (Erythrina sandwicensis) groves on the project site. *Grove size is categorized by the number of individual trees in the grove. Range and average canopy cover is measured in m^2.*

Number of Trees in Grove	Number of Groves	Range in Grove Canopy Cover (min-max) (m^2)	Mean Canopy Cover of the Grove (m^2) (+/- 1 S.E.)	Median Grove Canopy Cover (m^2)
1 to 5	417	0.8 - 1589.6	94.1	38.5
6 to 10	107	28.3 - 2862	523.5	254.3
11 to 15	28	12.6 - 706.5	839.1	706.5
16 to 25	12	314 - 2862	1453.9	961.6
26 to 60	5	254.3 - 1962.5	1029.2	873.3

Pili grass (*Heteropogon contortus*) was the only native grass species found within the Property (Figure 8). *Pili* (*H. contortus*) was limited to gulches within the *kiawe*-buffelgrass grassland in the northern half of the Property (Table 3). We mapped 1,493 *pili* (*H. contortus*) plants in 66 locations within the Property. All plants were limited to gulches within the *kiawe*-buffelgrass grassland in the northern half of the Property. Most individuals occurred in the southern drainage gullies of the grassland, becoming less abundant to the north. Adult plants were flowering at the time of our surveys. We did not observe signs of superficial damage or disease.

Five endemic Hawaiian moon flower (*Ipomoea tuboides*) vines were observed within the Property; all of which are limited to the southern 'a'ā portion of the Property (Table 3, Figure 8). At the time of the survey all plants were flowering.

One hundred and one *nehe* (*Lipochaeta rockii*) were found distributed in 24 clusters across the Property (Figure 8). All were within the southern 'a'ā portion of the Property. Two large clusters

contained 22 and 23 individuals respectively and were located in the center of the mixed *kiawe-wiliwili* shrubland. Smaller clusters (< 10 individuals) were found from central to southwestern portion of the shrubland. Clusters ranged from < 1 m^2 to 78.5 m^2 in area.

Twenty-one *naio* (*Myoporum sandwicense*) shrubs/trees were observed in 17 locations distributed throughout the *kiawe-wiliwili* shrubland (Table 3, Figure 8). No *naio* (*M. sandwicense*) seedlings were found. Fifteen of the 17 locations were occupied by a single shrub/tree. Aerial cover ranged from < 1 m^2 to 78.5 m^2, the largest of which consisted of three shrubs/trees.

Forty-three *kolomona* (*Senna gaudichaudii*) trees were mapped at 32 locations within the Property (Figure 8). The majority (37 individuals) of the plants occurred in the southern portion of the mixed *kiawe-wiliwili* shrubland. The cluster size ranged from one to five individuals, and 24 of 29 mapped locations consisted of solitary plants. The areal extent ranged from < 1 m^2 to 19.6 m^2. Evidence of herbivory was observed at four of 29 locations. Many of the plants found were flowering and/ or fruiting at the time of our surveys.

We mapped 113 *'ānunu* (*Sicyos hispidus*) vines at 49 locations within the Property (Table 3, Figure 8). These vines occurred primarily in the central and northern edge of the 'a'ā lava flow. Larger clusters (> 5 individuals) tended to be located in the central portion of the *kiawe-wiliwili* shrubland. Seedlings were observed at only one location and no signs of damage or herbivory were detected.

A second species of *'ānunu* (*Sicyos pachycarpus*) was found within the Property (Figure 8). Six hundred and three *S. pachycarpus* were mapped in 102 locations. The size of clusters varied greatly and ranged from one to 110 plants per location. The majority of the larger clusters (> 15 individuals) were concentrated in the center of the *kiawe-wiliwili* shrubland. Approximately 52% of mapped plants were seedlings. Many adults were observed flowering and/ or fruiting. Most of the vines appeared to be healthy; only one plant showed signs of herbivory.

3.4 GIS Density Analysis

Table 2 illustrates how SWCA botanists weighted each species in Group 1 (from Table 1) for density analysis. The resulting density analysis, conducted at a resolution of 100 m (328 ft) illustrated the core areas occupied by the highest densities of the most significant plant species. Figure 9 illustrates the results of the weighted density analysis for the eight most important native plant species. The colors represent the weighted average of the densities of the eight species.

3.5 Aerial Reconnaissance Survey

Wiliwili (*E. sandwicensis*) and *kiawe* (*P. pallida*) trees were the most distinctive tree species observed from aerial surveys. In contrast, understory was difficult if not impossible to identify from the air. Dense stands of *wiliwili* trees (*E. sandwicensis*) were found in several areas adjacent to, and well outside of, the Property (Figure 10). This includes a large geographical area of approximately 400 ha (1,000 ac) east of Pu'u Olai (Figure 11), stretching from the southern boundary of the Property into the Makena property and Ahihi-Kinau Natural Area Reserve in the south, and from the Makena Resorts southeast of Honua'ula toward the 'Ulupalakua Ranch. Our aerial reconnaissance confirmed input from others (A.C. Medeiros, USGS, pers. comm.; Altenberg 2007) suggesting that several additional high density *wiliwili* (*E. sandwicensis*) groves may be found near Pu'u Olai, Kanaio, Pu'u O Kali, Makena (Figure 12), La Perouse, Kaupo, and Lualailua.

4.0 DISCUSSION

The Property was viewed by Char and Linney (1988) and Char (1993, 2004) as having unremarkable vegetation. Until SWCA (2006) and Altenberg (2007), there had been no recognition of the remnant mixed *kiawe-wiliwili* shrubland as an area worthy of special recognition. Similarly, there have been no previous efforts by any Federal, State, local government agency, or conservation Non-governmental organizations (NGOs) to acquire and protect any portion of the Property.

Figure 10 - An east-northeasterly aerial view of the remnant mixed kiawe-wiliwili shrubland within and adjacent to the southern and southeastern boundaries of Honua'ula, on Makena Resort and Ulupalakua Ranch lands, respectively.

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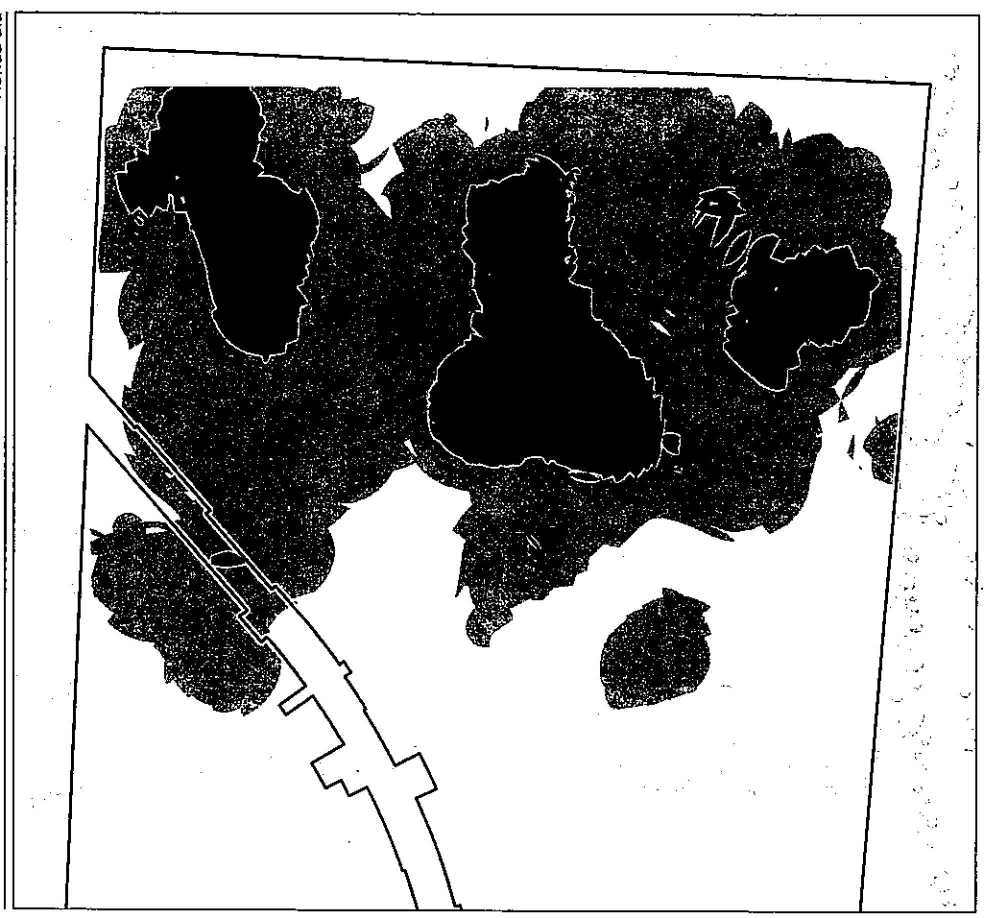

Figure 9
Visual Representation of Weighted Density Analysis of the Eight Most Important Plant Species within the Project Area

Weighted Average
- 5 - Highest Weighted Average
- 4
- 3
- 2
- 1 - Lowest Weighted Average

0 125 250 500 ft
0 25 50 100 M

N

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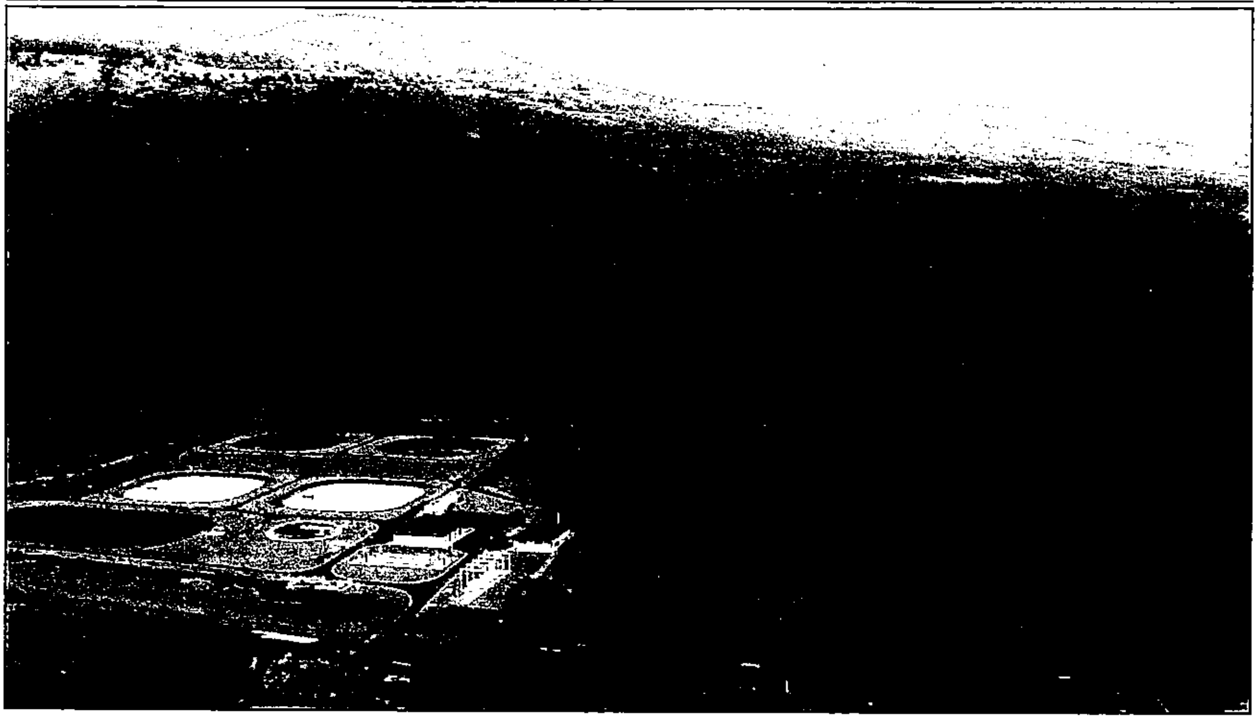

Figure 12. An easterly aerial view of dense remnant mixed kiawe-wiliwili shrublands surrounding the Makena Sewage Treatment Facility.

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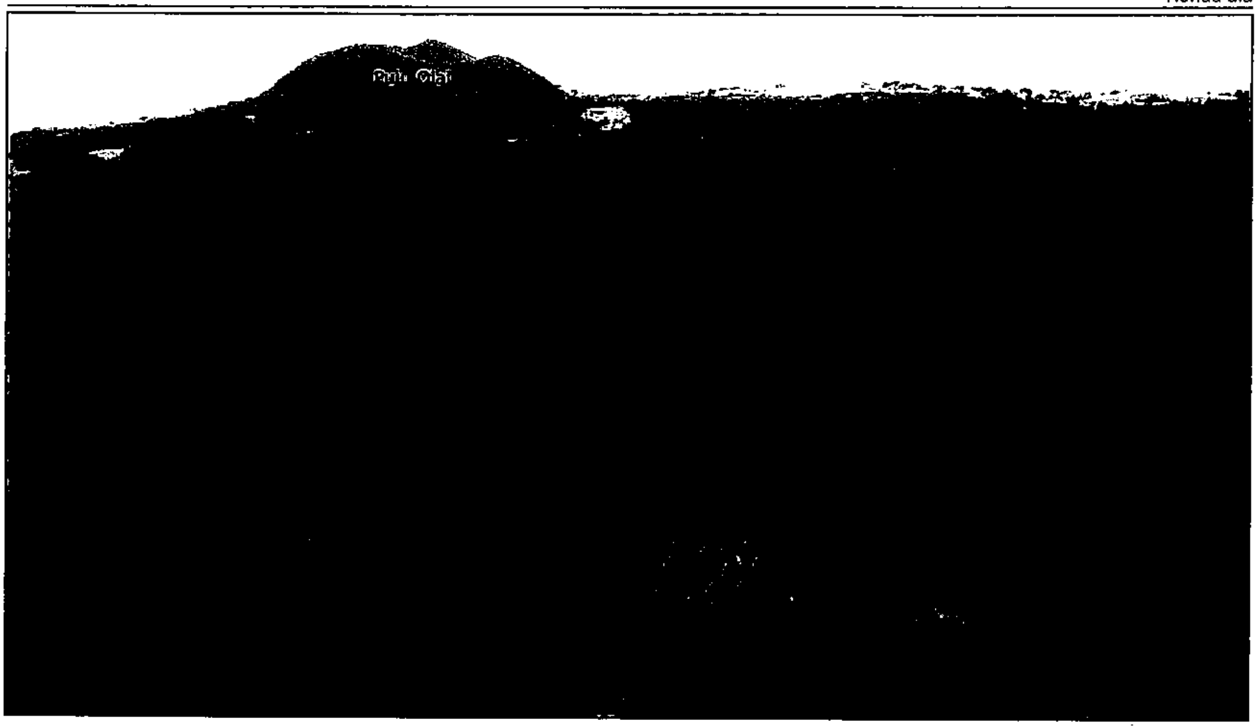

Figure 11 - A westerly aerial view of the dense remnant mixed kiawe-wiliwili shrublands adjacent to Pu'u Olai.

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The remnant native vegetation in the remnant mixed *kiawe-wiliwili* shrubland represents a highly degraded lowland dry shrubland in which *wiliwili* trees (*E. sandwicensis*) are a natural component. High density *wiliwili* (*E. sandwicensis*) stands occur in other locations throughout the region. Altenberg (2007) identified eight areas in southeast Maui, including the Property, where *wiliwili* (*E. sandwicensis*) groves are found. In this study, we also found dense *wiliwili* (*E. sandwicensis*) groves east of Pu'u Olai.

Far from being pristine, this dry shrubland has been degraded by human activities including unrestricted grazing by ungulates, cattle grazing, invasive plant species, road works, *kiawe* (*P. pallida*) logging, and military activities. Only 26 of the 146 species reported from the parcel are native, 14 of these are endemic, and 120 are introduced non-native species (Figure 6).

Canavalia pubescens Hook. & Arnott is "...uncommon in open dry sites such as lava fields, kiawe thickets, and dry forest, 15-540m, on Ni'ihau, Kaua'i (Nāpali Coast), Lāna'i, and leeward East Maui" (Wagner et al. 1999). In 1997, the species was added as a candidate species by the U.S. Fish and Wildlife Service (USFWS). The most recent USFWS (2009) information on the species includes the following:

> *"Canavalia pubescens is found on dry, open lava fields and in dryland forest. On Kauai, C. pubescens was found in open, moist forest and in dry scrub forest at elevations between 180 to 2,900 feet (ft) (55 to 884 meters (m)). On Nilhau, this species was last seen growing on an exposed basalt ledge at 300 ft (91 m) in elevation. On Lanai, C. pubescens was observed growing among sun-scorched lava rocks along a coastal trail at 50 ft (15 m) elevation with Cordia subcordata (kou) (H. Oppenheimer, PEP Program, pers. comm. 2007). On Maui, C. pubescens is found on recent lava flows in Erythrina (wiliwili) lowland dryland forest and shrubland with the following native species: Capparis sandwichiana (maiapilo), Chamaesyce celastroides var. lorifolia (akoko), Dodonaea viscosa (aalii), Ipomoea spp. (no common name), Morinda spp. (noni), Sida fallax (ilima), Rauvolfia sandwicensis (hao), and Waltheria indica (uhaloa); at elevations between 80 to 400 ft (24 to 122 m) (Wagner and Herbst 1999, p. 654; Hawaii Biodiversity and Mapping Program (HBMP) 2008)."*

> *"Currently, Canavalia pubescens is found on the island of Maui (HBMP 2008; H. Oppenheimer, Plant Extinction Prevention Program, pers. comm. 2006; F. Starr, U.S. Geological Survey, Biological Resources Discipline (USGS-BRD), pers. comm. 2006). No plants were observed at the last known location of this species on Lanai in 2007; however, it could possibly be found there again (H. Oppenheimer, pers. comm. 2007). There were a few individuals at Palauea-Keahou, but this area is currently undergoing development (Altenburg 2007, pp. 12-13; H. Oppenheimer, pers. comm. 2007)."*

> *"Five populations are known on Maui: Keokea and Puu o Kali with "hundreds" observed; southwest Kalua o Lapa with two individuals; Papaka Kai with six individuals; Ahihi-Kinau with a few individuals; and southeast Pohakea, with at least one individual (HBMP 2008; F. Starr, pers. comm. 2006; H. Oppenheimer, pers. comms. 2006, 2007). These populations total a little over 200 individuals, with the majority ("hundreds") in one population (Puu o Kali)."*

Altenberg (2007), F. Starr (pers. comm.), and H. Oppenheimer (pers. comm.) apparently presumed that the remaining *'āwikiwiki* (*C. pubescens*) at Palauea-Keahou [Honua'ula] have "... likely been destroyed by development" (as cited in USFWS 2008a and 2009). Contrary to this pessimistic outlook, all five individual on the Honua'ula Property continue to thrive. No construction or other development related activity other than recent fence building to keep cattle from the *kiawe-wiliwili* shrubland has been conducted in that area. Honua'ula Partners, LLC is committed to the Maui County Council as early as March 2006 to insure that all five *'āwikiwiki* (*C. pubescens*) plants within the Property are protected and managed to help ensure their conservation.

The Species Assessment and Listing Priority Assignment Form (USFWS 2009) notes that the USFWS has "promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed" and determined that the species "does not appear to be appropriate for emergency listing at this time because the immediacy of

the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process."

Nehe (*Lipochaeta rockii* Sherff) occurs in scattered locations on Maui, but is primarily known from Moloka'i and Kaho'olawe where it is scattered to common in coastal sites to dry forests, and along the margins of lava flows (Wagner et al. 1999). As noted above, *nehe* (*L. rockii*) within the Property have a distinct leaf shape; the leaves are less dissected compared to specimens at other Maui locations. However, it is not recognized as a separate subspecies or variety by botanical authorities (Wagner et al. 1999) and is suggested to easily hybridize with other plants of the same species (Herbst, Bishop Museum, pers. comm.). It is also not given statutory protection by State or Federal laws.

4.1 Comparison to Adjacent Hawaiian Dry Forests and Conservation Efforts

As stated above, there have been no previous efforts to acquire and protect any portion of the Property. Instead, government conservation efforts for native dry forest ecosystems have been focused on better examples of relatively intact ecosystems such as Pu'u o Kali, 'Auwahi, and similar areas. Figure 13 illustrates existing areas on southeastern Maui where remnant dry forest and shrubland communities are being protected by various entities.

'Auwahi Forest Reserve (Medeiros 2006) is a four hectare (10 ac) remnant native dry forest on the south slope of East Maui at 1,200 m (3,937 ft) elevation (Figure 13). This site has been undergoing restoration since 1997 under a partnership between landowners, government agencies and scientists. 'Auwahi has a rich plant diversity including 50 native tree species, at least five of which are endangered (Medeiros 2006).

Pu'u O Kali Forest Reserve is a remnant *wiliwili* (*E. sandwicensis*) forest on the slopes of east Maui above Kihei. It is among the most diverse and intact lowland dry forests on Maui which also supports endangered flora. As Monson (2005) quoted A.C. Medeiros, "*Pu'u-O-Kali* is the only place on this whole side that looks like it did in ancient times... It's the only place where a Hawaiian from long ago would look around and say, 'Oh, I know where I am.' They wouldn't recognize the rest of South Maui."

Kanaio Natural Area Reserve located to the south of the Property encompasses 354 ha (876 ac), portions of which include *wiliwili* (*E. sandwicensis*). Nearly 38% of the vegetation in Kanaio is native with about 14% indigenous and 24% endemic. Twenty-two species of Hawaiian dry land forest trees are found in Kanaio, over 35% of the total number of native species in the area (Medeiros et al. 1993).

A relatively pristine remnant native dry forest occurs at Palamanui, a 293 ha (725 ac) mixed use residential and commercial development in Kona, Hawai'i. Sixty two plant species have been described from the native forest there, of which 27 are native and 35 are introduced (Hart 2003). Roughly seven percent of the total Palamanui development parcel consists of a *lama-alahe'e-'iliahi* (*Diospyros-Psydrax-Santalum*) dry forest that has "apparently never received any major disturbance" (Hart 2003, Group 70 International 2004). Three federally listed endangered plant species are found at Palamanui: *uhi-uhi* (*Caesalpinia kavaiensis*), *alea* (*Nothocestrum breviflorum*) and *halapepe* (*Pleomele hawaiiensis*). Several large 'akoko (*Chamaesyce multiformis*), many of which are larger than have ever been seen before, have been described from Palamanui (Group 70 International 2004).

Another plant mitigation and preserve restoration plan has been developed for construction of The Villages at La'iōpua in Kealakehe, North Kona on the Island of Hawai'i for the Department of Hawaiian Home Lands (Leonard Bisell Associates LLC and Geometrician Associates, 2008). Originally conceived in 1999, the plan addresses the protection of two listed endangered plants: *aupaka* (*Isodendrion pyrifolium*) and *uhiuhi* (*Caesalpinia kavaiensis*) and 19 associated endemic and indigenous plants. Fifty-five species of introduced plant species have been recorded within or near the proposed preserves at La'iōpua. The several small preserves are planned for La'iōpua, the largest of which is 26.6 acres in area. The other preserves are 11 and 4 acres in size, with additional 'mini-preserves' proposed to protect individual trees. As with the proposed Native Plant Preservation Area at Honua'ula, the La'iōpua preserves also incorporate archaeological features, and include specific conservation principals, management objectives, and physical plans.

Protection of at least 22 ha (55 ac) of the dry forest remnant at Palamanui is an integral part of the overall development proposal. Significant elements of the proposed preserve management plan for Palamanui (Hart 2003; J. Price, UH Hilo, pers. comm.) are directly relevant to management of the proposed native plant preserve at Honua'ula and have been incorporated into our recommendations.

4.2 Relevant Dry Forest Research in Hawai'i

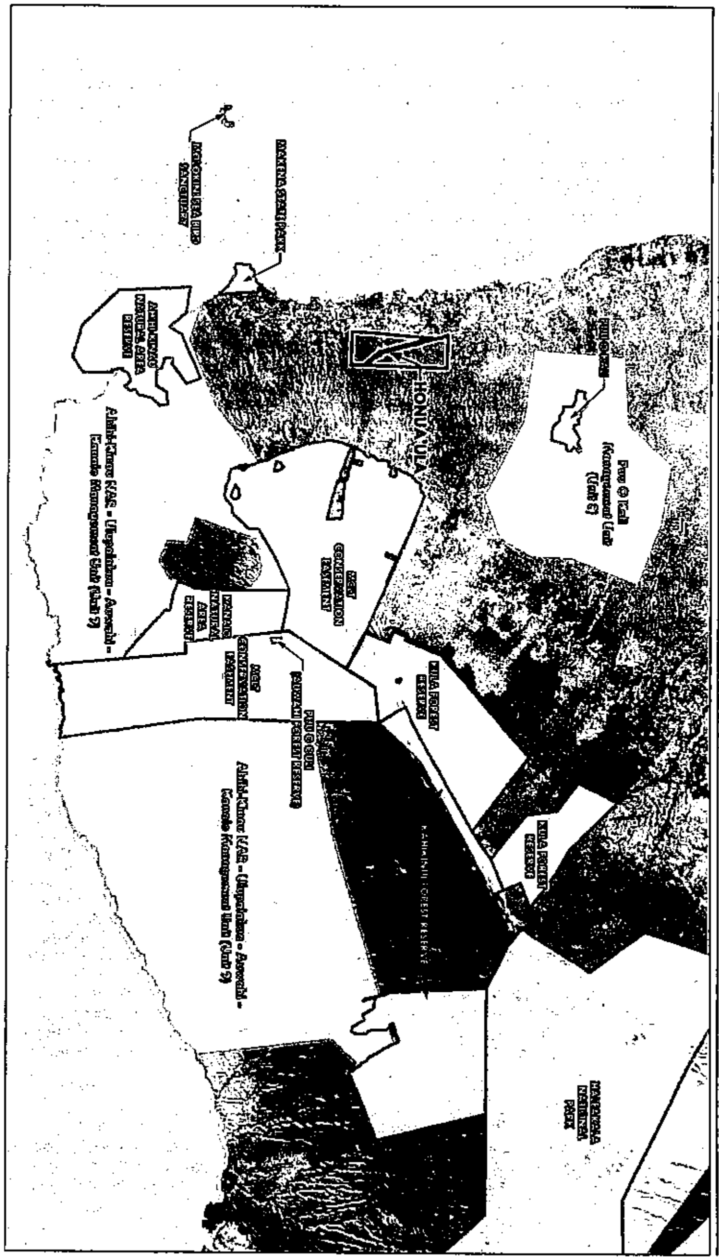
In their research studies conducted at Ka'upulehu dry forest on Hawai'i Island, Cabin et al. (2000a) found that excluding ungulates with fencing is effective in helping the recruitment of some native tree species. However, fencing alone was insufficient to restore native dry forests. In another study at Ka'upulehu, Cabin et al. (2002a) experimentally manipulated micro-site conditions (canopy vs. no canopy), water (ambient vs. supplemental), and weeding (removal vs. non-removal). They also added seeds of six native species in 64 1m² plots to investigate the regeneration of native dry forest species. The authors suggest that it is possible to restore degraded dry forests in Hawai'i by manipulating the ecological conditions particularly for the fast growing understory species which then create micro-sites more favorable for the establishment of native trees. Cabin et al. (2002b) investigated how light availability (full vs. 50% shade), alien grass control (bulldoze, herbicide, plastic mulch and trim treatments), and out-planting vs. direct seeding affected the establishment of native plants and suppression of invasive grasses. Their results highlight the fact that restoration can be site specific and hence it is important to examine species and treatment specific responses to these species before attempting large scale conservation efforts. They also suggest that relatively simple techniques can be used to simultaneously suppress invasive grasses and establish populations of vigorous native understory species even at larger scales.

These and other related studies (Allen 2000, Blackmore and Vitousek 2000, Cabin et al. 2000a, 2000b, 2001; Chang 2000, Chimera 2004, Cordell et al. 2001, 2002; D'Antonio et al. 1998, Henderson et al. 2001, Litton et al. 2004, Merlin and Juvik 1992, Sandquist et al. 2004, Stratton 1998, and Tunison 1992) give hope that even small restoration efforts consisting of a few hectares can help provide habitat for rare native dry forest species and can subsequently serve as urgently-needed sources of propagules. This hope is reinforced by the numerous sources on information on successful propagation of rare native Hawaiian plants specifically for landscaping (e.g., Tamimi 1999, Friday 2000, Wong 2003, Bornhorst and Rauch 2003, CTAHR 2006).

5.0 PROPOSED MITIGATION MEASURES

The Maui County Council promulgated 28 specific conditions in granting a Phase I project district zoning approval. Specific conditions related to vegetation within the Property appear in the following paragraphs.

> *"7. That Honua'ula Partners, LLC, its successors and permitted assigns, shall prepare an animal management plan that shall be submitted during Project District Phase II processing and approved by the Department of Land and Natural Resources prior to submittal of Project District Phase III processing. Said plan shall include procedures for the management of animal intrusions including, but not limited to, construction of boundary or perimeter fencing, wildlife control permits, and rodent and feral cat control. Honua'ula Partners, LLC, its successors and permitted assigns, shall implement the approved animal management plan. The Department of Land and Natural Resources may require periodic updates of the plan.*
>
> *27. That Honua'ula Partners, LLC, its successors and permitted assigns, shall provide the report "Remnant Wiliwili Forest Habitat at Wailea 670, Maui, Hawaii by Lee Altenberg, Ph.D.", along with a preservation/mitigation plan, to the State Department of Land and Natural Resources, the United States Fish and Wildlife Service, and the United States Corps of Engineers for review and recommendations prior to Project District Phase 11 approval. The Maui Planning Commission shall consider adoption of the plan prior to Project District Phase II approval.*
>
> *Such plan shall include a minimum preservation standard as follows: That Honua'ula Partners, LLC, its successors and permitted assigns, shall establish in perpetuity a*



Legend

Project Boundary

Reserves

Proposed Management Units for the Blackburn's Sphinx Moth

Image Source: State of Hawaii (LANDSAT)
Reserves and Management Units Source: State of Hawaii
Boundary Source: PBR Hawaii

Figure 13
Vicinity Conservation Efforts

SWCA ENVIRONMENTAL CONSULTANTS

Conservation Easement (the "Easement"), entitled "Native Plant Preservation Area", for the conservation of native Hawaiian plants and significant cultural sites in Kihei-Makena Project District 9 as shown on the attached map. The Easement shall comprise the portion of the property south of latitude 20°40'1 5.00"N, excluding any portions that the State Department of Land and Natural Resources, the United States Fish and Wildlife Service, and the United States Corps of Engineers find do not merit preservation, but shall not be less than 18 acres and shall not exceed 130 acres.

The scope of the Easement shall be set forth in an agreement between Honua'ula Partners, LLC and the County that shall include:

a. A commitment from Honua'ula Partners, LLC, its successors and permitted assigns, to protect and preserve the Easement for the protection of native Hawaiian plants and significant cultural sites worthy of preservation, restoration, and interpretation for public education and enrichment consistent with a Conservation Plan for the Easement developed by Honua'ula Partners, LLC and approved by the State Department of Land and Natural Resources, the United States Geological Survey, and the United States Fish and Wildlife Service; and with a Cultural Resource Preservation Plan, which includes the management and maintenance of the Easement, developed by Honua'ula Partners, LLC and approved by the State Department of Land and Natural Resources (collectively, the "Conservation/Preservation Plans").

b. That Honua'ula Partners, LLC, its successors and permitted assigns, shall agree to confine use of the Easement to activities consistent with the purpose and intent of the Easement.

c. That Honua'ula Partners, LLC, its successors and permitted assigns, shall be prohibited from development in the Easement other than erecting fences, enhancing trails, and constructing structures for the maintenance needed for the area, in accordance with the Conservation/Preservation Plans.

d. That title to the Easement shall be held by Honua'ula Partners, LLC, its successors and permitted assigns, or conveyed to a land trust that holds other conservation easements. Access to the Easement shall be permitted pursuant to an established schedule specified in the Conservation/Preservation Plans to organizations on Maui dedicated to the preservation of native plants, to help restore and perpetuate native species and to engage in needed research activities. These organizations may enter the Easement at reasonable times for cultural and educational purposes only.
e. Honua'ula Partners, LLC, its successors and permitted assigns, shall be allowed to receive all tax benefits allowable under tax laws applicable to the Easement at the time that said Easement is established in Kihei Makena Project District 9, which will be evidenced by the recordation of the Easement in the Bureau of Conveyances, State of Hawaii."

Active conservation management of any area to be conserved is integral to the long term success of a mitigation effort. Whether the protected area is 80 ha (200 ac) or 5.3 ha (13 ac), there is no guarantee that the best possible conservation efforts and best management practices will perpetually protect all plant species in the same numbers currently found within the Property. However, the immediate concerns for the preserve on the site should be: 1) elimination of browsing, grazing, and trampling pressure on native plants by feral ungulates, 2) removal of noxious invasive plant and animal species, 3) protection against wildland fires. Honua'ula Partners, LLC is proposing to implement the following measures to conserve elements of the remnant *kiawe-wiliwili* shrubland and protect native plants and animals on the Property.

- A conservation easement, hereinafter referred to as "Native Plant Preservation Area", encompassing a contiguous area within the remnant mixed *kiawe-wiliwili* shrubland will be dedicated in perpetuity to protect as much of the remnant native lowland dry shrubland plant community as possible. The protected area will meet the 7.3-52.6 ha (18-130 ac) directive imposed by the Maui County Council, and will ultimately be subject to approval by the Council. The Native Plant Preservation Area will encompass the highest densities of the rarest elements of the native vegetation within the project parcel.

- The development will conserve as many of the *wiliwili* trees (*Erythrina sandwicensis*) as possible outside the Native Plant Preservation Area and elsewhere within the remnant mixed *kiawe-wiliwili* shrubland as possible.
- The entire perimeter of the Property has already been fenced to discourage feral ungulates from entering the *kiawe-wiliwili* shrubland; however, the fence is porous. Fencing requirements will be reviewed and updated as establishment of the Native Plant Preservation Area and site construction begin. An animal management plan will be implemented as soon as possible to ensure that goats, deer, pigs, and stray cattle are removed *in a humane manner* from the Property.
- A Natural Resource Manager will be employed by Honua'ula Partners, LLC to help develop and implement specific conservation programs to help ensure the protection of native plants and animals within the Native Plant Preservation Area and other areas designated for native plant protection throughout the Property.
- Honua'ula Partners, LLC will implement a program to control and eradicate invasive grasses, weeds, and other non-native plants from Native Plant Preservation Area ***with the exception of*** the non-native tree tobacco (*Nicotiana glauca*), which is a recognized host plant for the endangered Blackburn's sphinx moth (*Manduca blackburni*).
- Honua'ula Partners, LLC will implement a native plant propagation program for landscaping with plants and seed naturally occurring on the Property. All plants native to the geographic area will be considered as potential species for use in landscaping.
- Honua'ula Partners, LLC will implement a seed predator control program to control rats, mice, and other seed predators within the Native Plant Preservation Area.
- Honua'ula Partners, LLC will implement a fire control program to help protect the Native Plant Preservation Area to help insure the success of plant propagation and conservation efforts.
- Honua'ula Partners, LLC will implement an education and outreach program open to the public at large, and sponsor service groups to assist with implementation of the management programs in the Native Plant Preservation Area and other areas designated for native plant protection.
- Honua'ula Partners, LLC will apply for additional program support offered by the State of Hawai'i (Natural Area Partnership Program and Hawaii Forest Stewardship Program) and U.S. Fish and Wildlife Service to promote sound management of the natural resources on the Property.
- All copies of all SWCA reports prepared for this project, including the Conservation and Stewardship Plan, along with Altenberg (2007) will be submitted to the Department of Land and Natural Resources (DLNR), USFWS, U.S. Geological Survey, and U.S. Army Corps of Engineers for review and comment.
- Long-term vegetation monitoring during wet and dry seasons will be continued to evaluate the health of native plants, and to support the development of the conservation and stewardship plan for the Native Plant Preservation Area and other areas designated for native plant protection.
- Finally, a multi-species Habitat Conservation Plan (HCP), to include the candidate endangered *'āwikiwiki* (*Canavalia pubescens*) is being prepared under Section 10(a)(1)(B) of the Endangered Species Act and in collaboration with DLNR and USFWS.

Taken together with the mitigation measures identified for wildlife (SWCA 2009), these actions fully satisfy the objectives and the intent of the special Project District Phase I conditions promulgated by the Maui County Council and recommendations of State and Federal resources agencies.

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APPENDIX A

CHECKLIST OF PLANTS REPORTED FROM HONUA'ULA

Checklist includes plants reported from Honua'ula by Char and Linney (1988), Char (1993, 2004), Altenberg (2007), and SWCA (this study). Plant names appear alphabetically by family and then by species into each of three groups: Ferns and Fern Allies (Pteridophytes), Monocots, and Dicots. The taxonomy and nomenclature of the flowering plants are based on Wagner et al. (1999), Wagner and Herbst (1999), and Staples and Herbst (2005). Recent name changes are those recorded in the Hawaii Biological Survey series (Evenhuis and Eldredge, eds, 1999-2002). The list includes scientific name with author citation, common English and/or Hawaiian name(s), biogeographic status, and location within the three dominant vegetation types at Honua'ula.

KEY to biographic status:
- E = endemic (occurring only in the Hawaiian Islands);
- I = indigenous (native to the Hawaiian Islands and elsewhere);
- X = introduced or alien (all those plants brought to the Hawaiian Islands after 1778).

KEY to vegetation types:
- KB = *kiawe*-buffelgrass grassland;
- MG = mixed gulch-vegetation;
- KW = mixed *kiawe-wiliwili* shrubland.

KEY to surveys:
- C = Char and Linney (1988), Char (1993), Char (2004);
- A = Altenberg (2007);
- S = SWCA (2008 - this study).

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
PTERIDOPHYTES						
Adiantaceae						
Adiantum capillus-veneris L.	maiden-hair fern	I	C		*	
Doryopteris decipiens (Hook.) J. Sm.	*'iwa'iwa*	E	C, A, S	*	*	*
Pellaea ternifolia (Cav.) Link	*pellaea*	I	C		*	*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Aspleniaceae						
Nephrolepis multiflora (Roxb.) F.M. Jarrett ex. C.V. Morton	sword fern	X	C	*		*
MONOCOTS						
Agavaceae						
Furcraea foetida (L.) Haw.	*malina*	X	S			*
Cannaceae						
Canna indica L.	indian shot	X	C	*		
Commelineaceae						
Commelina benghalensis L.	hairy *honohono*	X	C, S	*	*	*
Commelina diffusa N.L. Burm.	blue day flower	X	C	*	*	
Liliaceae						
Crinum sp.	crinum	X	C	*		
Yucca sp.	yucca	X	C	*		
Poaceae						
Bothriochloa pertusa (L.) A. Camus	hurricane grass	X	C	*	*	
Brachiara subqudripa (Trin.) A.S. Hitchc	brachiara	X	C	*		
Cenchrus ciliaris L.	buffelgrass	X	C, S			*
Cenchrus echinatus L.	sandbur	X	C	*		

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Zoysia sp.	zoysia	X	C	*		
DICOTS						
Amaranthaceae						
Amaranthus spinosus L.	spiny amaranth	X	C, S	*	*	*
Asclepiadaceae						
Asclepias physocarpa (E.Mey.) Schltr.	balloon plant	X	C, S	*		*
Stapelia gigantea (N.E. Brown)	zulu giant	X	S			*
Asteraceae						
Ageratum conyzoides L.	*maile hohono*	X	C, S	*	*	*
Bidens cynapiifolia Kunth	beggar tick	X	C, S	*	*	*
Bidens pilosa L.	Spanish needle	X	C, S	*	*	*
Calyptocarpus vialis Less.	straggler daisy	X	C, S			*
Centaura melitensis L.	star thistle	X	S			*
Cirsium vulgare (Savi) Ten.	bull thistle	X	S			*
Conyza bonariensis (L.) Cronq.	hairy horseweed	X	C	*		
Conyza canadensis (L.) Cronq.	horseweed	X	C, S	*		*
Crassocephalum crepidioides (Benth.) S.Moore		X	C, S	*	*	*
Emilia fosbergii Nicolson	red *pualele*	X	C	*		*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Chloris barbata (L.) Sw.	swollen finger grass	X	C, S	*	*	*
Chloris radiata (L.) Sw.	plush finger grass	X	C	*	*	*
Cynodon dactylon (L.) Pers	*manienie*	X	C, S	*		*
Digitaria ciliaris (Retz.) Koeler	Henry's crab grass	X	C	*		
Digitaria insularis (L.) Mez ex Ekman	sour grass	X	C, S	*	*	*
Digitaria radicosa (Presl.) Miq.	digitaria	X	C	*		
Digitaria sp.	crab grass	X	C	*		
Eleusine indica (L.) Gaertn.	goose grass	X	C	*	*	*
Eragrostis cilianensis (All.) Vign. ex Janchen	stink grass	X	C	*	*	
Eragrostis tenella (L.) Beauv. ex R. & S.	love grass	X	C	*		
Eragrostis sp.	eragrostis	X	C	*		
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	*pili* grass	E	C, A, S	*	*	*
Panicum maximum L.	guinea grass	X	C, S	*	*	*
Panicum torridum Gaud.	*kakonakona*	E	C			*
Rhynchelytrum repens (Willd.) Hubb.	natal red top	X	C, S			*
Setaria verticillata (L.) P. Beauv.	*mau'u pilipili*	X	C	*	*	*
Tragus berteronianus J.A. Schultes	goat grass	X	C	*	*	*
Urochloa subquadripara (Trin.) R. Webster	signal grass	X	C	*		

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Cactaceae						
Opuntia ficus-indica (L.) Mill.	*panini*	X	C, S	*	*	*
Pilocereus royenii (L.) Byles & Rowley	Royen's tree cactus	X	S			*
Capparaceae						
Capparis sandwichiana DC.	*maiapilo*	E	C, A, S	·		*
Cleome gynandra L.	spider flower	X	C	*		*
Caryophyllaceae						
Polycarpon tetraphyllum (L.) L.		X	C	*	*	
Chenopodiaceae						
Chenopodium carinatum R.Br.		X	C, S	*	*	*
Chenopodium murale L.	*aheahea*	X	C, S	*	*	*
Convolvulaceae						
Dichondria repens J. R. & G. Forst.		X	C	*		
Ipomoea indica (J. Burm.) Merr.	*koali awahia*	I	C, A, S	*	*	*
Ipomoea obscura (L.) Ker Gawl.	yellow bindweed	X	C, S	*		
Ipomoea tuboides (Degener & Ooststr.)	Hawaiian moon flower	E	C, A, S			*
Merremia aegyptia (L.) Urb.		X	C, S	*	*	*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Galinsoga parviflora Cav.		X	C	*	*	
Gnaphalium cf. *japonicum* Thunb.	cudweed	X	C	*	*	
Hypochoeris sp. L.	cat's ear	X	C	*	*	*
Lactuca serriola L.	prickly lettuce	X	C, S			*
Lipochaeta rockii Sherff	*nehe*	E	C, A, S			*
Parthenium hysterophorus L.	false ragweed	X	S			*
Sigesbeckia orientalis L.		X	C	*	*	
Sonchus asper (L.) J. Hill	spiny snowthistle	X	C	*	*	*
Sonchus oleraceus L.	*pualele*	X	C, S	*	*	*
Sphagneticola trilobata (L.) Pruski	wedelia	X	S			*
Synedrella nodiflora (L.) Gaertn.	node weed	X	C	*	*	*
Tridax procumbens L.	coat buttons	X	C, S	*	*	*
Verbesina encelioides (Cav.) Benth. & Hook	golden crown beard	X	C, S	*	*	*
Xanthium strumarium L. var. *canadense* (Miller)	cocklebur	X	C	*	*	*
Zinnia peruviana (L.) L.	wild zinnia	X	C, S	*	*	*
Brassicaceae						
Cornopus didymus (L.) Sm.	wart cress	X	C	*		

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Chamaecrista nictitans (L.) Moench	partridge pea	X	C, S	*		*
Crotalaria incana L.	fuzzy rattlepod	X	C	*		
Crotalaria pallida Aiton	smooth rattlepod	X	C	*		
Desmanthus virgatus (L.) Willd.	virgate mimosa	X	C, S	*		*
Desmodium tortuosum (Sw.) DC.	beggar weed	X	C			*
Erythrina sandwicensis O.Deg.	*wiliwili*	E	C, A, S	*	*	*
Indigofera suffritocosa Mill.	*iniko*	X	C, S	*		*
Leucaena leucocephala (Lam.) de Wit	*koa haole*	X	C, S	*	*	*
Macroptilium lathyroides (L.) Urb.	wild bean	X	C, S	*		*
Prosopis pallida (Humb. & Bonpl. Ex Willd.) Kunth	*kiawe*	X	C, S	*	*	*
Samanea saman (Jacq.) Merr	monkey pod	X	C	*		
Senna alata (L.) Roxb	candle bush	X	C	*		
Senna gaudichaudii (Hook. & Arn.) H.S.Irwin & Barneby	*kolomona*	I	C, A, S		*	*
Senna occidentalis (L.) Link	coffee senna	X	C			*
Lamiaceae						
Ocimum basilicum L.	sweet basil	X	C, S	*		*
Ocimum gratissimum L.	basil	X	C, S	*	*	*
Leonotis nepetifolia (L.) R. Br.	lion's ear	X	S			*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Cucurbitaceae						
Cucumis dipsaceus (Ehrenb. ex Spach	wild cucumber	X	C, S	*		*
Momordica charantia L.	bitter melon	X	C, S	*	*	*
Sicyos hispidus Hillebr.	*'anunu*	E	C, A, S			*
Sicyos pachycarpus Hook. & Arnott	*'anunu*	E	A, S			*
Euphorbiaceae						
Chamaesyce celastroides var. lorifolia (A. Gray) Degener & I. Degener	*'akoko*	E	A			*
Chamaesyce hirta (L.) Millsp.	hairy spurge	X	C, S	*	*	*
Chamaesyce hypercifolia (L.) Millsp.	graceful spurge	X	C	*		
Euphorbia heterophylla L.	*kaliko*	X	C, S	*	*	*
Phyllanthus tenellus Roxb.		X	C, S	*		
Ricinus communis L.	castor bean	X	C, S	*	*	*
Fabaceae						
Acacia farnesiana (L.) Willd.	klu	X	C, S		*	*
Bauhinia blakeana Dunn	orchid tree	X	C	*		
Calopogonium mucunoides Desv.		X	C			*
Canavalia pubescens Hook. & Arnott	*'āwikiwiki*	E	C, A, S			*
Cassia fistula L.	golden shower	X	C	*		

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Nyctaginaceae						
Boerhavia coccinea Mill.		X	C	*		
Boerhavia acutifolia (Choisy) J.W.Moore	*alena*	I	S			*
Boerhavia herbstii Fosb.	*alena*	E	A			*
Boerhavia repens L.	*alena*	I	C, S			*
Mirabilis jalapa L.	four-o' clock	X	C			*
Oxalidaceae						
Oxalis corniculata L.	wood sorrel	X	C, S	*	*	
Papavaraceae						
Argemone glauca (Nutt. Ex Prain (Pope)	*pua kala*	E	A, S			*
Argemone mexicana L.	prickly poppy	X	C, S			*
Bocconia frutescens L.		X	S			*
Eschscholzia californica Cham.	California poppy	X	S			*
Passifloraceae						
Passiflora foetida L.	love-in-a-mist	X	C	*		*
Passiflora subpeltata Ort.	passion flower	X	C, S			*
Plumbaginaceae						
Plumbago zeylanica L.	*'ilie'e*	I	C, A, S	*	*	*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Stachys arvensis L.	stagger weed	X	C	*	*	*
Malvaceae						
Abutilon grandifolium (Willd.) Sweet	*ma'o*	X	C, S	*	*	*
Abutilon incanum (Link.) Sweet	hoary abutilon	I	C, A, S	*	*	*
Malva parviflora L.	cheese weed	X	C, S	*	*	*
Malvastrum coromandelianum (L.) Garcke	false mallow	X	C	*	*	*
Sida fallax Walp.	*'ilima*	I	C, A, S	*	*	*
Sida rhombifolia L.		X	C	*		
Meliaceae						
Melia azedarach L.	Chinaberry	X	S			*
Moraceae						
Ficus elastica Roxb.ex Hornem	rubber tree	X	C	*		
Ficus microcarpa L. f.	Chinese banyan	X	C, S	*	*	
Myoporaceae						
Myoporum sandwicensis A. Gray	*naio*	E	C, A, S			*
Myrtaceae						
Psidium guajava L.	guava	X	C	*		

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Sterculiaceae						
Waltheria indica L.	*'uhaloa*	I	C, A, S	*	*	*
Tiliaceae						
Triumfetta semitriloba Jacq.	Sacramento bur	X	C, S			*
Verbenaceae						
Lantana camara L.	Sacramento bur	X	C, A, S	*	*	*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Polygonaceae						
Antigonon leptopus H. & A.	coral vine	X	C	*		
Portulacaceae						
Portulaca oleracea L.	pigweed	X	C, S	*	*	*
Portulaca pilosa L.	*'akulikuli*	X	C, S	*	*	*
Primulaceae						
Anagallis viscosa L.	scarlet pimpernel	X	C	*	*	*
Sapindaceae						
Dodonaea viscosa Jacq.	*'a'ali'i*	I	C, A, S			*
Solanaceae						
Capsicum annum L.	chili pepper	X	C, S	*		
Datura stramonium L.	jimson weed	X	C	*	*	*
Lycopersicon pimpinellifolium (Jusl.)	currant tomato	X	C, S	*	*	*
Nicandra physalodes (L.) Gaertn.	apple of Peru	X	C	*	*	*
Nicotiana glauca R.C. Graham	tree tobacco	X	C, S	*	*	*
Solanum americanum Mill.	*popolo*	I	C, S	*	*	*
Solanum seaforthianum Andrews		X	S			*

Appendix B

Native Plant Information Sheets

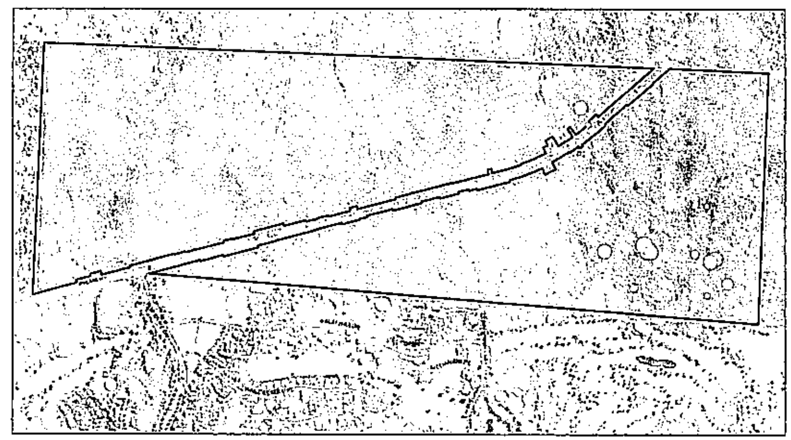
Argemone glauca (Nutt. ex Prain) Pope (Papaveraceae)

Hawaiian Name: *Pua kala*
Status: Endemic

Ecological and Cultural Significance: "Scattered to locally common in coastal dry forest and subalpine forest, 0-1,900 m, on the leeward sides of all of the main islands" (Wagner et al 1999). "Early Hawaiians used the seeds and sap of the stalk as a narcotic and analgesic for toothaches, neuralgia, and ulcers; the sap was used to treat warts" (Wagner et al 1999).

Honua'ula Photos: The majority of *pua kala* clusters occurred in the southwestern portion of the *kiawe-wiliwili* shrubland, usually in relatively open sunny locations of the lava flow. All plants we observed were flowering at the time of the surveys.

Distribution and Density at Honua'ula: We found 412 *pua kala* (*Argemone glauca*) in 26 locations within the Property. Most clusters averaged 16 individuals, most of which were seedlings (60%). Canopy cover of *pua kala* clusters ranged from one to 39 m^2 with the average being 4 m^2 (n= 26 clusters).



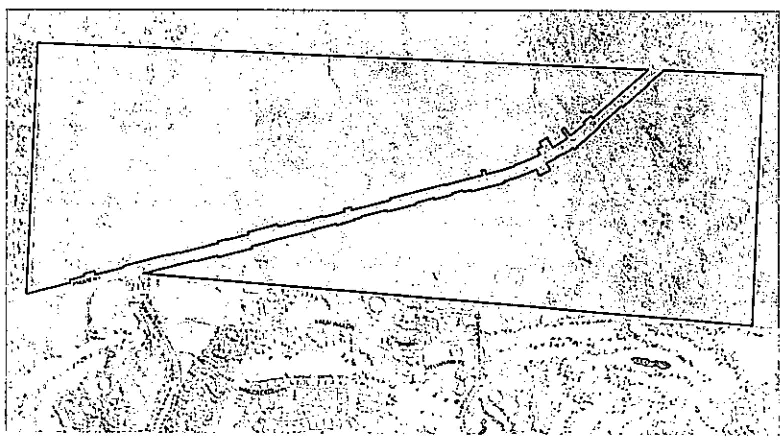
Canavalia pubescens Hook. & Arnott (Fabaceae)

Hawaiian Name: *'Āwikiwiki*
Status: Endemic (Candidate Endangered Species)

Ecological and Cultural Significance: "Presently uncommon in open dry sites such as lava fields, kiawe thickets, and dry forest, 15-540m, on Ni'ihau, Kaua'i (Nāpali Coast), Lāna'i, and leeward East Maui" (Wagner et al 1999). "Five populations are known on Maui: Keokea and Puu o Kali with "hundreds" observed, southwest Kalua o Lapa with two individuals, Papaka Kai with six individuals, Ahihi-Kinau with a few individuals, and southeast Pohakea, with at least one individual (HBMP 2008; F. Starr, pers. comm. 2006; H. Oppenheimer, pers. comm. 2006, 2008). These populations total a little over 200 individuals, with the majority ("hundreds") in one population (Puu o Kali)" (USFWS 2009).

Honua'ula Photos: All five 'āwikiwiki were flowering and fruiting at the time of the survey; however, no seedlings were detected. The plants appeared to be healthy with no signs of damage or disease.

Distribution and Density at Honua'ula: Altenberg (2007) illustrated GPS points for some 15 plants within the development. During this intensive field survey, however, SWCA's project botanists found only five 'āwikiwiki plants.



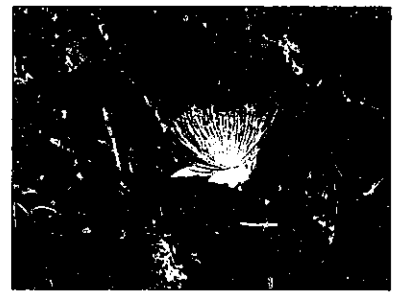
Botanical Survey of Honua'ula / Wailea 670, Kihei, Maui

Capparis sandwichiana DC (Capparaceae)

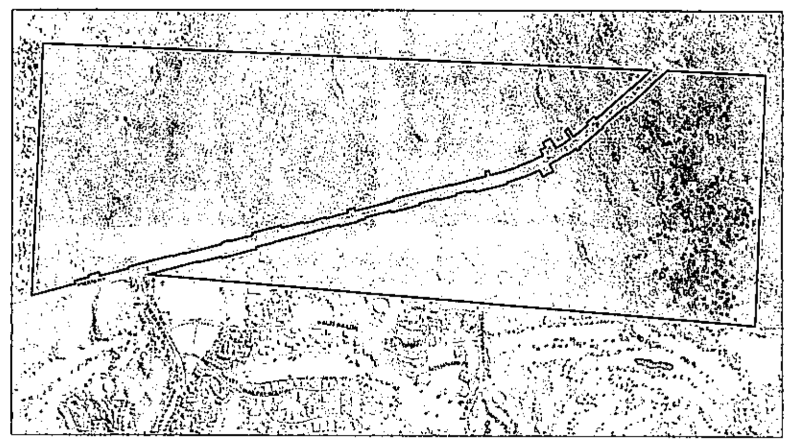
Hawaiian Name: *Maiapilo*
Status: Endemic

Ecological and Cultural Significance: "Scattered on coral, basaltic rocks, or in soil along the coast or somewhat inland, 0-100 (-575) m, on Midway Atoll, Pearl and Hermes Atoll, Laysan, and all of the main islands" (Wagner et al 1999).

Honua'ula Photos: Several *maiapilo* clusters were flowering and fruiting but the frequency of seedlings was low (2.5%). About 20% of the plants showed mild to heavy signs of insect herbivory where the epidermis (upper layer of the leaves) appeared to be scrapped away.



Distribution and Density at Honua'ula: *Maiapilo* (*Capparis sandwichiana*) is a common shrub throughout the understory of mixed *kiawe-wiliwili* shrubland. We found 563 *maiapilo* during the survey and all but one individual was limited to the southern 'a'ā lava flow. Most clusters ranged from one to five individuals; 11 were larger, consisting of six to 10 individuals. The aerial cover of the largest cluster was 531 m^2, others ranged from one to 314 m^2 (average cover of 17 m^2).



SWCA Environmental Consultants

Dodonaea viscosa Jacq. (Sapindaceae)

Hawaiian Name: *'A'ali'i*
Status: Indigenous

Ecological and Cultural Significance: "Pantropical; in Hawaii scattered to dominant, often in open sites such as ridges and lava fields, sometimes successional on lava or in pastures, ranging from coastal dunes, low elevation shrubland communities to dry, mesic, and wet forest, also subalpine shrubland, 3-2,350 m, on all of the main islands except Kaho'olawe" (Wagner et al 1999). "An extremely polymorphic species...Both the breeding system and morphological features of the *Dodonaea viscosa* complex are polymorphic" (Wagner et al 1999). "The fruit and leaves of *Dodonaea* are popular in lei making" (Wagner at al 1999).

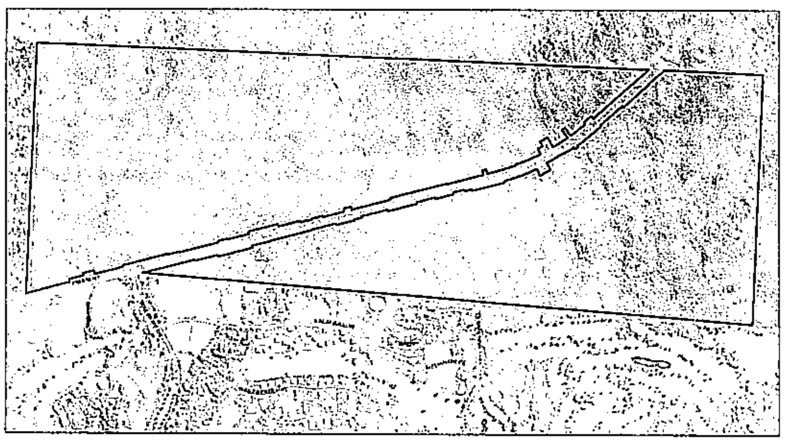
Photos: One *'a'ali'i* plant was observed fruiting, and no seedlings were observed in the vicinity of the adult shrubs. All plants were healthy with no detectable signs of damage, disease or herbivory.

Both photos by Forest & Kim Starr (www.hear.org)

Left: *'a'ali'i flowers from Kanaio, Maui*

Right: 'a'ali'i near Auwahi, Maui

Distribution and Density at Honua'ula: We observed 16 *'a'ali'i* in seven locations, all limited to the south western corner of the *kiawe-wiliwili* shrubland. Six of the seven locations had one to four individuals while the largest cluster comprised of six individuals. Average cover of *'a'ali'i* is about 26 m^2 where the aerial cover of two clusters were 79 m^2 each and the remaining five ranged from one to 20 m^2.

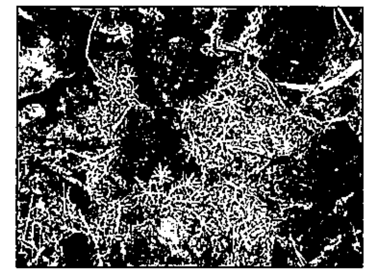


Doryopteris decipiens (Hook.) J. Sm. (Pteridaceae)

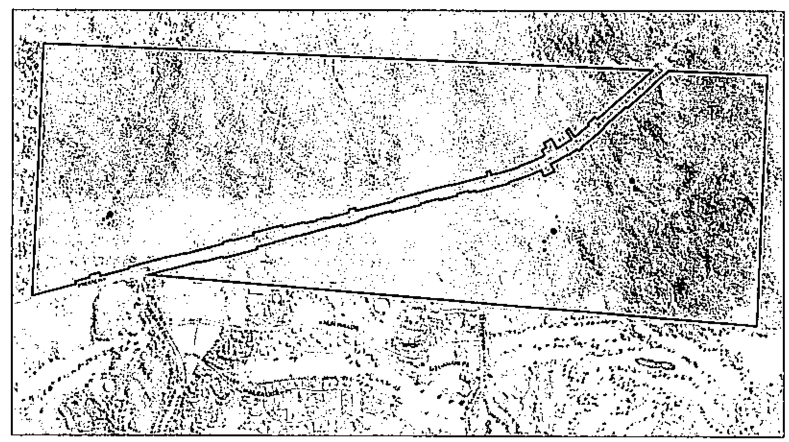
Hawaiian Name: *Iwaiwa*
Status: Endemic

Ecological and Cultural Significance: Reported from all major Hawaiian Islands and Ni'ihau, Lehua, and Kaho'olawe" (Palmer 2003). "Common in dry shrublands, grasslands and forests, often growing on exposed basalt, 30-915 m" (Palmer 2003).

Honua'ula Photos: Some iwaiwa plants within the development area showed signs of dehydration; most plants in the largest cluster (16 individuals) were very dry.



Distribution and Density at Honua'ula: Fifty-four *Iwaiwa* (*Doryopteris decipiens*) ferns were distributed at about 14 locations within the Property. Of these seven ferns were found within the *kiawe-wiliwili* shrubland, the others in the drainage gulches within in the northern portion of the site. The number of individuals within a cluster ranged from one to 16, the majority of which were adults (96%). Aerial cover of the largest cluster was approximately 7 m^2 while the others ranged from one to 3 m^2.



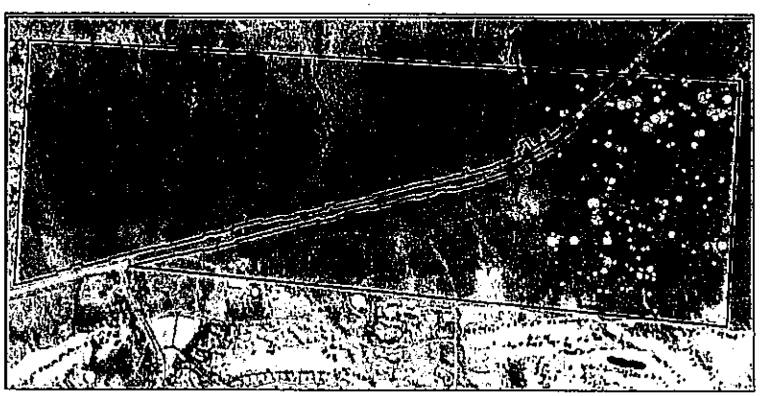
Erythrina sandwicensis Degener (Fabaceae)

Hawaiian Name: *Wiliwili*
Status: Endemic

Ecological and Cultural Significance: "Locally common in dry forest, up to 600m, on leeward slopes of all the main islands". "The soft, light wood was and still is used for the outriggers of traditional Hawaiian canoes. It also was formerly used for fishnet floats and surfboards. The seeds are strung into lei." Wagner et al (1999)

Honua'ula Photos: Most wiliwili trees showed some form of damage, primarily from the Erythrina gall wasp (*Quadristichus erythrinae* Kim) and the seed eating bruchid beetle (*Specularius impressithorax* Pic). Many trees were flush with new leaves following heavy rains in the spring of 2008, suggesting recovery from gall wasp damage.

Distribution and Density at Honua'ula: Wiliwili (*Erythrina sandwicensis*) is the most common native tree species in the *kiawe-wiliwili* shrubland. We mapped a total of 2478 individuals of which 2439 occurred in the southern 'a'ā portion of the Property in groves of various sizes. The largest groves (>15 individuals) tended to be located in the eastern portion of the kiawe-wiliwili shrubland. The frequency of adult wiliwili trees was greater (86%) than seedlings and juveniles.



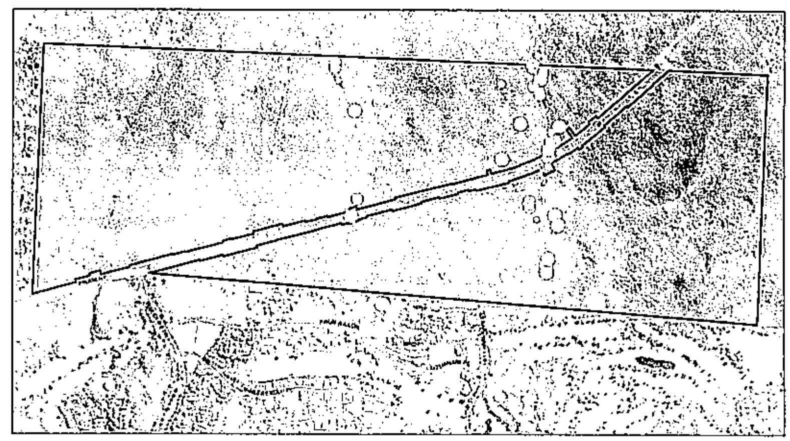
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult. (Poaceae)

Hawaiian Name: *Pili* grass
Status: Indigenous

Ecological and Cultural Significance: "Widely distributed throughout the tropics; in Hawai'i indigenous or possibly a Polynesian introduction, occurring on dry rocky cliffs, ledges, or slopes close to ocean exposure, 0-700 m, on all the main islands" (Wagner et al 1999). In dryer places, *pili* was favored for thatching material because of its pleasant odor, and was often used under a finishing thatch of *tī*, *hala*, or *kō* (Abbott 1992).

Honua'ula Photos: *Pili* grass (*Heteropogon contortus*) was the only native grass species found within the project area. Adult plants were flowering at the time of our surveys. We did not observe signs of superficial damage or disease.

Distribution and Density at Honua'ula: *Pili* grass was limited to gulches within the kiawe-buffel grass grassland in the northern half of the Project site. Most of *pili* grass occurred in the southern drainage gullies of the grassland, becoming less abundant to the north. We mapped 1493 *pili* grass plants in 66 locations within the Property.



Ipomoea tuboides Degener & Ooststr. (Convolvulaceae)

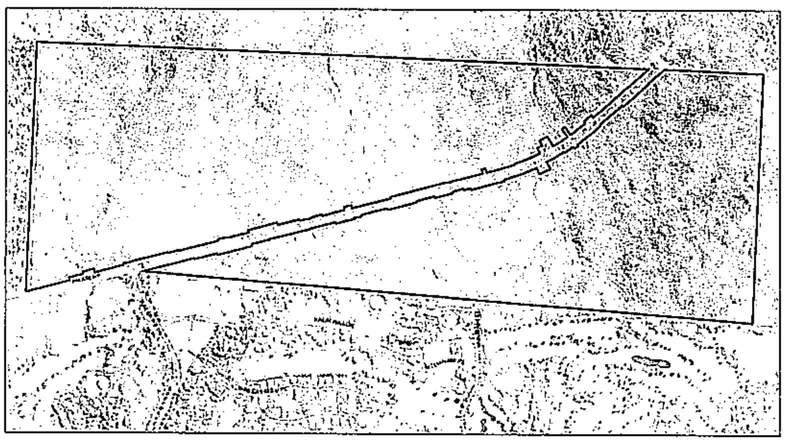
Hawaiian Name: Hawaiian Moon Flower
Status: Endemic

Ecological and Cultural Significance: "Occurring on arid rocky talus slopes or aa lava, 0-610 m, on all of the main islands" (Wagner et al 1999).

Honua'ula Photos: At the time of the SWCA 2008 surveys, all the Hawaiian moon flower plants within the development were flowering.

Photo above by Forest & Kim Starr of *Ipomoea tuboides* at Kanalo, Maui. (www.hear.org).

Distribution and Density at Honua'ula: Five Hawaiian moon flower (*Ipomoea tuboides*) vines were observed within the southern 'a'ā portion of the Property .



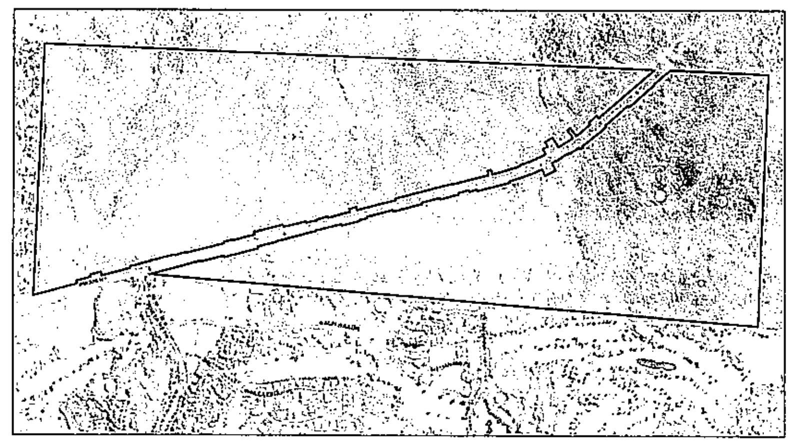
Lipochaeta rockii Sherff (Asteraceae)

Hawaiian Name: *Nehe*
Status: Endemic

Ecological and Cultural Significance: "Scattered to common in coastal sites to dry forest, often in disturbed areas and margins of lava flows, 15-550m, on Moloka'i, from scattered localities on Maui, common the coast on Kaho'olawe, also a single collection presumably from Hawai'i" (Wagner et al 1999). Synonymous with *L. lobata* (Gaud.) DC var. *makenensis* Degener & Sherff, *L. rockii* today is not recognized as a separate variety or subspecies (Herbst, Bishop Museum, pers. comm.)

Honua'ula Photos: The population of nehe within the Honua'ula project area has a unique leaf shape.

Distribution and Density at Honua'ula: One hundred and one *nehe* (*Lipochaeta rockii*) were found distributed in 24 locations. Two large clusters contained 22 and 23 individuals respectively and were located in the center of the mixed *kiawe-wiliwili* shrubland. Smaller clusters (< 10 individuals) were found from central to southwestern portion of the shrubland. The aerial cover of clusters ranged from < 1 m^2 to 78.5 m^2.



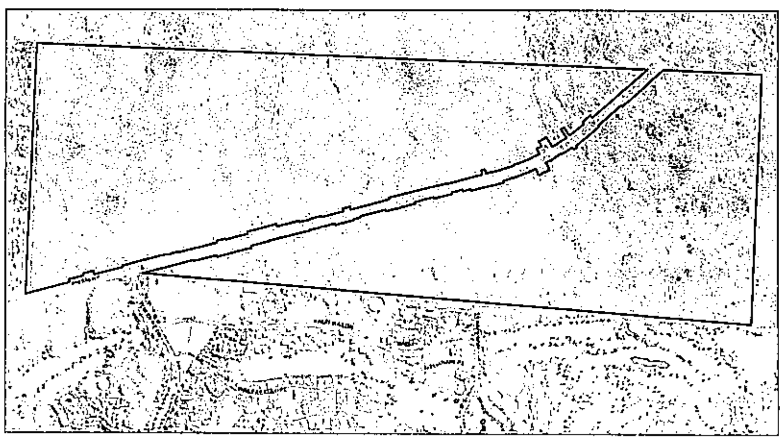
Myoporum sandwicense A. Gray (Myoporaceae)

Hawaiian Name: *Naio*
Status: Indigenous

Ecological and Cultural Significance: "Occurring on Mangaia in the Cook Islands and Hawai'i; in Hawai'i, occasional to common in strand vegetation, dry forest, 'a'ā lava, mesic to wet forest, and a dominant element of subalpine forest, 0-2,380 m, probably on all of the main islands but not documented from Kaho'olawe" (Wagner et al 1999). "The wood, while drying or burning, has an odor similar to that of sandalwood. It was once shipped to China as a substitute after the local sandalwood supply was exhausted, but it was not accepted. Also,it formerly was a preferred wood for house frames" (Wagner et al 1999).

Honua'ula Photos:

Distribution and Density at Honua'ula: Twenty one *naio* (*Myoporum sandwicense*) trees were observed in 17 locations distributed throughout the southern portion of the *kiawe-wiliwili* shrubland. No *naio* seedlings were found. Fifteen of the 17 locations were occupied by a single tree. Aerial cover ranged from < 1 m^2 to 78.5 m^2, the largest of which consisted of three trees.

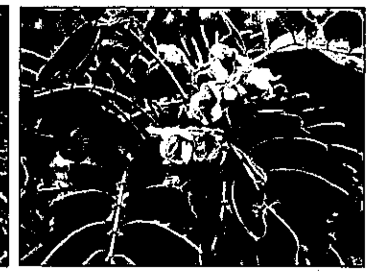


Senna gaudichaudii (Hook. & Arnott) H. Irwin & Barneby (Fabaceae)

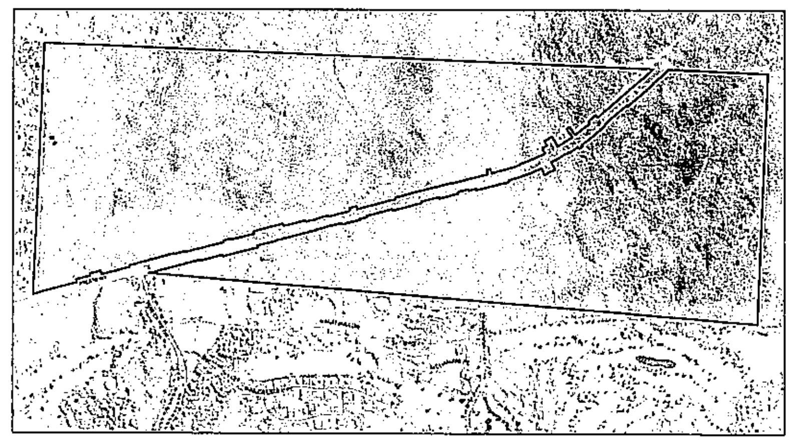
Hawaiian Name: *Kolomona, uhiuhi*
Status: Indigenous

Ecological and Cultural Significance: "Occurring in the Pacific Basin, including the New Hebrides, Austral Islands, Rapa, Henderson Island, Fiji, Hawai'i, and perhaps New Caledonia and Tahiti; in Hawai'i primarily occurring in leeward sites usually on talus slopes, lava flows, or rocky sites in coastal *Leucaena-Prosopis* shrubland, disturbed hala forest, dry forest, and occasionally lower portions of mesic forest, 5-920 m, documented from all of the main islands except Ni'ihau and Kaho'olawe" (Wagner et al 1999).

Honua'ula Photos: Evidence of herbivory was observed at four of 32 locations. Many of the plants found were flowering and / or fruiting at the time of our surveys.



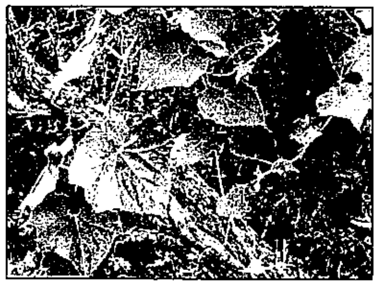
Distribution and Density at Honua'ula: Thirty-nine *kolomona* (*Senna gaudichaudii*) trees were mapped at 32 locations within the Property. Most were distributed in the southern portion of the mixed *kiawe-wiliwili* shrubland. The cluster size ranged from one to five individuals, and 24 of 32 mapped locations consisted of solitary plants. The aerial cover ranged from < 1 m^2 to 19.6 m^2.



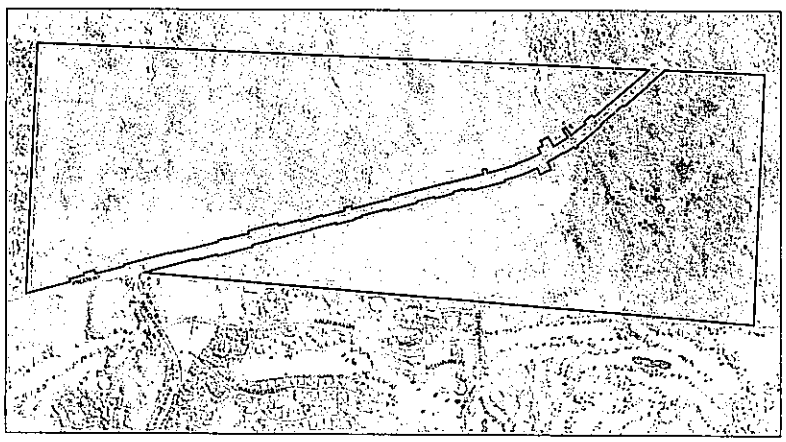
Sicyos hispidus Hillebr. (Cucurbitaceae)
Hawaiian Name: *'Ānunu*
Status: Endemic

Ecological and Cultural Significance: "Occurring in dry forest or alien vegetation, from near sea level up to 800 m, on Moloka'i, Lāna'i, Maui in the valley area from Kahului and Kīhei, and Hawai'i in the North Kona area" (Wagner et al 1999).

Honua'ula Photos: *'Ānunu* vines within the Property did not show any signs of damage or herbivory.



Distribution and Density at Honua'ula: We mapped 113 *'ānunu* (*Sicyos hispidus*) vines at 49 locations within the Property. *'Ānunu* occurred primarily in the central and northern edge of the *kiawe-wiliwili* shrubland. Larger clusters (> 5 individuals) tended to be located in the central portion of the *kiawe-wiliwili* shrubland.

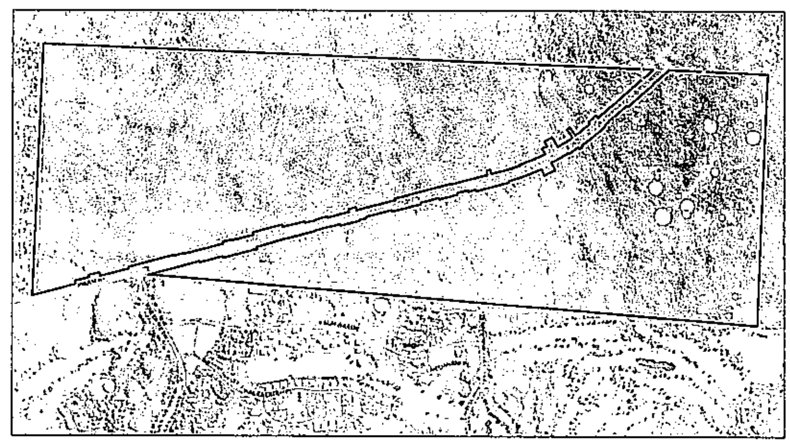


Sicyos pachycarpus Hook. & Arnott (Cucurbitaceae)
Hawaiian Name: *'ānunu*
Status: Endemic

Ecological and Cultural Significance: "Widespread in herb or shrubland coastal communities, dry forest, and alien vegetation such as *Leucaena* or *Prosopis* shrubland, on coral sand and clay loam, 0-900 m, primarily on the lower leeward slops of all the main islands; also on the Northwestern Hawaiian Islands where collected from Laysan and Nihoa" (Wagner et al 1999).

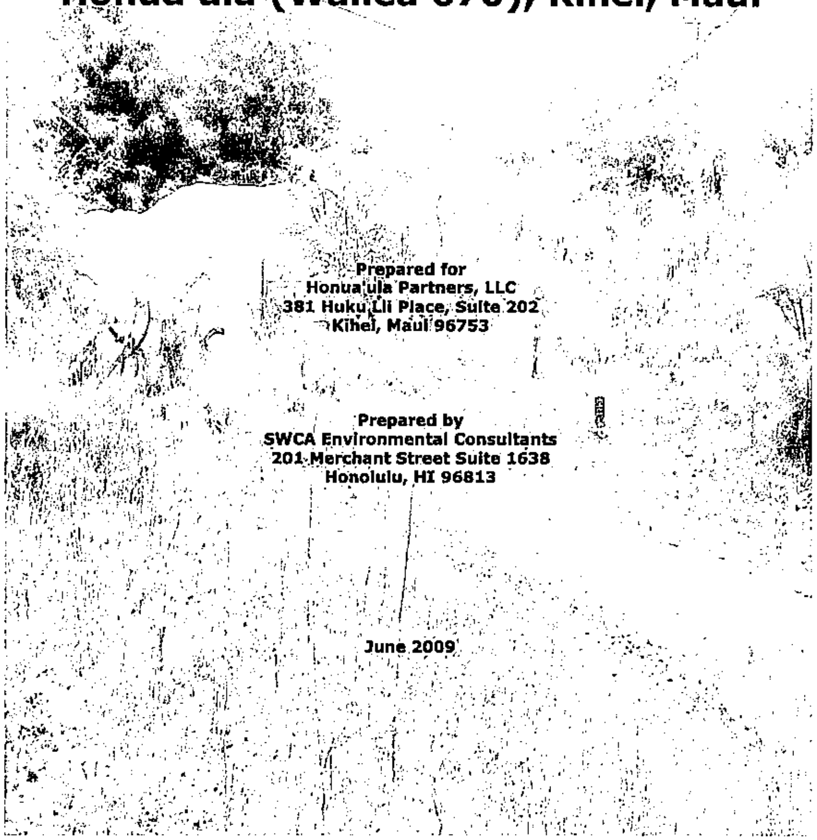
Honua'ula Photos: Approximately 52% of mapped plants were seedlings. Many adults were observed flowering and/ or fruiting. Most of the *'ānunu* vines appeared to be healthy with only one plant showing some signs of herbivory.

Distribution and Density at Honua'ula: Six hundred and three *S. pachycarpus* were mapped in 102 locations. The size of clusters varied greatly and ranged from one to 110 plants per location. The majority of the larger clusters (> 15 individuals) were concentrated in the south and central portions of the *kiawe-wiliwili* shrubland.



Botanical Survey – Wastewaterline

Botanical Survey of Alternative Wastewater Line Alignments for Honua'ula (Wailea 670), Kīhei, Maui



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June 2009

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1.0 INTRODUCTION

This report summarizes the findings of a botanical survey conducted by SWCA Environmental Consultants (SWCA) in August 2008 along three proposed alternative routes, for the conveyance of wastewater from the Honua'ula Project site to the Makena Wastewater Reclamation Facility located on the Makena Resort property.

Honua'ula is located in the Wailea area of Kihei, Maui (Figure 1). In April 2008, R.M. Towill Corporation conducted a feasibility study for conveyance of wastewater from Honua'ula to the existing Makena Resort Wastewater Reclamation Facility (MRWRF), for treatment and disposal. This study by R. M. Towill investigated the following four alternative wastewater conveyance routes from Honua'ula to MWWRF on the Makena property.

Alternative A – pump directly to MWWRF
Alternative B – pump to a high point and gravity flow to MWWRF
Alternative C – gravity flow to MWWRF
Alternative D- gravity flow to the Makena Wastewater Pump Station (MWWPS) "MU"

R. M. Towill Corporation determined that alternative C was infeasible because the elevation difference did not allow for gravity flow from the Project Site to the MRWRF (R. M. Towill Technical Memorandum, 2008). SWCA conducted botanical surveys along the three feasible alternative routes A, B and D (Figure 2) between the Project site and MRWRF for the conveyance of wastewater and the return of treated water for non-potable re-use at Honua'ula.

The objectives of the botanical survey are:

- To identify and document the vegetation and all plant species within a 20 m-wide corridor along the three alternative wastewater line alignments;
- To map any State or Federally listed candidate, threatened or endangered plant species, species of concern and/ or rare (either locally or Statewide) plants within the study area.
- To recommend mitigation measures as appropriate to minimize impacts to native plants.

2.0 METHODS OF STUDY

Botanists Shahin Ansari Ph.D., Tiffany Thair (M.S. candidate), Maya Legrande M.S., and Talia Portner B.S. conducted plant surveys along each of the three alternative wastewater line alignments on August 8, 2008. A Trimble GeoXT mapping-grade GPS unit preloaded with the study transects was used to guide the survey and collect point data on native plants. The botanists walked the transects at 5-meter intervals to cover a 20-meter wide corridor along each of the three wastewater line alignments. The botanists thoroughly scanned each 5-m wide corridor and documented all plant species observed. We did not survey a portion of alternative route B that runs along the southern boundary of the Honua'ula project Site, because this section was previously surveyed by SWCA in March of 2008 as part of the botanical survey for the Wailea 670 parcel (SWCA 2008).

3.0 RESULTS

The botanists observed 84 plant species, including eight native species two of which are endemic and six are indigenous (Appendix 1). No federally listed threatened, endangered, or candidate plants were detected along any of the alternative wastewater line alignments.

Previous botanical surveys of Honua'ula (Char and Linney 1988, 1993, 2004; SWCA 2009) reported that the vegetation along the southern border of the Honua'ula property is kiawe-wiliwili shrubland with scattered wiliwili, anuanu (*Sicyos pachycarpus*) and alena (*Boerhavia sp.*) (Figure 3). In this survey, all remaining areas surveyed consist of kiawe shrubland. Kiawe (*Prosopis pallida*) was the dominant canopy species along all three alternative routes (Figure 4). Some of the common herbs and shrubs included golden crown beard (*Verbesina encelioides*), *Bidens* species, false ragweed (*Parthenium hysterophorus*), klu (*Acacia farnesiana*), sweet basil (*Ocimum basilicum*), koa haole (*Leucena leucocephala*) and tree tobacco (*Nicotiana glauca*). Common

grasses found across the alternative conveyance routes include buffel grass (*Cenchrus ciliaris*), guinea grass (*Panicum maximum*), natal red top (*Melinus repens*) and sour grass (*Digitaria insularis*).

Alternative route 'A' extends for a length of 1940 linear m (6366 linear ft). About 753 m (2470 ft) of this route is adjacent to a paved road on the Makena property while the remaining 1187 m (3896 ft) runs through the kiawe shrubland and parts of the golf course on the Makena property (Figure 3). Alternative route 'A' requires the construction of a pump station (pump A, Figure 2) (Towill 2008) which would be located in the kiawe-wiliwili shrubland on the Honua'ula property (SWCA 2008) in the southwestern corner of the Honua'ula project site. Alternative route 'A' overlaps with route 'D' for 753 m (2470 ft) (Figure 3). Along the section where alternative routes 'A' and 'D' overlap, we found three native species, wiliwili (*Erythrina sandwicensis*, n=5), uhiuhi (*Senna gaudichaudii*, n=1) and maiapilo (*Capparis sandwichiana*, n=2). We also mapped thirty-three wiliwili trees at five locations towards the southern end of alternative route A (Figure 3 and 5).

Alternative route 'B' is 3212 linear m (10,538 linear ft) in length. Route 'B' would require the construction of two pump stations; pump A, and an additional pump station B (Figure 2) about 107 m (350 ft) to the east of pump A (Towill 2008). Location of pump B and the 856 m (2807 ft) stretch of route 'B' (Figure 2) runs through the kiawe-wiliwili shrubland (SWCA 2009) on the Honua'ula project site which inhabits the native species of wiliwili, anuanu (*Sicyos pachycarpus*) and alena (*Boerhavia sp.*) (Figure 3). The remaining 2356 m (7731 ft) of route B passes through the kiawe shrubland vegetation and parts of the golf course greens on the Makena property (Figure 2). Botanists found 14 wiliwili trees along the section of route 'B' that runs along the property line between Makena and the Lokelani Resort properties (Figure 3 and 6). They also found a clump of 11 to 15 individuals of hoary abutilon on Route B near the MRWRF (Figure 3).

Alternative route 'D' is 2027 linear m (6650 linear ft) in length. Similar to route 'A', the initial 753 m (2470 ft) of route 'D' also runs adjacent to a paved road on the Makena property. The remainder of 1274 m (4180 ft) of route 'D' runs through the kiawe shrubland and parts of the golf course before terminating at the 'MU' wastewater pump station (Figure 2 and 7). On the section of route 'D' that does not overlap with route 'A', we found one wiliwili tree and a clump of about 11 to 15 individuals of hoary abutilon (*Abutilon incanum*) close to the wastewater treatment plant (Figure 3 and 8).

4.0 DISCUSSION AND RECOMMENDATIONS

The construction and operation of any of the three alternative wastewater lines is not likely to have a major impact either on the vegetation or terrestrial ecosystems on either the Honua'ula or Makena parcels. The native species of plants found within the alternative wastewater line alignments are common throughout Maui and the other islands in the State. Ninety percent (90%) of the plants found on all three alternative alignments are introduced species.

Only a portion of alternative Route 'B' passes through the kiawe-wiliwili vegetation. This alternative requires the construction of two pump stations A and B, also within the kiawe-wiliwili vegetation. Construction of alternative Route 'A' is likely to disturb a greater number of native plant species. Alternative Route D is likely to have the least impact on the vegetation in general and on the native plants in particular.

- The the extent possible, as many wilwiliw trees as possible should remain undisturbed by construction. Where no alternative exists to removal of individual wiliwili trees, saplings can be propagated in areas adjacent to the wastewater lines, as appropriate.

- Non-native tree tobacco (*Nicotiana glauca*) trees, which occur along all three alternative wastewater line alignments, are host plants for the listed endangered Blackburn sphinx moth (*Manduca blackburni*). *M. blackburni* has been found on tree tobacco plants elsewhere in Kīhei and within Honua'ula (SWCA 2009). To help insure against the accidental take of individual sphinx moths, a qualified wildlife biologist should first screen each tree tobacco plant, prior to any land clearing. If sphinx moths or signs of sphinx moths (frass, cut stems or leaves, caterpillars, pupae, or adults) are found on any tree, that tree should be marked and protected against disturbance, and the US Fish and Wildlife Service and Maui Office of the Department of Land and Natural Resources, Division of Forestry and Wildlife should be consulted.

- Landscaping following construction should focus on the use of native plant species normally found on adjacent lands. Suitable species may include, 'ilima (*Sida fallax*), ilie'e (*Plumbago zeylanica*), maiapilo (*Capparis sandwichiana*), uhluhi (*Senna gaudichaudii*) and naio (*Myoporum sandwicensis*). Seeds or seedlings for these native plants may be obtained from various native plant nurseries on Maui such as Ho'olawa Farms or Native Nursery LLC.

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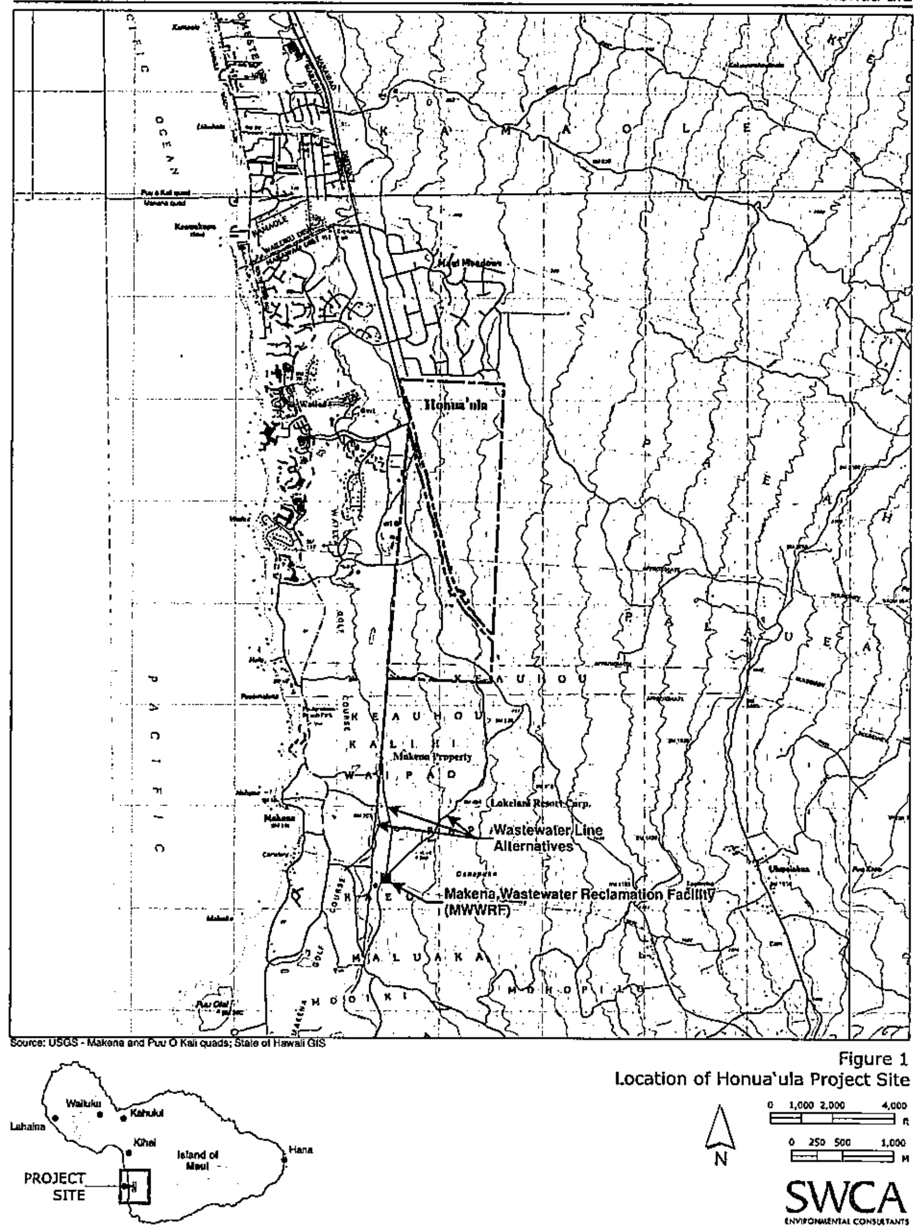
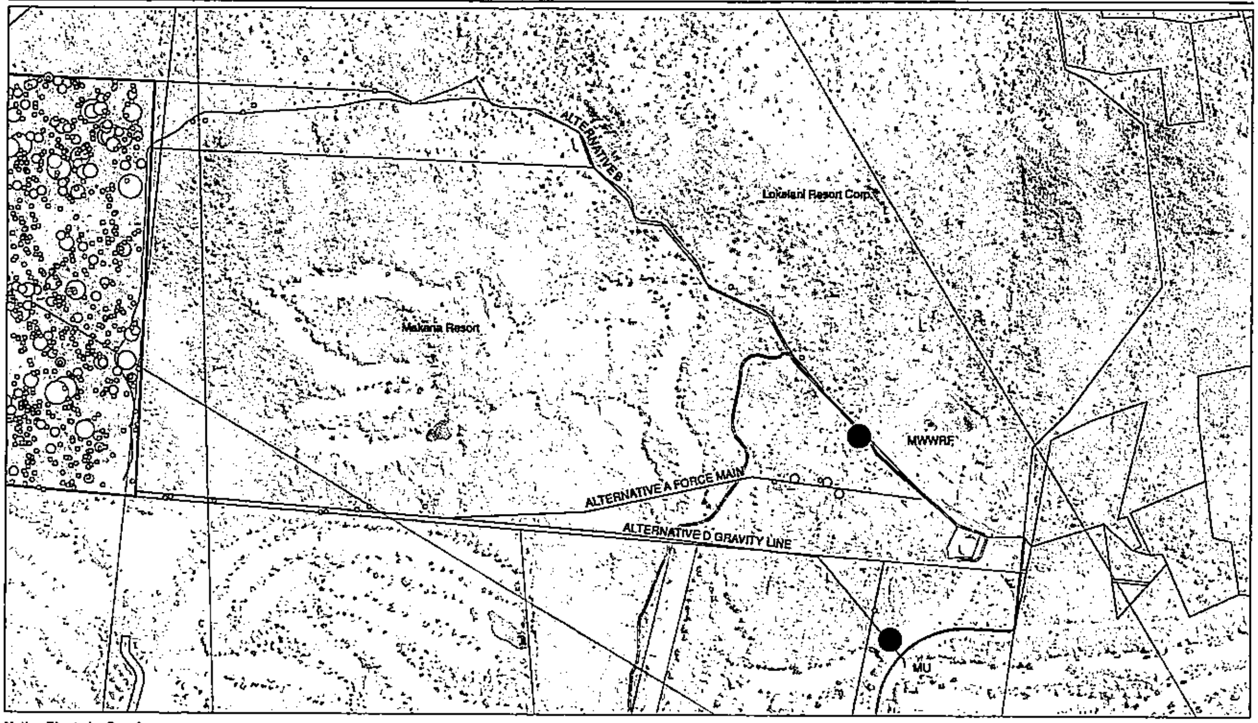


Figure 1
Location of Honua'ula Project Site



Native Plants by Species

- ○ *Argemone glauca*
- ● *Abutilon incanum*
- ○ *Boerhavia sp.*
- ● *Canavalia pubescens*
- ○ *Capparis sandwichiana*
- ● *Doryopteris decipiens*
- ○ *Dodonea viscosa*
- ○ *Erythrina sandwicensis*
- ○ *Heteropogon contortus*
- ○ *Ipomoea tuboides*
- ○ *Lipochaeta rockii*
- ○ *Myoporum sandwicense*
- ○ *Senna gaudichaudii*
- ○ *Sicyos hispidus*
- ○ *Sicyos pachycarpus*

Native Plants by Count Classes

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 25
- 26 - 60
- 61 - 110

Plant Source: Native Plants were mapped with GPS
Boundary Source: PBR Hawaii
Aerial Source: PDC (Pacific Disaster Center)

Figure 3
Locations of Native Plants

N
0 250 500 1,000 ft
0 50 100 200 M

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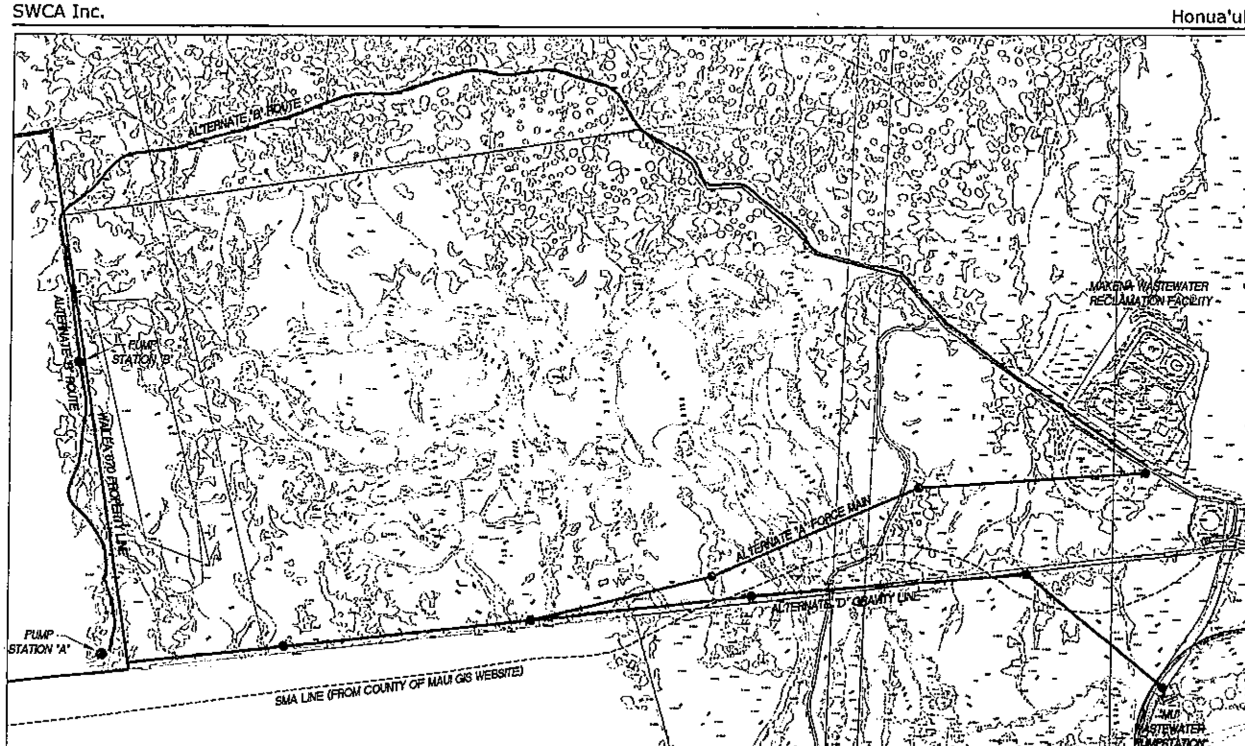

R. M. TOWILL CORPORATION

Figure 2
Offsite Wastewater Line
Alternatives Map

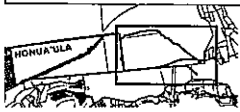

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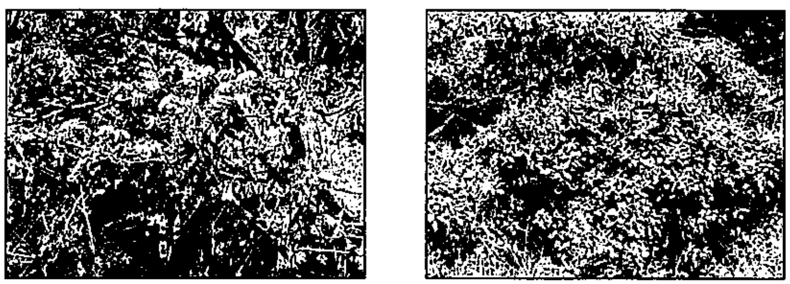
Figure 4. Kiawe shrubland was the typical vegetation type along route 'A' (above) and the other wastewater conveyance routes 'B' and 'D'.



A **B**

Figure 5. Maiapilo (*Capparis sandwichiana*) (A) and uhiuhi (*Senna gaudiachaudii*) (B) adjacent to the paved road along the section where routes 'A' and 'D' overlap.

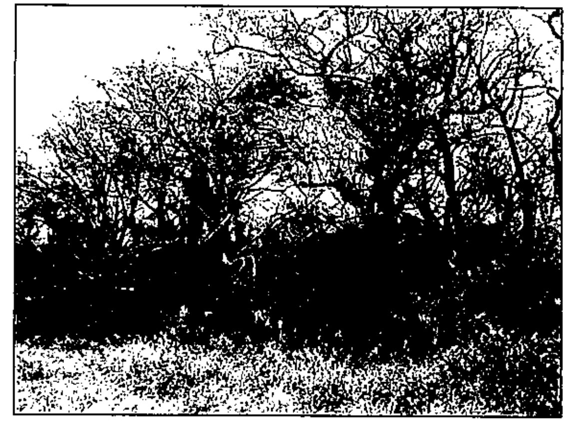


Figure 6. Grove of wiliwili (*Erythrina sandwicensis*) trees along wastewater conveyance route 'B'.

Figure 7. Vegetation along alternative wastewater conveyance route 'D' overlooking the waste water pump station.

Figure 8. Hoary abutilon (*Abutilon incanum*) on route 'D'.

APPENDIX 1. LIST OF PLANTS OBSERVED ON ALTERNATIVE WASTEWATER LINE ALIGNMENTS.

The taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999), Wagner and Herbst (1999), and Staples and Herbst (2005). Recent name changes are those recorded in the Hawaii Biological Survey series (Evenhuis and Eldredge, eds, 1999-2002). (✓) indicated species presence.

The following symbols are used:

E = endemic = native only to the Hawaiian Islands.
I = indigenous = native to the Hawaiian Islands and elsewhere.
X = introduced or alien = all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after 1778.

Scientific Name	Common Name	Status	Alt B	Alt A	Alt D
AGAVACEAE					
Furcraea foetida (L.) Haw.	mauritius hemp, malina	X		✓	
ALOEACEAE					
Aloe vera (L.) N.L.Burm.	aloe	X	✓	✓	
COMMELINACEAE					
Commelina benghalensis L.	hairy honohono, dayflower	X		✓	
POACEAE					
Axonopus fissifolius (Raddi)Kuhlm.	narrow-leaved carpetgrass	X	✓		
Brachiaria mutica (Forssk.) Stapf	California grass	X		✓	
Cenchrus ciliaris L.	buffelgrass	X	✓	✓	✓

Scientific Name	Common Name	Status	Alt B	Alt A	Alt D
Ageratum conyzoides L.	maile hohono, maile	X		✓	
Bidens cynapiifolia Kunth	Spanish needle, beggartick	X	✓	✓	✓
Bidens pilosa L.	Spanish needle	X	✓	✓	✓
Conyza bonariensis (L.) Cronq.	hairy horseweed	X	✓	✓	✓
Crassocephalum crepidioides(Benth.) S.Moore	crassocephalum	X		✓	
Emilia fosbergii Nicolson	red pualele	X	✓	✓	
Lactuca serriola L.	prickly lettuce	X		✓	
Parthenium hysterophorus L.	false ragweed, Santa Maria	X	✓	✓	✓
Pluchea carolinensis (Jacq.) G.Don	sourbush	X	✓	✓	
Pluchea indica (L.) Less.	Indian fleabane	X		✓	
Pluchea x *fosbergii* Coopper. &Galang	fleabane	X		✓	
Sonchus oleraceus L.	pualele	X	✓		
Sphagneticola trilobata (L.)Pruski	wedelia	X		✓	
Tridax procumbens (L.)	coat buttons	X	✓	✓	✓
Verbesina encelioides (Cav.)Benth. & Hook	golden crown-beard	X	✓	✓	✓

Scientific Name	Common Name	Status	Alt B	Alt A	Alt D
Chloris barbata (L.) Sw.	swollen fingergrass	X	✓	✓	✓
Cynodon dactylon (L.) Pers	manienie	X	✓	✓	✓
Digitaria insularis (L.) Mez exEkman	sourgrass	X	✓	✓	✓
Melinus repens (Willd.) Zizka	natal redtop	X	✓	✓	✓
Panicum maximum L.	guinea grass	X	✓	✓	
Setaria verticillata (L.) P.Beauv.	bristly foxtail, mau'u pilipili	X	✓	✓	✓
ACANTHACEAE					
Asystasia gangetica (L.) T.Anderson	chinese violet	X		✓	
AMARANTHACEAE					
Alternanthera pungens Kunth	khaki weed	X	✓	✓	✓
Amaranthus spinosus L.	spiny amaranth	X	✓		
Amaranthus viridis L.	slender amaranth	X		✓	✓
ASCLEPIADACEAE					
Asclepias physocarpa (E.Mey.)Schltr.	balloon plant	X	✓	✓	✓
ASTERACEAE					

Scientific Name	Common Name	Status	Alt B	Alt A	Alt D
Coccinea grandis (L.) Voigt	ivy gourd	X	✓	✓	✓
Momordica charantia L.	balsam pear	X		✓	
EUPHORBIACEAE					
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X	✓	✓	✓
Chamaesyce hypercifolia (L.)Millsp.	graceful spurge	X		✓	
Chamaesyce hyssopifolia (L.)Small		X	✓		
Euphorbia heterophylla L.	kaliko	X		✓	
Ricinus communis L.	castor bean	X	✓	✓	✓
FABACEAE					
Acacia farnesiana (L.) Willd.	klu, aroma, kolu	X	✓	✓	✓
Chamaecrista nictitans (L.)Moench	partridge pea	X	✓	✓	✓
Crotalaria incana L.	fuzzy rattlepod	X	✓		
Crotalaria pallida Aiton	smooth rattlepod	X	✓	✓	
Desmanthus pernambucanus(L.) Thell.	slender or virgate mimosa	X	✓	✓	✓
*Erythrina sandwicensis*O.Deg.	wiliwili	E	✓		

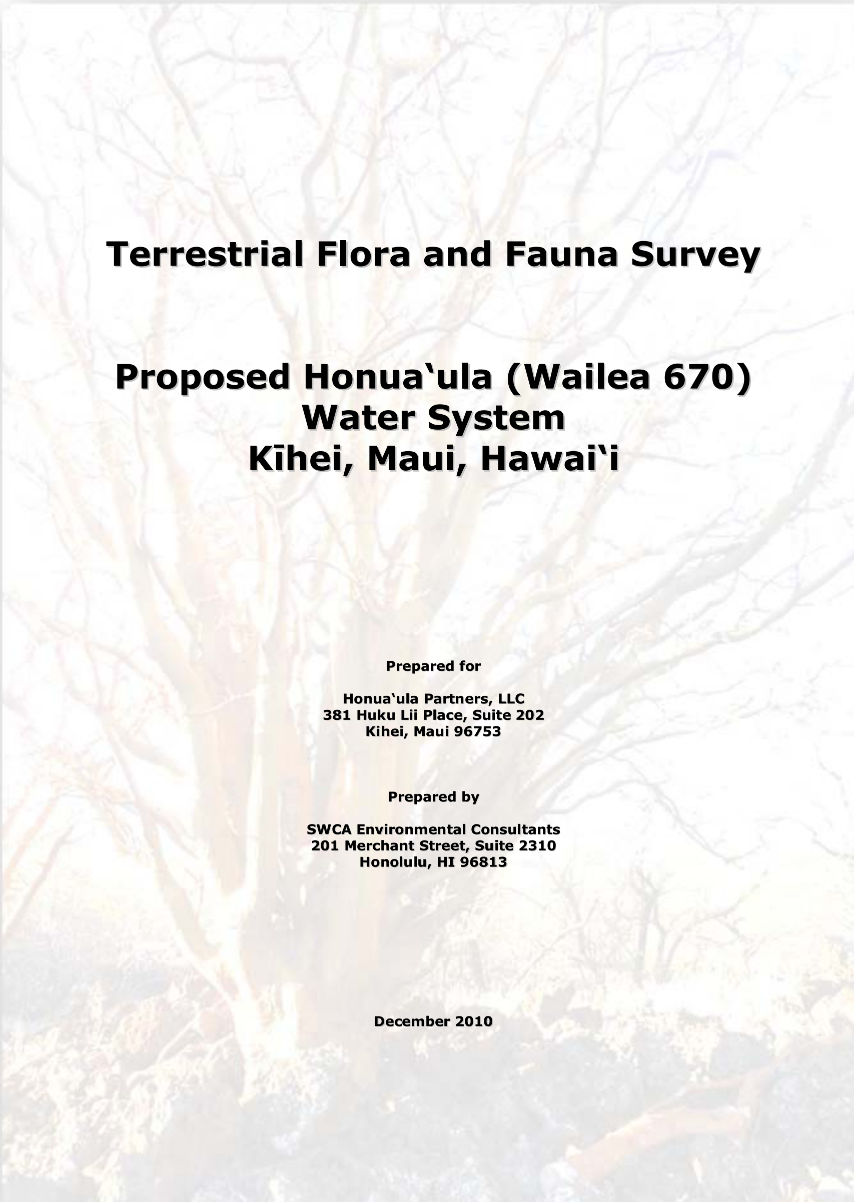
Scientific Name	Common Name	Status	Alt B	Alt A	Alt D
Xanthium strumarium L. var.*canadense* (Miller)	kikania	X	✓	✓	
BORAGINACEAE					
Heliotropium procumbens Mill. var. *depressum* (Cham.) Fosberg		X	✓		
CACTACEAE					
Opuntia ficus-indica (L.) Mill.	panini	X	✓	✓	✓
CAPPARACEAE					
Capparis sandwichiana DC.	maiapilo	E		✓	
Cleome gynandra L.	wild spider flower	X	✓	✓	
CHENOPODIACEAE					
Atriplex semibaccata R.Br.	Australian saltbush	X	✓	✓	✓
Chenopodium murale L.	aheahea	X	✓		
CONVOLVULACEAE					
Ipomoea obscura (L.) Ker Gawl.		X	✓	✓	✓
Merremia aegyptia (L.) Urb.	hairy merremia	X	✓	✓	✓
CUCURBITACEAE					

Scientific Name	Common Name	Status	Alt B	Alt A	Alt D
Malva parviflora L.	cheese weed	X	✓	✓	✓
Malvastrum coromandelianum(L.) Garcke	false mallow	X	✓	✓	✓
Sida fallax Walp.	'ilima	I	✓	✓	✓
Sida spinosa L.	prickly sida	X	✓	✓	✓
NYCTAGINACEAE					
Boerhavia coccinea Mill.		X	✓	✓	✓
PASSIFLORACEAE					
Passiflora foetida L.	love-in-a-mist	X		✓	
PLUMBAGINACEAE					
Plumbago zeylanica L.	'ilie'e	I		✓	
PORTULACACEAE					
Portulaca oleracea L.	pigweed	X	✓	✓	✓
SOLANACEAE					
Datura stramonium L.	jimson weed	X	✓		
Nicandra physalodes (L.)Gaertn.	apple of Peru	X		✓	

Scientific Name	Common Name	Status	Alt B	Alt A	Alt D
Indigofera suffritocosa Mill.	iniko	X	✓	✓	✓
Leucaena leucocephala (Lam.) de Wit	koa haole	X	✓	✓	✓
Macroptilium lathyroides (L.)Urb.	wild bean	X	✓	✓	
Pithecellobium dulce (Roxb.)Benth.	opiuma	X		✓	
Prosopis pallida (Humb. &Bonpl. Ex Willd.) Kunth	kiawe, algaroba	X	✓	✓	✓
Samanea saman (Jacq.) Merr.	monkeypod	X		✓	
Senna occidentalis (L.) Link	coffee senna	X		✓	
Senna gaudichaudii (Hook. &Arn.) H.S.Irwin & Barneby	kolomona, uhiuhi	I		✓	
LAMIACEAE					
Hyptis pectinata (L.) Poit.	comb hyptis	X	✓		
Leonotis nepetifolia (L.) R.Br.	lion's ear	X	✓	✓	✓
Ocimum basilicum L.	sweet basil	X	✓	✓	✓
MALVACEAE					
Abutilon grandifolium (Willd.)Sweet	hairy abutilon	X	✓	✓	✓
Abutilon incanum (Link.)Sweet	hoary abutilon	I	✓	✓	✓

Scientific Name	Common Name	Status	Alt B	Alt A	Alt D
Nicotiana glauca R.C. Graham	tree tobacco	X	✓	✓	✓
Solanum americanum Mill.	glossy nightshade, popolo	I		✓	
Solanum lycopersicum L. var.*cerasiforme* (Dunal)Spooner, G.J. Anderson &R.K. Jansen	cherry tomato	X	✓	✓	✓
*Solanum seaforthianum*Andrews		X	✓	✓	
STERCULIACEAE					
Waltheria indica L.	'uhaloa	I	✓	✓	✓
TILIACEAE					
Triumfetta semitriloba Jacq.	Sacramento bur	X	✓	✓	✓
Verbenaceae					
Lantana camara L.	lākana	X	✓	✓	

Botanical and Wildlife Survey – Waterline



Terrestrial Flora and Fauna Survey

Proposed Honua'ula (Wailea 670) Water System Kīhei, Maui, Hawai'i

Prepared for

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1.0 INTRODUCTION

In August 2010, SWCA Environmental Consultants (SWCA) was tasked by Honuaʻula Partners, LLC to conduct a terrestrial flora and fauna survey for a proposed conveyance system to provide both potable and non-potable water for the proposed Honuaʻula project. The survey was conducted in support of an Environmental Impact Statement (EIS) being prepared by PBR Hawaii & Associates, Inc. (PBR Hawaii), in compliance with Chapter 343 Hawaii Revised Statutes (HRS) and Habitat Conservation Plan (HCP) being prepared by SWCA under Section 10 of the Endangered Species Act (ESA) for the proposed Honuaʻula project.

Honuaʻula is a master-planned, mixed-residential community encompassing a rectangular area of 271 hectares (ha) or 670 acres (ac) east of, and adjacent to, the existing Wailea Resort in Kīhei, Maui (Figure 1). It is bounded by the Maui Meadows subdivision to the north, the Makena Golf Course to the south, the Wailea Golf Course to the west, and the ʻUlupalakua Ranch to the east.

The offsite components of the proposed private water system consist of: 1) brackish water wells within the subject well field; 2) one potable water storage tank and one non-potable water tank located mauka of the project area; and 3) waterlines to convey brackish water from the wells to the project area and the mauka tanks and then back to the project area. Water treatment and storage facilities and waterlines for the proposed water system also occur within the Honuaʻula project area (PBR Hawaii 2010).

This report summarizes the findings of a terrestrial flora and fauna survey conducted by SWCA biologists Ling Ong, Ph.D., Shahin Ansari, Ph.D., Jaap Eijzenga, M.S., Tiffany Thair, M.S. candidate, and Ryan Taira, B.A. between August 30 and September 1, 2010 and on November 23, 2010. The survey area is shown in Figure 2. The objectives of the survey were:

1. To identify and document the presence and relative abundance of all plant species which occur within the survey area;
2. To provide a general description of the vegetation in the survey area;
3. To identify and document the presence and relative abundance (as appropriate) of bird, mammal, amphibian, reptile, and invertebrate macrofauna which occur within the survey area;
4. Identify and map any State- or Federally listed candidate, threatened, or endangered species, species of concern and/or rare (either locally or State-wide) species found or known to occur at the survey area.

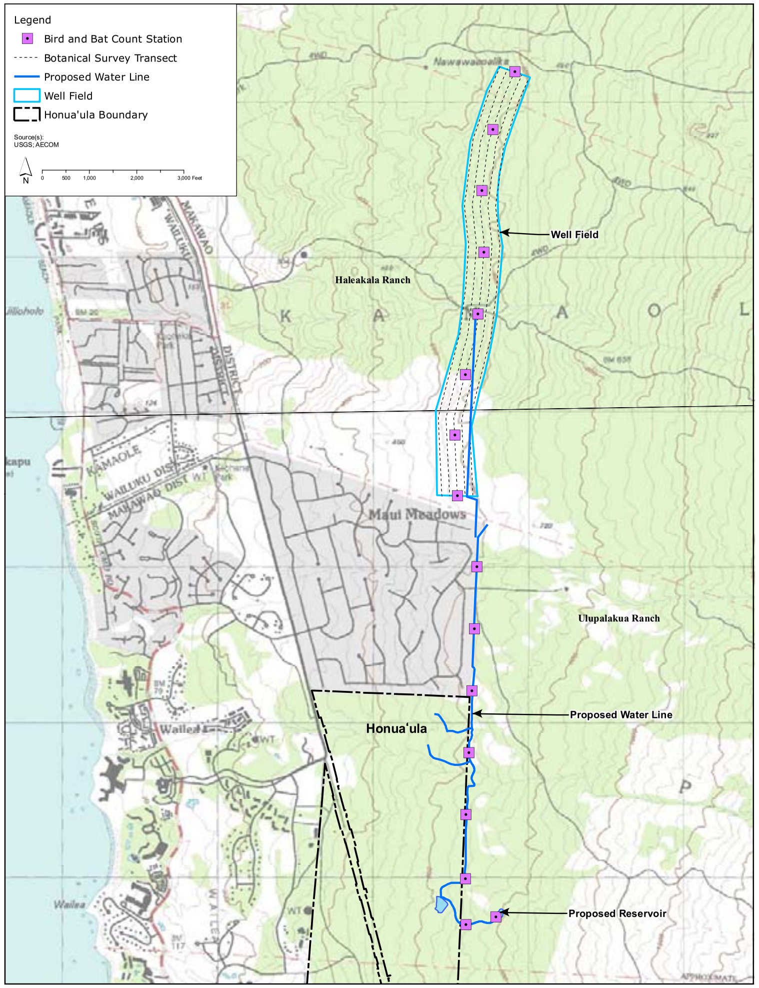
2.0 DESCRIPTION OF THE SURVEY AREA

The survey area is located on the lower slopes of Haleakalā in the Kīhei-Mākena region on the leeward side of East Maui (Figure 1). The climate in the region is generally dry with an average annual rainfall ranging from 178 to 761 mm (7.01-29.97 inches) and an annual average temperature of about 76°F (County of Maui 2008). The survey area can be divided into two distinct areas: 1) the well field; and 2) the water distribution line/tanks (Figure 2).

The well field is a rectangular area located on agricultural land owned by Haleakalā Ranch immediately north of the Maui Meadows subdivision and 4 km (2.5 mi) to the north of Honuaʻula. The area is designated for well development for Honuaʻula. The general topography of the well field is characterized as relatively flat to gently sloping westerly toward the ocean. Soils are primarily characterized as Keawakapu Extremely Stony Silty Clay Loam, 3 to 25% slopes, with a small area of Very Stony Land in the north (Foote et al. 1972). The substrate of the well field is primarily rocky. Several small drainage gulches, characterized by patches of exposed bedrock, transverse portions of the field; however, these intermittent gulches likely only carry water for a short time following intense rainfall events. Most of the field is underlain by ʻaʻā and pāhoehoe lava flows ranging from 140,000 to 950,000 years old. A younger flow, between 13,000 and 30,000 years old, crosses the northern portion of the field (Sherrod et al. 2007). The younger flows have not undergone as extensive weathering and are characterized by a rough surface composed of broken ʻaʻā lava. Numerous jeep roads cross over the area.

Figure 1. Vicinity Map.

Figure 2. Honuaʻula Water System Survey Area.



The proposed water distribution line is located along the eastern (mauka) boundary of the Maui Meadows subdivision and proposed Honuaʻula project and adjacent areas within lands owned by ʻUlupalakua Ranch. A 9 m (30 ft) wide easement exists for the distribution line. It is anticipated that all construction related impacts would be confined to the easement; thus, our survey area for the distribution line is roughly 9 m wide. Two proposed offsite water storage tanks are located mauka of the distribution line at approximately 247 m (810 ft) elevation (PBR Hawaii 2010; Wilson Okamoto Corporation 2010). SWCA surveyed an area of approximately 0.25 ha (0.61 ac) for the tanks. SWCA also surveyed a 7 m (24 ft) wide and 229 m (750 ft) long area connecting the waterline from the Honuaʻula property line to the offsite tanks.

This portion of the survey area is primarily flat, but slopes seaward near the proposed water tanks and slightly slopes seaward toward the adjacent residences. Soils are defined entirely as Keawakapu Extremely Stony Silty Clay Loam, 3 to 25% slopes (Foote et al. 1972). The majority of this area is underlain by ʻaʻā and pāhoehoe lava flows ranging from 140,000 to 950,000 years old. A portion is underlain by a younger ʻaʻā flow between 55,000 and 140,000 years old (Sherrod et al. 2007). The landscape and vegetation in the area has been historically influenced by military training activities (WWII), invasion by non-native plants species, cattle grazing, grazing by feral ungulates, residential development, and fires (SWCA 2010a).

Several components of the water system occur within the proposed Honuaʻula project area including one potable water tank, one non-potable water tank, a reverse osmosis plant, two brackish water wells, and portions of the distribution line. The flora and fauna of the Honuaʻula property were already surveyed by SWCA in 2008 (SWCA 2010a, 2010b).

3.0 PREVIOUS STUDIES

Various flora and fauna surveys have been conducted within the nearby Honuaʻula property (Char and Linney 1988; Char 1993, 2004; Bruner 1988, 1993 and 2004; and SWCA 2006, 2009a, 2009b, 2010a and 2010b; Altenberg 2007); however, none have been conducted specifically within the areas where the offsite components of the water system are proposed.

As mentioned above, some of the components of the water system fall within the boundaries of the Honuaʻula property. Three distinct vegetation types are found within Honuaʻula: kiawe-buffelgrass (*Prosopis pallida-Cenchrus ciliaris*) grassland, gulch vegetation, and mixed kiawe-wiliwili (*Prosopis pallida-Erythrina sandwicensis*) shrubland (SWCA 2010a). All of the proposed onsite components of the water system occur within the kiawe-buffelgrass grassland of the Honuaʻula property. During SWCA's botanical survey of the project area in March and May 2008, no native plant species were identified within the footprint of the water system components within the Honuaʻula property.

No Blackburn's sphinx moths (*Manduca blackburni*), caterpillars or signs were observed within the footprint of the water system components on the Honuaʻula property by SWCA (2010b) or Bruner (1988, 1993 and 2004). SWCA biologists observed a single endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) flying seaward over the property at the southern boundary (SWCA 2010b). Sixteen species of introduced birds and one native bird, the pueo (*Asio flammeus sandwichensis*), have also been seen at Honuaʻula (SWCA 2010b). Prior surveys of the same parcel by Bruner (1988, 1993 and 2004) documented similar non-native avian species. Bruner (1988, 1994 and 2004) did not find pueo or the endangered Hawaiian hoary bat.

4.0 SWCA SURVEY METHODS

4.1 Flora

SWCA biologists initially conducted a literature review of available scientific and technical literature regarding natural resources within the vicinity of the survey area. A pedestrian survey of the area was conducted on August 31, September 1, and November 23, 2010. A Trimble GeoXT mapping-grade GPS unit preloaded with the study transects was used to guide the survey and collect point data on rare native plants (Figure 2). The SWCA botanists walked transects at 50 m (164 ft) intervals. Each botanist thoroughly scanned roughly 25 m (82 ft) on both sides of each transect and documented all plant species observed. Due to the exceptionally dry conditions in the survey area, the biologists conducted more intensive searches of gullies, overhangs, steep slopes, shaded sites, and other areas most likely to support vegetation.

All plant species observed within the survey area were documented and notes were made on their abundance and distribution, community structure, and disturbances. Plants were identified in the field wherever possible. Plants which could not be positively identified were collected for later determination in the herbarium and for comparison with the most recent taxonomic literature.

Plants recorded during the survey are indicative of the season and environmental conditions at the time of the survey. This survey was conducted during an extensive drought period, which can mask the presence or identification of plant species known to occur in similar habitats within the region. It is possible that additional surveys conducted at a different time of the year, or after a significant rain event, would result in variations in the species and abundances of plants observed due to species present in the seed bank or dispersal from adjacent areas.

4.2 Fauna

SWCA wildlife biologists conducted avian point count surveys on August 31, September 1, and November 23, 2010. Sixteen point count stations were placed within the study area (Figure 2). The location of the observer at each point count site was established in the field with a hand-held GPS receiver. Field observations of birds were recorded using 10 x 50 binoculars with a 6.5 degree field of vision. The observer also listened for avian vocalizations. The relative densities of species were estimated using eight-minute 100 m (328 ft) radius point counts (Lynch 1995) during peak bird activity periods (0600–1100, 1600–1900) to maximize the likelihood of detecting birds during the survey. Birds observed between count stations were also noted. Mammals, reptiles, amphibians, insects, and other invertebrates seen or heard during the point count surveys or between count stations were also documented.

SWCA biologists conducted evening surveys for the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*). Surveys were conducted on the evenings of August 30 and 31, and November 23, 2010 (between 1800 and 0000). The same point count stations for the avian fauna survey were used and each count station was sampled for eight minutes. These surveys were conducted under ideal weather conditions using night vision goggles (Morovison PVS-7 Ultra) during count stations surveyed after twilight. The detection distance for bats using night vision goggles was estimated to be 30 m (98 ft) radius at each point count station.

Surveys for the endangered Blackburn's sphinx moth (*Manduca blackburni*) were conducted by inspecting non-native tree tobacco plants (*Nicotiana glauca*) encountered in the survey area. This species is a host plant used by the various life stages of Blackburn's sphinx moths. Leaves and stems were examined carefully for the presence or sign of moths, including frass (fecal matter), cut stems and leaves, and eggs. Normally, caterpillars and sign are expected to be more abundant in November to December following periods of heavy rainfall (USFWS 2005).

5.0 FINDINGS

5.1 Flora

Thirty (30) plant species were recorded within the survey area, none of which are listed as threatened, endangered, or candidate endangered species or rare native Hawaiian plant species by the Federal or State governments. Six of these species (or 20% of the total species) are native to the Hawaiian Islands: wiliwili (*Erythrina sandwicensis*), ʻuhaloa (*Waltheria indica*), pili grass (*Heteropogon contortus*), ʻiwaʻiwa (*Doryopteris decipiens*), pua kala (*Argemone glauca*), and ʻilieʻe (*Plumbago zeylanica*). Of these, only wiliwili, ʻiwaʻiwa, and pua kala are endemic, or found only in the Hawaiian Islands (Wagner et al. 1999; Palmer 2003). A list of all plant species observed by SWCA biologists within the survey area is included in Appendix 1 of this report.

The vegetation in the well field portion of the survey area is characterized as kiawe-buffelgrass (*Prosopis pallida-Cenchrus ciliaris*) grassland. The kiawe trees range from 4.5 to 8 m (15-26 ft) tall with sparse buffelgrass cover in the understory due to dry conditions and grazing by ungulates (Figure

3). Guinea grass (*Urochloa maxima*) and tree tobacco (*Nicotiana glauca*) are scattered throughout the field, and ʻuhaloa is present on some of the rocky outcrops. A small wiliwili grove, consisting of six trees, occurs in the northeastern portion of the well field. As mentioned in Section 4 above, most of the vegetation in the well field was extremely dry or dead during the survey due to prolonged drought conditions in southeast Maui. Extensive grazing has also disturbed the vegetation in the area.

The waterline/tanks portion of the survey area supports vegetation similar to that found in the well field. Kiawe trees are abundant in the canopy and buffelgrass is sparsely present in the understory (Figure 4). Several ornamental species are growing over the fence line from the adjacent subdivision such as *Plumbago auriculata* and coconut (*Cocos nucifera*). Other non-native weedy trees isolated throughout the distribution line area include koa haole (*Leucaena leucocephala*), African tulip tree (*Spathodea campanulata*), and chinaberry (*Melia azedarach*).

5.2 Fauna

No State- or Federally listed threatened, endangered, or candidate bird, mammal, or insect species were observed during our survey. None of the fauna recorded by SWCA biologists during the survey are native to the Hawaiian Islands. Fifteen introduced bird species and a single migratory visiting bird species were recorded during the survey. Zebra doves (*Geopelia striata*) were notably the most abundant during the survey. Grey francolin (*Francolinus pondicerianus*), common myna (*Acridotheres tristis*), Japanese white-eye (*Zosterops japonicus*), and African silverbill (*Lonchura cantans*) were also common. All of these species are common to the main Hawaiian Islands, particularly in urban or disturbed areas (HAS 2005). The migratory Pacific golden-plover (*Pluvialis fulva*) or kolea was also heard during the survey. Several additional non-naturalized birds were also heard near the Maui Meadows subdivision including blue macaw (*Cyanopsitta spixii*), African grey parrot (*Psittacus erithacus*), and salmon-crested cockatoo (*Cacatua moluccensis*). The relative abundance of observed bird species is shown in Table 1.

The avian diversity and abundance in the survey area is low, possibly due to the prolonged drought in the area. Based on observations at similar habitats at the nearby Honuaʻula project area under normal rainfall conditions, other birds that may occur in the area include Erckel's francolin (*Francolinus erckelli*), nutmeg manikin (*Lonchura punctulata*), and chestnut munia (*Lonchura atricapilla*). The native Hawaiian short-eared owl (*Asio flammeus sandwichensis*) and the introduced barn owl (*Tyto alba*) may also be expected to be in the area based upon previous surveys of adjacent lands (SWCA 2010b).

The endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) was not seen during the three evenings. The only living mammals observed during the survey were mice (*Mus domesticus*), dogs (*Canis lupus familiaris*), mongoose (*Herpestes javanicus*), and axis deer (*Axis axis*). Skeletal remains of six cows (*Bos taurus*), and several deer were seen in the well field. Deer and cow droppings were reported from both areas. Although not observed, it is likely that non-native rats (*Rattus* spp.), and feral cats (*Felis catus*) also occur in the area.

There are no native reptiles or amphibians in Hawaiʻi (McKeown 1996). During the survey, geckos (Family: Gekkonidae) were heard, but not seen.

Neither adult nor larval endangered Blackburn sphinx moths (*Manduca blackburni*) were observed by SWCA biologists during the survey. Despite the presence of the tree tobacco (*Nicotiana glauca*), a non-native larval host plant, no sign of the Blackburn sphinx moth (e.g., cut stems and leaves, frass and eggs) was observed. Other insects and invertebrates observed in the survey area include the carpenter bee (*Xylocopa sonorina*), moths (Order: Lepidoptera), including a large number of koa haole moths (*Macaria abydata*) and dragonflies (Order: Odonata).

Figure 3. View of the drought stricken kiawe-buffelgrass (*Prosopis pallida-Cenchrus ciliaris*) grassland in the well field portion of the survey area.

Figure 4. View of kiawe trees (*Prosopis pallida*) and sparse buffelgrass (*Cenchrus ciliaris*) cover near the Maui Meadows subdivision along the proposed distribution line.

Table 1. Relative abundance of birds observed during point counts.

Species Name	Common Name(s)	Status	Birds per point count (n=16)	Abundance Rank
ARDEIDAE				
Bulbulcus ibis	Cattle egret	X	0.06	10
PHASIANIDAE				
Francolinus francolinus	Black francolin	X	0.06	10
Francolinus pondicerianus	Grey francolin	X	1.94	2
CHARADRIIDAE				
Pluvialis fulva	Pacific golden-plover	V	*	*
COLUMBIDAE				
Geopelia striata	Zebra dove	X	4.63	1
Streptopelia chinensis	Spotted dove	X	0.87	6
Zenaida macroura	Mourning dove	X	0.063	10
ZOSTEROPIDAE				
Zosterops japonicus	Japanese white-eye	X	1.19	4
MIMIDAE				
Mimus polyglottos	Northern mockingbird	X	0.13	9
STURNIDAE				
Acridotheres tristis	Common myna	X	1.56	3
EMBERIZIDAE				
Cardiinalis cardinalis	Northern cardinal	X	0.50	7
Paroaria coronata	Red-crested cardinal	X	0.13	9
FRINGILLIDAE				
Carpodacus mexicanus	House finch	X	0.50	7
PASSERIDAE				
Padda oryzivora	Java sparrow	X	0.13	9
Passer domesticus	House sparrow	X	0.31	8
Lonchura cantans	African silverbill	X	0.94	5
Unknown			1.50	

* = observed outside of point count stations.
X = non-native/introduced to the Hawaiian Islands.
V = visitor; seasonally present in the Hawaiian Islands.

6.0 CONCLUSIONS AND RECOMMENDATIONS

No Federal or State candidate, proposed or listed threatened or endangered species were observed or previously reported to be within the proposed well field, waterline, or tank areas. The majority of the species observed in the proposed water system area (80% of the flora and over 95% of the birds and mammals) are introduced to the Hawaiian Islands. Most of the native plants observed during the survey are commonly found throughout Maui and the main Hawaiian Islands. Of the native plants in the survey area, only wiliwili has a limited distribution throughout the Hawaiian Islands. It remains locally common in southeastern Maui. The only native bird species recorded during the survey - the

Pacific golden-plover - is abundant throughout Hawai'i and uses a variety of habitats including mudflats, lawns and rooftops (HAS 2005).

As stated above, this survey was conducted during an extensive drought period, which can possibly mask the presence or identification of plant species known to occur in similar habitats within the region. It is possible that additional surveys conducted at a different time of the year or after a significant rain event would result in variations in the species and abundances of plants observed due to species present in the seed bank or dispersal from adjacent areas. Patches of native plants [e.g., wiliwili (*Erythrina sandwicensis*) and maiapilo (*Capparis sandwichiana*)] do occur in the vicinity of the well field in the adjacent younger lava flows.

Based on findings of this survey and the results of prior flora and fauna surveys within the Honua'ula project area, no intact native ecosystems are expected to be impacted by the proposed well development and waterline transmission work associated with the Honua'ula development. Furthermore, given that the survey area has been highly altered by human activity and lacks any native species or habitats of special concern, the proposed work is not expected to result in any significant adverse impact on the flora or fauna in this part of Maui.

Wiliwili trees throughout Maui were damaged or destroyed during the statewide outbreak of the invasive gall wasp (*Quadrastichus erythrinae*). Protecting local surviving wiliwili tress will contribute to enhancing the island-wide population of this endemic species. It is recommended that during construction of the water system the wiliwili trees located in the northern portion of the well field and within the proposed waterline be avoided to the maximum extent possible.

If non-native tree tobacco plants need to be removed or disturbed while conducting the proposed work, the plants should first be surveyed by a qualified biologist for the presence of Blackburn's sphinx moth eggs, larvae, or "signs" indicating the possibility of pupating larvae (frass, chewed stems or other browsing characteristic of Blackburn's sphinx moth on tree tobacco plants). If the tree tobacco plant is entirely herbaceous (such as a small un-branched young plant), and there are no Blackburn's sphinx moth eggs, larvae, or signs indicating the possibility of pupating larvae, the plant may be removed by the roots. If Blackburn's sphinx moth eggs, larvae, or "signs" indicating the possibility of pupating larvae (such as frass, chewed stems or other browsing characteristic of Blackburn's sphinx moth on the plant) are observed, the USFWS recommends that the plant not be removed until the plants are free of Blackburn's sphinx moth eggs and larvae. Then the following steps should be taken to minimize potential impacts to Blackburn's sphinx moth individuals:

- If the plant is woody and there are no Blackburn's sphinx moth eggs, larvae, or signs indicating the possibility of pupating larvae (such as frass, chewed stems or other browsing characteristic of Blackburn's sphinx moth on the plant), the above-ground portion of the plant may be cut off and removed.

- If the plant has developed woody structure, it is possible that the signs of Blackburn's sphinx moth foraging have been shed and that root disturbance could dislodge larvae. Therefore, the soil and plant roots should be left undisturbed for a one-year period. A 10 m (33 ft) buffer should be established around the woody host plant to prevent disturbance to any pupating larvae which may be in the ground in the area around the plant. Cut stems should be maintained to be free of re-growth (by either carefully painting herbicide on the cut stem or frequent hand clipping) to prevent leaf growth and potential use by the moth. After one year, the plant roots may be removed. Because Blackburn's sphinx moth larvae burrow into the substrate near host plants and may remain in a state of torpor for up to a year before emerging from the soil (USFWS 2005), soil disturbance at the base of the tobacco plants may harm Blackburn's sphinx moth larvae. The one-year period will ensure any larvae pupating in the soil will have pupated and emerged from soil prior to disturbance of the plant or soil.

During construction of the wells, waterline, and storage tanks, care should be taken to minimize the introduction of new weeds into the area. All vehicles, entering or leaving the construction site should be thoroughly cleaned (preferably pressure washed). If landscaping is included as part of the proposed water system, native plants should be employed to the maximum extent practicable. If native plants do not meet landscaping objectives, plants with a low risk of becoming invasive may be substituted.

Additional information can be gleaned from the following websites for use in selecting appropriate native species for landscaping: Native Plants Hawai'i (http://nativeplants.hawaii.edu/); Pacific Island Ecosystems at Risk (http://www.hear.org/Pier); and Weed Risk Assessments for Hawai'i and Pacific Islands (http://www.hpwra.org/).

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APPENDIX 1: List of Plant Species Observed

The following checklist is an inventory of all the plant species observed by SWCA biologists at the proposed Honuaʻula private water system survey area in Kīhei-Mākena, Maui, Hawaiʻi. The plant names are arranged alphabetically by family and then by species into three groups: Ferns, Monocots, and Dicots. The taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999), Wagner and Herbst (2003), and Staples and Herbst (2005). Fern taxonomy follows Palmer (2003). Recent name changes are those recorded in the Hawaii Biological Survey series (Evenhuis and Eldredge 1999-2002).

Status:

E = endemic = native only to the Hawaiian Islands.
I = indigenous = native to the Hawaiian Islands and elsewhere.
P = Polynesian = introduced by Polynesians.
X = introduced/ alien = all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact (Cook's arrival in the islands in 1778).

Abundance Location:

Field = Proposed well field on Haleakalā Ranch land.
Dist/Tank = Proposed distribution line and tanks on ʻUlupalakua Ranch land.

Relative Site Abundance:

Abundant = forming a major part of the vegetation within the survey area.
Common = widely scattered throughout the area or locally abundant within a portion of the area.
Uncommon = scattered sparsely throughout the area or occurring in a few small patches.
Rare = only a few isolated individuals within the survey area.

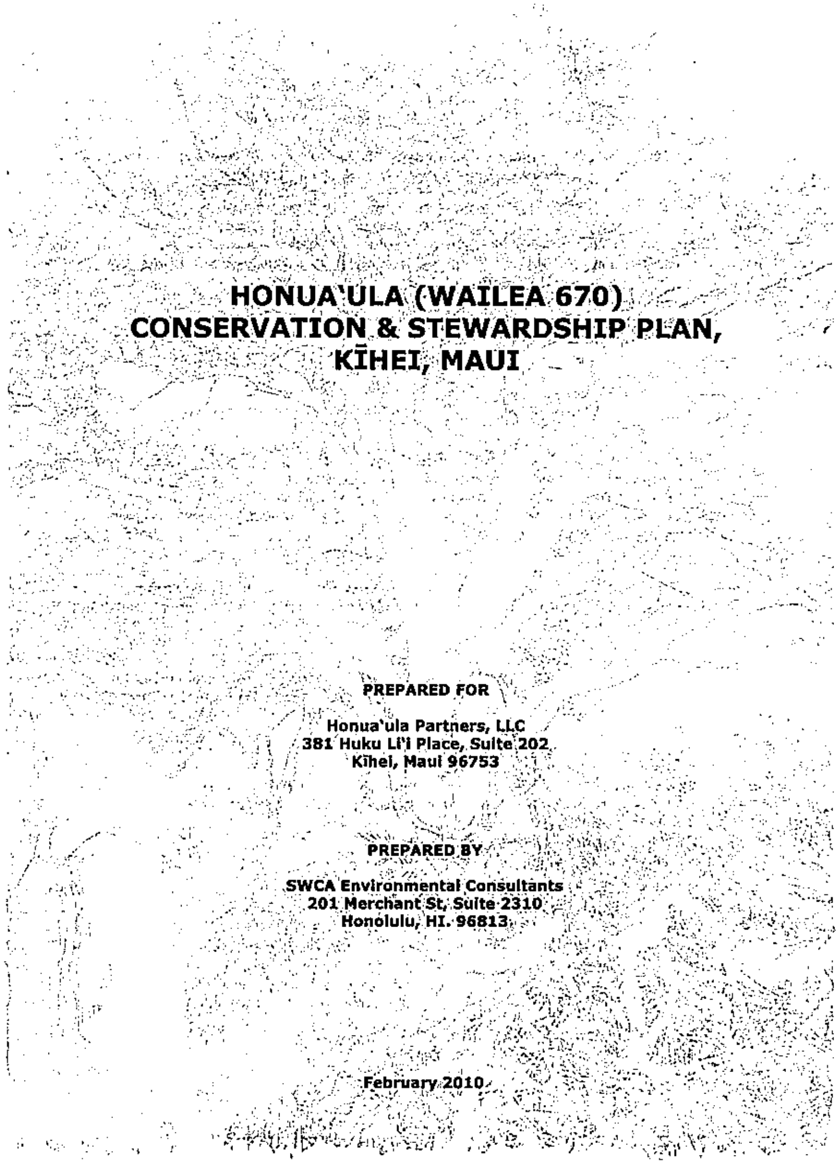
Scientific Name	Hawaiian, Common Name(s)	Status	Abundance	
			Field	Dist/Tank
FERNS				
Adiantaceae				
Doryopteris decipiens (Hook.) J. Sm.	ʻiwaʻiwa	E		Rare
MONOCOTS				
Aloeaceae				
Aloe vera (L.) Burm.f.	aloe	X		Rare

Scientific Name	Hawaiian, Common Name(s)	Status	Abundance	
			Field	Dist/Tank
Arecaceae				
Cocos nucifera L.	niu, ololani, coconut	P		Rare
Poaceae				
Cenchrus ciliaris L.	buffelgrass	X	Abundant	Abundant
Heteropogon contortus (L.) P.Beauv. ex Roem. & Schult.	pili, lule	I	Rare	Rare
Urochloa maxima (Jacq.) R.D. Webster	Guinea grass	X	Uncommon	Uncommon
DICOTS				
Asclepiadaceae				
Calotropis gigantea (L.) W.T.Aiton	crownflower, giant milkweed	X	Rare	
Tridax procumbens L.	coat buttons	X		Rare
Asteraceae				
Senecio madagascariensis Poiret	fireweed	X		Rare
*Verbesina encelioides (*Cav.) Benth. & Hook	golden crown beard	X		Rare
Bignoniaceae				
Spathodea campanulata P.Beauv.	African tulip tree	X		Rare
Cactaceae				
Opuntia ficus-indica (L.) Mill.	panini	X		Rare
Pilocereus royenii (L.) Byles & Rowley	Royen's tree cactus	X		Rare
Cucurbitaceae				
Momordica charantia L.	balsam pear, bitter melon	X		Rare
Euphorbiaceae				
Chamaesyce hypercifolia (L.) Millsp.	graceful spurge	X	Rare	Rare

Scientific Name	Hawaiian, Common Name(s)	Status	Abundance	
			Field	Dist/Tank
Fabaceae				
Erythrina sandwicensis O.Deg.	wiliwili	E	Rare	Rare
Indigofera suffritocosa Mill.	iniko	X	Rare	
Leucaena leucocephala (Lam.) de Wit	koa haole	X	Uncommon	Uncommon
Macroptilium lathyroides (L.) Urb.	wild bean, cow pea	X		Rare
Prosopis pallida (Humb. & Bonpl. Ex Willd.) Kunth	kiawe	X	Abundant	Abundant
Lamiaceae				
Leonotis nepetifolia (L.) R.Br.	lion's ear	X		Rare
Malvaceae				
Abutilon grandifolium (Willd.) Sweet	hairy abutilon, maʻo	X	Rare	Rare
Malvastrum coromandelianum (L.) Garcke	false mallow	X		Rare
Meliaceae				
Melia azedarach L.	chinaberry, pride-of-India	X		Rare
Papavaraceae				
Argemone glauca (Nutt. Ex Prain (Pope)	pua kala	E	Rare	
Plumbaginaceae				
Plumbago auriculata Lam.		X		Rare
Plumbago zeylanica L.	ʻilieʻe	I	Rare	
Solanaceae				
Nicotiana glauca R.C. Graham	tree tobacco	X	Uncommon	
Sterculiaceae				
Waltheria indica L.	ʻuhaloa	I	Uncommon	Rare
Verbenaceae				
Lantana camara L.	Sacramento bur	X	Rare	Rare

Appendix F

Conservation & Stewardship Plan



HONUA'ULA (WAILEA 670) CONSERVATION & STEWARDSHIP PLAN, KĪHEI, MAUI

PREPARED FOR

Honua'ula Partners, LLC
381 Huku Li'i Place, Suite 202
Kihei, Maui 96753

PREPARED BY

SWCA Environmental Consultants
201 Merchant St, Suite 2310
Honolulu, HI. 96813

February 2010

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1.0 INTRODUCTION AND BACKGROUND

1.1 Project Summary

Honua'ula is a master-planned residential community encompassing a rectangular area of 271 hectares (ha) or 670 acres (ac) east of, and adjacent to, the existing Wailea Resort in Kīhei, Maui (hereinafter referred to as the 'Property'). The proposed community is composed of single and multi-family homes, supporting commercial uses, open space, an 18-hole golf course and club, and other recreational amenities. The Property is located on the lower slopes of Haleakalā and is bounded by the Maui Meadows subdivision to the north, the Makena golf course to the south, the Wailea golf course to the west, and the 'Ulupalakua Ranch to the east (Figure 1).

An Environmental Impact Statement (EIS) was first published for the Property (then known as Wailea 670) in 1988 (PBR Hawaii, Inc. 1988). Since 1988, ownership of the Property and the conceptual plan for the Property has changed several times. In January 2000, WCPT/GW Land Associates, LLC acquired the Property, and the new owner proposed a revised plan from what earlier landowners had proposed. In July 2007, the Property was acquired by Honua'ula Partners, LLC, an entity comprised primarily of the same members as WCPT/GW Land Associates. Honua'ula Partners did not change the revised master plan and continued to process the applications previously prepared and submitted by WCPT/GW Land Associates. An EIS for the current proposed project is currently being prepared for Honua'ula by PBR Hawaii, Inc. (2009) in accordance with Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200, Hawaii Administrative Rules (HAR).

Recently, Altenberg (2007) drew attention to the southern portion of the Property which he claimed to be among the best examples of a remnant native lowland dry forest remaining on Maui. He suggested that Honua'ula "contains most of the 3rd largest contiguous area of *wiliwili* (*Erythrina sandwicensis*) habitat on Maui, approximately 110 acres in the southern 1/6 of the property" (Altenberg 2007). Altenberg recommended that an area of approximately 45 ha (110 ac) be preserved for its ecological significance.

To address concerns raised by Altenberg over the presence of native plants within the southern portion of the Property, SWCA Environmental Consultants (SWCA) was tasked to conduct a thorough quantitative botanical assessment within the Property (SWCA 2009a). A companion document addressing wildlife and plant-related wildlife issues was also prepared by SWCA (2009b). In collaboration with federal and state natural resource agency staffs, SWCA developed mitigation measures to help protect and conserve native plant and animal resources at Honua'ula (SWCA 2009a, 2009b). The specific mitigation measures developed by SWCA, in collaboration with USFWS and DLNR, for botanical and wildlife resources are listed in the natural resources reports prepared by SWCA (2009a, 2009b, respectively).

1.2 Project Approval and Natural Resource Conditions

The former owner of the Property obtained several land use entitlements, as outlined in the *Environmental Assessment / Environmental Impact Statement Preparation Notice* (PBR Hawaii, Inc. 2009). Project district zoning was approved for the entire Property in 1993, and approximately 170 ha (420 ac) was approved for golf course development and accessory uses. The following year, the State Land Use Commission issued a decision to reclassify the Property from an Agricultural District to an Urban District.

In June 2000, the current owner (now Honua'ula Partners, LLC) submitted applications to Maui County for a Change in Zoning and Project District Phase I Approval for the revised master plan (PBR Hawaii, Inc. 2009). After six years of project revisions by the present owner to accommodate community concerns, including issues with native plants in the southern portion of the Property, the Maui County Council approved Phase I conditional Project District Zoning for 271 ha allowing for residential, limited commercial, golf course, and open space zoning. With this approval, the Maui County Council passed Ordinance No. 3554 in March 2008, which promulgated 28 specific conditions in granting a Phase I project district zoning approval for Honua'ula. Ordinance No. 3554 included several conditions regarding the conservation of natural resources, including the creation of a conservation easement and stewardship plan. The following conditions are related to the purpose and scope of this plan:

27. That Honua'ula Partners, LLC, its successors and permitted assigns, shall provide the report "Remnant Wiliwili Forest Habitat at Wailea 670, Maui, Hawaii by Lee Altenberg, Ph.D.", along with a preservation/mitigation plan, to the State Department of Land and Natural Resources, the United States Fish and Wildlife Service, and the United States Corps of Engineers for review and recommendations prior to Project District Phase II approval. The Maui Planning Commission shall consider adoption of the plan prior to Project District Phase II approval.

Such plan shall include a minimum preservation standard as follows: That Honua'ula Partners, LLC, its successors and permitted assigns, shall establish in perpetuity a Conservation Easement (the "Easement"), entitled "Native Plant Preservation Area", for the conservation of native Hawaiian plants and significant cultural sites in Kihei-Makena Project District 9 as shown on the attached map. The Easement shall comprise the portion of the property south of latitude 20°40'1 5.00"N, excluding any portions that the State Department of Land and Natural Resources, the United States Fish and Wildlife Service, and the United States Corps of Engineers find do not merit preservation, but shall not be less than 18 acres and shall not exceed 130 acres.

The scope of the Easement shall be set forth in an agreement between Honua'ula Partners, LLC and the County that shall include:

a. A commitment from Honua'ula Partners, LLC, its successors and permitted assigns, to protect and preserve the Easement for the protection of native Hawaiian plants and significant cultural sites worthy of preservation, restoration, and interpretation for public education and enrichment consistent with a Conservation Plan for the Easement developed by Honua'ula Partners, LLC and approved by the State Department of Land and Natural Resources, the United States Geological Survey, and the United States Fish and Wildlife Service; and with a Cultural Resource Preservation Plan, which includes the management and maintenance of the Easement, developed by Honua'ula Partners, LLC and approved by the State Department of Land and Natural Resources (collectively, the "Conservation/Preservation Plans").

b. That Honua'ula Partners, LLC, its successors and permitted assigns, shall agree to confine use of the Easement to activities consistent with the purpose and intent of the Easement.

c. That Honua'ula Partners, LLC, its successors and permitted assigns, shall be prohibited from development in the Easement other than erecting fences, enhancing trails, and constructing structures for the maintenance needed for the area, in accordance with the Conservation/Preservation Plans.

d. That title to the Easement shall be held by Honua'ula Partners, LLC, its successors and permitted assigns, or conveyed to a land trust that holds other conservation easements. Access to the Easement shall be permitted pursuant to an established schedule specified in the Conservation/Preservation Plans to organizations on Maui dedicated to the preservation of native plants, to help restore and perpetuate native species and to engage in needed research activities. These organizations may enter the Easement at reasonable times for cultural and educational purposes only.

e. Honua'ula Partners, LLC, its successors and permitted assigns, shall be allowed to receive all tax benefits allowable under tax laws applicable to the Easement at the time that said Easement is established in Kihei Makena Project District 9, which will be evidenced by the recordation of the Easement in the Bureau of Conveyances, State of Hawaii.

1.3 Purpose and Scope of this Plan

To help meet Maui County Phase I conditions, Honua'ula Partners, LLC, in cooperation with SWCA, developed this *Honua'ula Conservation and Stewardship Plan*. This plan incorporates findings, conclusions, and recommendations from previous botanical and wildlife surveys and biological assessments on the Property (Char and Linney 1988; Bruner 1988, 1993; Char 1993,

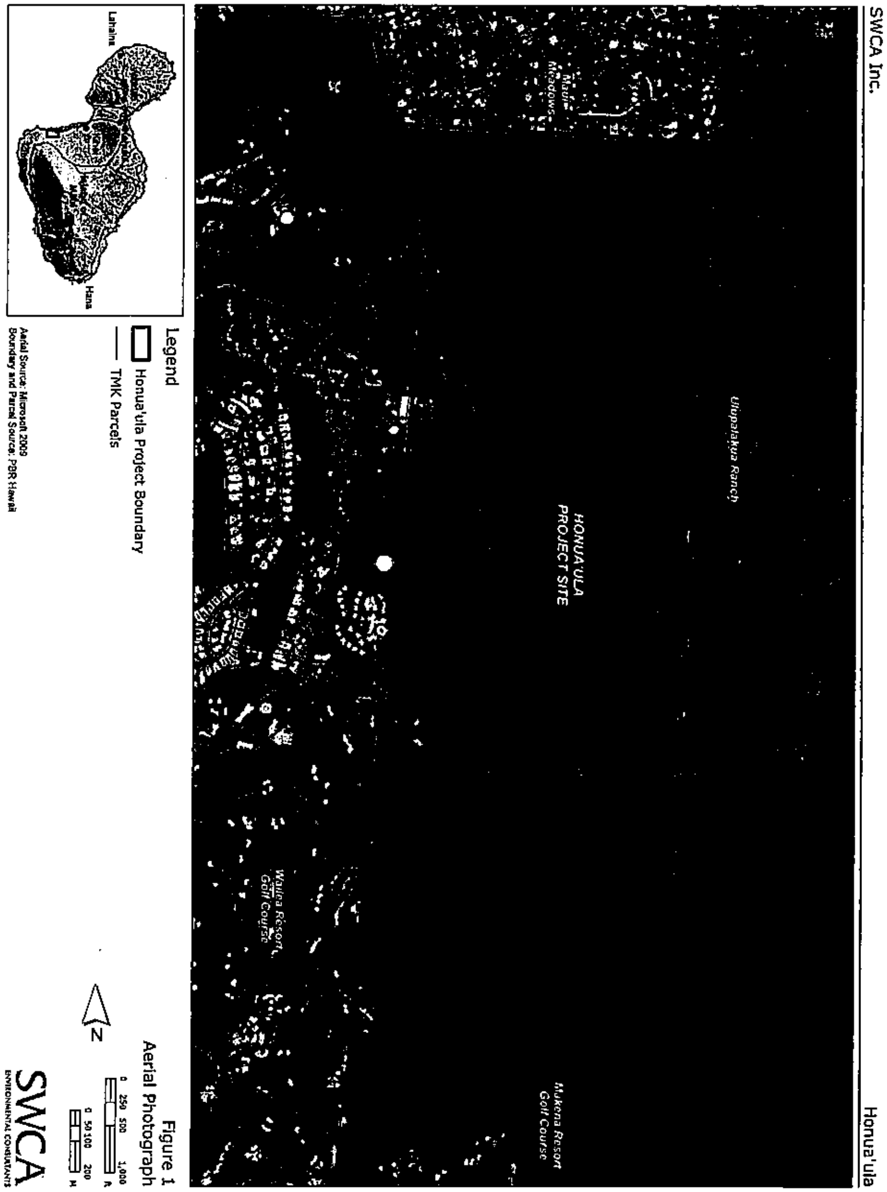


Figure 1
Aerial Photograph

2004; Altenberg 2007; SWCA 2009a, 2009b). The *Honua'ula Conservation and Stewardship Plan* recommends proactive stewardship actions to manage the proposed Easement (hereinafter referred to as the 'Native Plant Preservation Area') and the related management and enhancement areas.

The overall goal of the *Honua'ula Conservation and Stewardship Plan* is to conserve elements of the *kiawe-wiliwili* shrubland and other portions of the Honua'ula Property, as much as possible, to protect native plants and animals within the Property. The secondary goals of this plan are to cooperate with researchers in furthering the science of native plant propagation, provide education and outreach opportunities, and enhance the natural beauty of the proposed Honua'ula project. This plan focuses specifically on management actions to preserve and conserve native plants within the Property. Management actions to address native animals on the Property will be addressed in a separate multi-species Habitat Conservation Plan (HCP) being prepared under Section 10(a)(1)(B) of the Endangered Species Act (ESA).

In accordance with the County of Maui Ordinance No. 3554, copies of all SWCA reports prepared for this project, including this *Honua'ula Conservation and Stewardship Plan* for the proposed Native Plant Preservation Area, along with the report by Altenberg (2007) have been submitted to the Department of Land and Natural Resources (DLNR), U.S. Fish and Wildlife Services (USFWS), U.S. Geological Survey (USGS), and U.S. Army Corps of Engineers for review and comment.

2.0 STATUS OF HAWAIIAN LOWLAND DRY FORESTS AND SHRUBLANDS

At one time, Rock (1913) suggested that lowland dry and mesic forests in Hawai'i had more native tree species than any other area in the state. In addition to supporting native flora and fauna, dry forests were a source of food, fiber, and medicine for native Hawaiians. Since then, however, the amount of true native dry forests has declined (Wagner, et al. 1999). Tropical dry forests are acknowledged as the rarest native plant community within the main Hawaiian Islands (Bruegmann 1996, Sakai et al. 2002, Pau et al. 2009) and the nation (Janzen 1988, Noss and Peters 1995, Janzen 2002). Bruegmann (1996) estimated that over 90 percent of Hawai'i's native dry forest habitats have been severely fragmented and degraded.

The decline of Hawaiian dry forests is the result of a variety of factors, which began prior to European contact. Zimmerman (1963), Kirsch (1982), Wagner et al. (1985), Stone (1985), Cuddihy and Stone (1990), Gagné and Cuddihy (1999), Athens et al. (2002), Ziegler (2002), and Burney and Flannery (2005) summarized the impacts to the Hawaiian landscape caused by activities of prehistoric Polynesians beginning about 1,600 years ago. By the time the first Europeans arrived in Hawai'i, the Hawaiians had modified "virtually all valley bottoms with permanent stream flow...into reticulate irrigation systems" (Handy and Handy 1972, Kirsch 1977, 1982). In 1789, Vancouver reported that literally half the Island of Hawai'i appeared to have been cleared for taro plantations. Kirch (1982) found archaeological evidence of significant human-induced soil erosion, siltation, and shoreline change by 1200 A.D.

Following centuries of lowland land clearing by native Hawaiians, other factors contributed to the loss of native Hawaiian dry forests. These include ungulate grazing; invasions and competition from alien plants; development of lowlands for agricultural, urban, and military uses; loss of native pollinators, seed predation by rodents, and loss of native birds that scarified and dispersed seeds (Williams 1990; Cabin et al. 2000a, 2000b; Medeiros et al. 1993; Chimera 2004b).

Non-native ungulates have specifically been identified as a major contributor to the decline of native ecosystems in Hawai'i, including dry forests and shrublands. Although domestic animals, including the Polynesian pig, were introduced into Hawai'i between 400 and 600 A.D., it is unlikely that they spread rapidly into neighboring ecosystems because the pigs at that time were highly domesticated and reliant upon humans (Stone 1989, Cuddihy and Stone 1990). But by the time comprehensive descriptions of the Hawaiian landscape appeared in western literature in the late 1700s, feral ungulates and non-native ornamental plants and trees had already begun to dramatically change the nature of Hawaiian watershed structure and function.

The ban or kapu placed upon killing introduced cattle permitted the unchecked growth of large herds, which along with introduced sheep beginning in 1793 decimated native lowland forests. Non-native axis deer (*Axis axis*) were introduced to Maui by legislative mandate in 1960 (Tomich

1986). Because they occupied mostly private lands, their populations on Maui were not censused regularly by state wildlife biologists. Ueoka (1982) noted the extension of their range into dryland forests in Kīhei between 'Ulupalakua and Makena. Today, large herds of axis deer roam freely throughout the dryland forest of Honua'ula.

Ungulate impacts were accompanied by the intentional introduction of non-native plants, which were quick to dominate landscapes denuded by fire or clearing. Introduced trees were regarded as a means to protect denuded watersheds from erosion, and forestry agencies were established to address problems caused by overgrazing and deforestation at the turn of the 20th century.

3.0 PHYSICAL SETTING AND HISTORIC LAND USE OF HONUA'ULA

Honua'ula encompasses a rectangular area of 270 ha (670 ac) on the southeastern slope of Mt. Haleakalā, Paeahu Ahupua'a, Maui, between 90-245 m (295-804 ft) elevation (Figure 1). Located on the leeward side of the island, the climate is generally dry with an average annual rainfall ranging from 406 to 508 mm (16 to 20 inches) throughout the region (Maui County Data Book 2007). The terrain slopes gently at about 12% in an east to west direction across the Property.

Approximately 200 ha (495 ac) of land in the northern three-quarters of the Honua'ula Property is underlain by older lava flows of the Kula Volcanic Series (ranging from 13,000 to 950,000 years old). Weathering of lavas led to the formation of a thin layer of soil over the northern portion. About 70 ha (173 ac) of younger lava of the Hana Volcanic Series (between 5,000 and 13,000 years old) makes up the southern quarter of the Property. The southern lava flows have not undergone extensive weathering. This southern area is characterized by an extremely rough surface composed of broken 'a'ā lava blocks called clinker with little or no soil accumulation (PBR Hawaii, Inc. 1988). The soils and lavas covering the Property, and the drainage gulches that run across the land, strongly influence the nature of the vegetation that grows there.

The Palauea Cultural Preserve, located about 770 m (2,500 ft) west of the Honua'ula Property, represents the remains of a traditional fishing village which lies just above the shore within the same 'a'ā lava flow that underlies the southern portion of Honua'ula. Other archaeological remains found in the region include pre-contact religious temples (*heiau*), house foundations (*hale*), agricultural terraces and foot trails, cairns (*ahu*), and possibly water wells (http://www.anthropology.hawaii.edu/Projects/Palauea%20Cutural%20Preserve/index.html; Sinoto and Pantaleo 2006, Hana Pono LLC 2009). By the late 1800's, the area was used for cattle grazing.

During the Second World War, the military used lands in Kīhei for training and maneuvers (P. Erdman, Ulupalakua Ranch, pers. comm.). Historic activities within and adjacent to the Property included a Navy Underwater Demolition Team (UDT) training base at Kamaole, an Army camp at Makena, and amphibious assault training exercises by the Marine Corps. Jeep roads were bulldozed inland and cross-country movement by armored vehicles and troops were conducted. Following 1945, the area was returned to open pasture. Periodic bulldozing of the highway easement connecting Kīhei to 'Ulupalakua by the State of Hawai'i, grazing pressure from axis deer (*Axis axis*) and feral goats (*Capra hircus*), and unauthorized *kiawe* (*Prosopis pallida*) logging have caused further disturbance to the area.

4.0 VEGETATION AT HONUA'ULA

Gagné and Cuddihy (1999) noted that native dry forest communities occur on all of the main islands between 300 and 1,500 m (984-4,921 ft) elevation, especially on leeward aspects or in the rain shadows of mountains. Precipitation is between 500 and 2,000 mm (17-79 in) annually, and is usually concentrated between November and March. Gagne and Cuddihy (1999) noted that lowland dry forests usually "grade into lowland dry grasslands or shrub lands below 300 m elevation..." The semi-arid Honua'ula project area lies between 90 and 245 m (295-804 ft) elevation, and is estimated to receive about 300 mm (12 in) of precipitation annually. Hence, the southern portion of the Property may be described more accurately as a highly disturbed, remnant native coastal dry shrubland (sensu Gagne and Cuddihy 1999) in which *wiliwili* (*Erythrina sandwicensis*) has become a common inhabitant.

The recent US Geological Survey GAP Analysis Program (Figure 2) maps classified landcover within the Property as largely "XT: open klawe forest and shrubland (alien grasses)", "Y: uncharacterized open-sparse vegetation", with small patches of "XG: alien grassland" and "XT: alien forest". Price et al. (2007) recently developed methods using bioclimatic data to map habitat quality and range for *wiliwili* (*Erythrina sandwicensis*) throughout the Hawaiian Islands. The area encompassed by the Property appears on these maps as 'medium' to 'low' habitat quality for *wiliwili* (*E. sandwicensis*). However, numerous areas in southeastern Maui located between Pu'u Ola'i and Kaupo outside the Property did appear as having 'high' habitat characteristics on the maps prepared by Price et al. (2007). Medeiros (USGS, pers. comm.) suggested that mature *wiliwili* (*E. sandwicensis*) may be found throughout southeastern Maui, often in abundance and greater densities than those encountered in the Property. Altenberg (2007) identified eight *wiliwili* (*E. sandwicensis*) forests in southeast Maui including Kanaio, Pu'u o Kali, Honua'ula / Wailea 670, Makena, La Perouse, Kaupo, Lualailua, and Waikapu.

4.1 Previous Surveys

Various botanical surveys have been conducted within the Property (Char and Linney 1988, Char 1993, Char 2004, Altenberg 2007, and SWCA 2009a). Similar to the vegetation categories described by Char and Linney (1988) during the first survey on the Property, SWCA (2009a) found three distinct vegetation types within the Property (see Figure 3). Each of these is described below. Figure 4 illustrates the percent of introduced and native plants reported from each of the three predominant vegetation types.

- *Kiawe*-Buffelgrass Grassland

About 75% of the northern portion of the project parcel is characterized by an extensive grassland comprised primarily of *kiawe* (*Prosopis pallida*) *and* buffelgrass (*Cenchrus ciliaris*). There is scattered evidence that trespassers may be logging *kiawe* (*P. pallida*) trees for charcoal in this area. Guinea grass (*Urochloa maxima*), natal redtop (*Rhynchelytrum repens*), and sour grass (*Digitaria insularis*) are also scattered throughout the northern portion of the Property. Other plants found here include the invasive *koa haole* (*Leucaena leucocephala*), lantana (*Lantana camara*), partridge pea (*Chamaecrista nictitans*) and cow pea (*Macroptilium lathyroides*).

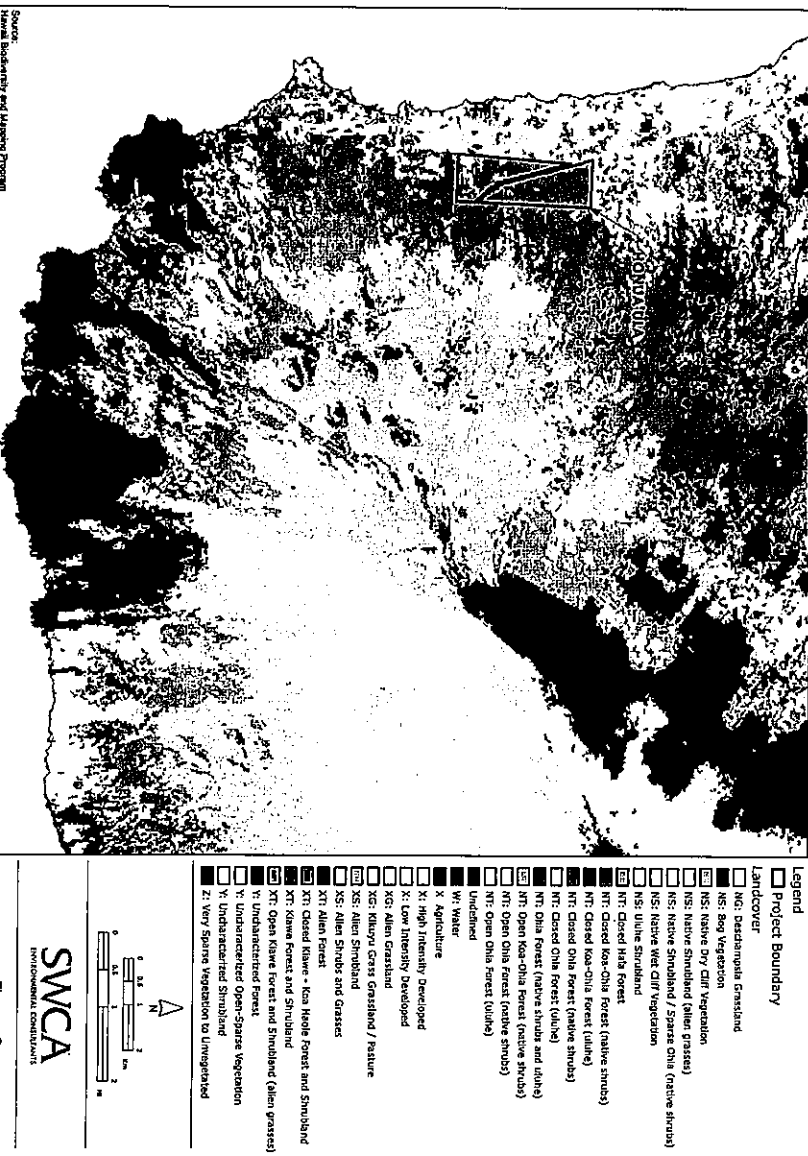
The area has been disturbed throughout by numerous jeep trails and unrestricted grazing by axis deer. Some open areas that appeared to be heavily grazed were devoid of buffelgrass (*Cenchrus ciliaris*), but contained the native shrubs *'ilima* (*Sida fallax*) and hoary abutilon (*Abutilon incanum*), and the introduced golden crown beard (*Verbesina encelioides*).

- Gulch Vegetation

The vast expanse of *kiawe*-buffelgrass in the northern three quarters of the Property is bisected from east to west by several gulches that carry flood waters to the sea (Figure 3). These intermittent gulches vary in depth and are characterized by patches of exposed bedrock. The gulches are shaded by their steep walls providing relatively cool and moist conditions. Three species of ferns including maidenhair fern (*Adiantum capillus-veneris*), sword fern (*Nephrolepis multiflora*), and the endemic *'iwa'iwa* fern (*Doryopteris decipiens*) were found in the shaded rocky outcrops and crevices within the gulches. Native *Pili* grass (*Heteropogon contortus*) was found in more open and sunny locations. Other species found within the gulches include tree tobacco (*Nicotiana glauca*), *wiliwili* (*Erythrina sandwicensis*), lantana (*Lantana camara*), partridge pea (*Chamaecrista nictitans*), golden crownbeard (*Verbesina encelioides*), *'ilima* (*Sida fallax*), hoary abutilon (*Abutilon incanum*), *koa haole* (*Leucaena leucocephala*), indigo (*Indigofera suffruticosa*), *'uhaloa* (*Waltheria indica*) and lion's ear (*Leonotis nepetifolia*).

- Mixed *Kiawe-Wiliwili* Shrubland

Remnant mixed *kiawe-wiliwili* shrubland was limited to the southern 'a'ā lava flow in the southern quarter of Property (Figure 3). Scattered groves of large-stature *wiliwili* (*Erythrina sandwicensis*) and *kiawe* trees co-dominated the upper story. Native shrubs, such as *'ilima* (*Sida fallax*) and *malapilo* (*Capparis sandwichiana*), and the native vine *'ānunu* (*Sicyos pachycarpus*), were represented in the understory.



Source:
Hawaii Biodiversity and Mapping Program
Center for Conservation Research and Training (CCRT)
University of Hawaii

Figure 2
HI-GAP Landcover

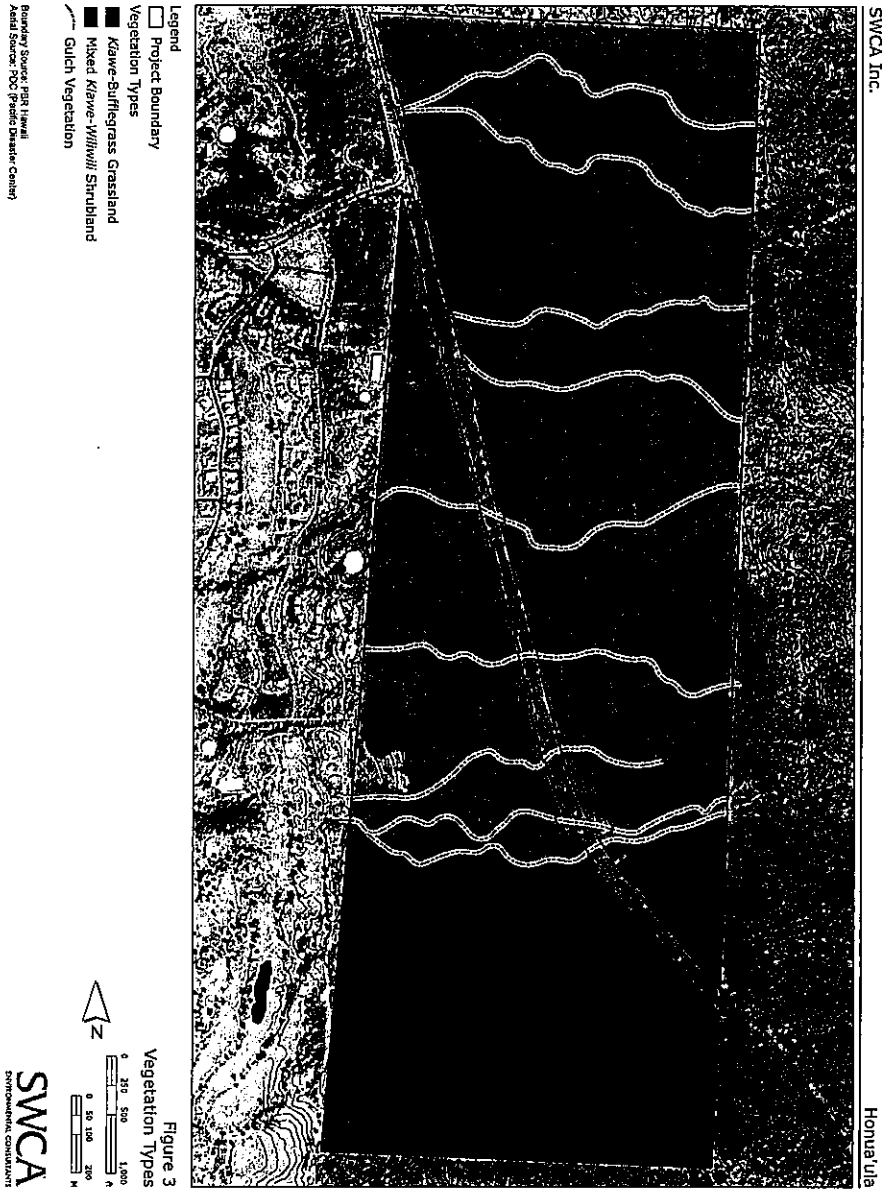


Figure 3
Vegetation Types

Introduced shrubs, introduced grasses, and introduced vines and herbaceous species dominated the ground vegetation. Lantana (*Lantana camara*), found throughout the mixed *kiawe-wiliwili* shrubland, showed signs of dieback. Although abundant, the guinea grass (*Urochloa maxima*) found on the site was grazed to stubble, probably by axis deer.

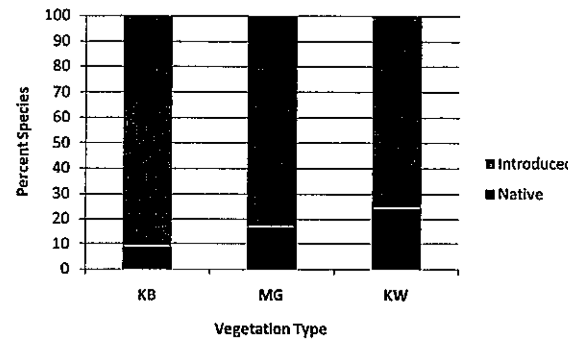


Figure 4. Percent of native and introduced plant species found in each of the three predominant vegetation types within the Property. *Data is pooled across all plant species (n= 146) observed by Char and Linney (1988), Altenberg (2007) and SWCA (this study). KB = Kiawe-buffelgrass grassland (n= 105, 9 natives and 96 introduced), MG = mixed gulch vegetation (n= 66, 11 natives and 55 introduced), KW = kiawe-wiliwili shrubland (n= 106, 26 natives and 80 introduced).*

In all, 146 plant species have been identified within the Property during these surveys. Of these species, 14 are endemic and 12 are indigenous to Hawai'i (Table 1). None are endemic to Maui. The remaining 120 plant species are introduced non-native species. Table 2 lists the occurrence of adult and seedling native plants identified within the Property by SWCA in 2008 (SWCA 2009a). Figure 5 illustrates the distribution of native plant species within the Property by count. A complete list of all plants found within the Property is provided in Appendix A.[1]

The 26 native species known to occur in the Property were arranged in order of their relative importance by the SWCA botanists (Table 1). Only the top eight endemic and indigenous plant species that are uncommon within the Property and elsewhere in the State were included in a GIS density analysis as a means of identifying suitable boundaries for a conservation easement within a portion of the Property based upon their greatest concentration.

Using the ArcView GIS Spatial Analyst extension, SWCA converted species count classes of the eight species to density (number of species/acre) classes. These resulting density maps allow comparison of native plants on the same spatial scale. However, density maps for these species varied greatly from 0-57 plants per acre for *wiliwili* (*Erythrina sandwicensis*) to 0-1 plant per acre for *'āwikiwiki* (*Canavalia pubescens*). Therefore, the maps were further standardized by reclassifying the densities for the species to a common scale where nine (9) represented the highest density for each species, and one (1) represented lowest.

[1] *Portulaca* sp. nov. was reported by Char and Linney (1988); however, it is not included in Appendix A because the species level was never determined and no known collections were made by Char and Linney (1988).

Table 1. Native plants reported from the Property arranged in order of their relative importance by project botanists. *Group 1 = endemic (E) and indigenous (I) plants uncommon within the Property as well as elsewhere in the State, and/or of significance to life stages of the endangered Blackburn sphinx moth (Manduca blackburni); Group 2 = relatively common endemic species throughout Hawai'i, Group 3 = relatively common native (indigenous) species throughout Hawai'i.*

Species	Status	Hawaiian Name	Family
GROUP 1			
Lipochaeta rockii	E	*nehe*	Asteraceae
Canavalia pubescens	E	*paunu*	Fabaceae
Erythrina sandwicensis	E	*wiliwili*	Fabaceae
Capparis sandwichiana	E	*maiapilo*	Capparaceae
Senna gaudichaudii	I	*kolomona*	Fabaceae
Sicyos hispidus	E	*'ānunu*	Cucurbitaceae
Sicyos pachycarpus	E	*'ānunu*	Cucurbitaceae
Chamaesyce celastroides var. *lorifolia**	E	*'akoko*	Euphorbiaceae
Argemone glauca	E	*pua kala*	Papaveraceae
GROUP 2			
Myoporum sandwicense	E	*naio*	Myoporaceae
Panicum torridum	E	*kakonakona*	Poaceae
Heteropogon contortus	E	*pili*	Poaceae
Ipomoea tuboides	E	*ipomea*	Convolvulaceae
Boerhavia herbstii	E	*alena*	Nyctaginaceae
Doryopteris decipiens	E	*'iwa'iwa*	Adiantaceae
Plumbago zeylanica	E	*'ilie'e*	Plumbaginaceae
GROUP 3			
Dodonaea viscosa	I	*'a'ali'i*	Sapindaceae
Sida fallax	I	*'ilima*	Malvaceae
Boerhavia spp.**	I	*alena*	Nyctaginaceae
Abutilon incanum	I	hoary abutilon	Malvaceae
Ipomoea indica	I	*koali awahia*	Convolvulaceae
Waltheria indica	I	*'uhaloa*	Sterculiaceae
Pellaea ternifolia	I	*pellaea*	Adiantaceae
Adiantum capillus-veneris	I	maidenhair fern	Pteridaceae
Solanum americanum	I	*popolo*	Solanaceae

** A single stunted akoko was found within the Property in 2006; however, the plant was found to be dead in the late summer of 2007, and was not found at all during the 2008 surveys. Therefore, it is not considered in further plant density analysis for the purpose of defining boundaries of the native plant preserve.*
*** Two indigenous species of Boerhavia (repens and acutifolia) were reported within the Property during the SWCA surveys. Char and Linney (1988) and Char (1993, 2004) also found B. repens within the Property.*

The reclassified density map was then overlaid with a percent weight assigned to each. Each species was assigned a different weight by the project botanists based on their relative botanical importance throughout the State and the Property (Table 3). The density map and the overlay analysis were developed using 100 m (328 ft) resolution to define specific and contiguous preservation areas that protect the greatest concentration of rare native plant species within the Property. Figure 6 illustrates the results of the weighted density analysis for the eight most important native plant species. The colors represent the weighted average of the densities of the eight species.

The Property was viewed by Char and Linney (1988) and Char (1993, 2004) as having unremarkable vegetation. Until SWCA (2006) and Altenberg (2007), there had been no recognition of the remnant mixed *kiawe-wiliwili* shrubland as an area worthy of special recognition. Similarly, there have been no previous efforts by any Federal, State, local government agency, or conservation Non-governmental organizations (NGOs) to acquire and protect any portion of the Property.

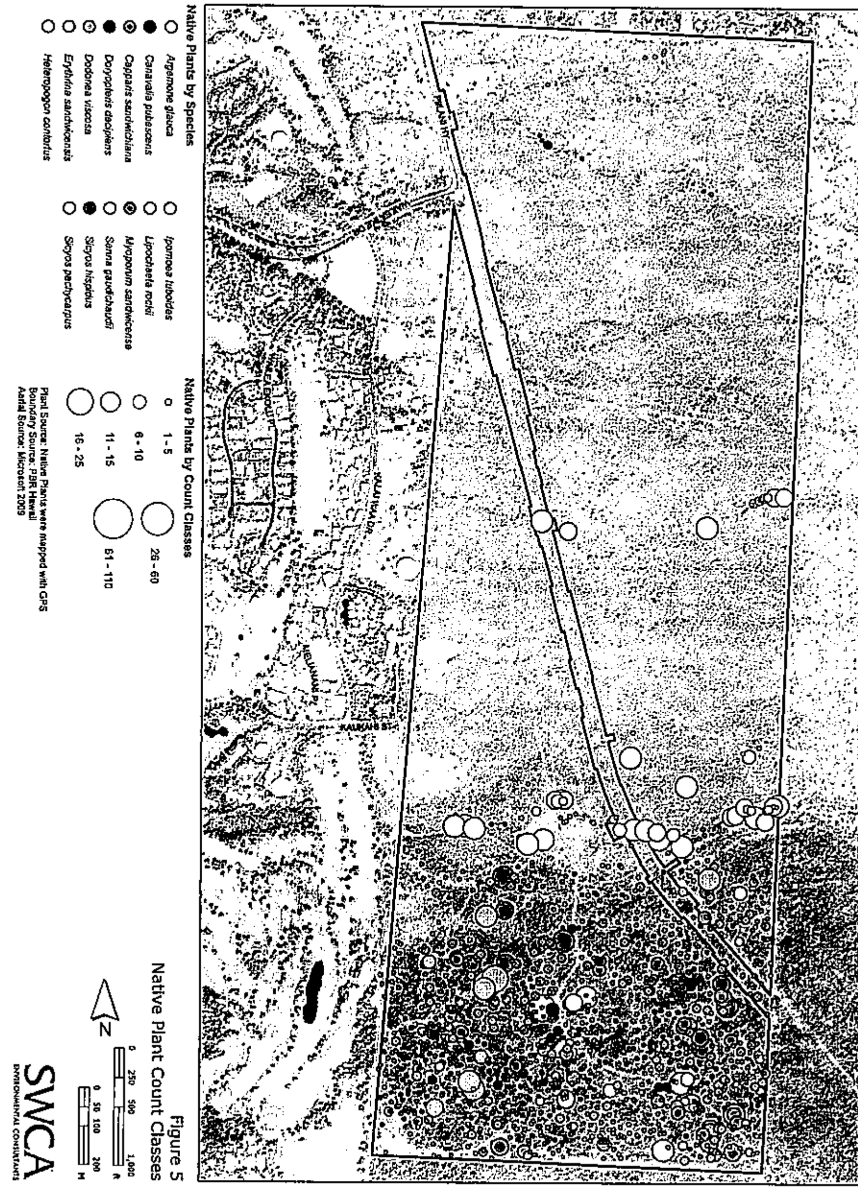


Figure 5
Native Plant Count Classes

Table 2. A comparison of the number of native plants and seedlings observed within the entire Honua'ula Property and the remnant mixed kiawe-wiliwili shrubland in the southern portion of the Property. *Prop = entire Honua'ula Property, KW = kiawe-wiliwili shrubland.*

Species (Hawaiian name)	Number of Points		Number of Seedlings		Number of Adults		Total Numbers Observed	
	KW	Prop	KW	Prop	KW	Prop	KW	Prop
Argemone glauca (pua kala)	26	26	247	247	165	165	412	412
Canavalia pubescens ('āwikiwiki)	5	5	0	0	5	5	5	5
Capparis sandwichiana (maiapilo)	311	312	14	14	548	549	562	563
Dodonea viscosa ('a'ali'i)	7	7	0	0	16	16	16	16
Doryopteris decipiens ('iwa'iwa)	2	14	0	2	7	52	7	54
Erythrina sandwicensis (wiliwili)	546	569	334	341	2105	2137	2439	2476
Heteropogon contortus (pili)	0	66	0	384	0	1109	0	1493
Ipomoea tuboides (ipomea)	5	5	0	0	5	5	5	5
Lipochaeta rockii (nehe)	24	24	56	56	45	45	101	101
Myoporum sandwicense (naio)	17	17	0	0	21	21	21	21
Senna gaudichaudii (kolomona)	28	32	1	5	36	38	37	43
Sicyos hispidus ('ānunu)	48	49	5	5	107	108	112	113
Sicyos pachycarpus ('ānunu)	101	102	313	313	289	290	602	603

Table 3. Percent weight assigned for the eight species selected for density analysis; *based on their relative botanical importance throughout the State and the Honua'ula Property.*

Species	Common Name	Percent Weight
Lipochaeta rockii (E)	*nehe*	16
Canavalia pubescens (E)	*'āwikiwiki*	15
Erythrina sandwicensis (E)	*wiliwili*	14
Capparis sandwichiana (E)	*maiapilo*	13
Senna gaudichaudii (I)	*kolomona*	12
Sicyos hispidus (E)	*'ānunu*	11
Sicyos pachycarpus (E)	*'ānunu*	10
Argemone glauca (E)	*pua kala*	9

The remnant native vegetation in the remnant mixed *kiawe-wiliwili* shrubland represents a highly degraded lowland dry shrubland in which *wiliwili* trees (*E. sandwicensis*) are a natural component. High density *wiliwili* (*E. sandwicensis*) stands occur in other locations throughout the region. Altenberg (2007) identified eight areas in southeast Maui, including the Property, where *wiliwili* (*E. sandwicensis*) groves are found. SWCA also found dense *wiliwili* (*E. sandwicensis*) groves east of Pu'u Olai (2009a). Far from being pristine, this dry shrubland has been degraded by human activities including unrestricted grazing by ungulates, cattle grazing, invasive plant species, road works, *kiawe* (*P. pallida*) logging, and military activities.

4.2 Endangered, Threatened and Candidate Endangered Plants

No Federal or State of Hawai'i listed threatened, or endangered plant species were found in the Property. Honua'ula is not located within or immediately adjacent to any designated critical habitat or recovery management units designated by the USFWS. All the native plant species described from the Property are known to occur elsewhere on Maui and most also occur throughout the main Hawaiian Islands.

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Figure 6
Visual Representation of Weighted Density Analysis of the Eight Most Important Plant Species within the Project Area

Nehe (*Lipochaeta rockii*) occurs in scattered locations on Maui, but is primarily known from Moloka'i and Kaho'olawe where it is scattered to common in coastal sites to dry forests, and along the margins of lava flows (Wagner et al. 1999). The *nehe* plants (*L. rockii*) reported from the Property have a distinct leaf shape that appears to be limited to the Property (A.C. Medeiros, USGS, pers. comm.); the leaves are less dissected compared to specimens at other Maui locations. However, the current Manual of Flowering Plants of Hawaii (Wagner et al. 1999) did not find sufficient scientific evidence to recognize it as a distinct variety or subspecies. Herbst (Bishop Museum, pers. comm.) suggested that it might easily hybridize with other plants of the same species. This species, including individuals with a distinct leaf shape, is also not given statutory protection by State or Federal laws.

One candidate endangered species, *'āwikiwiki* (*Canavalia pubescens*), has been identified in the project area. Over a period of time, Altenberg (2007) collected roughly 15 GPS points for *'āwikiwiki* (*C. pubescens*) within the *kiawe-wiliwili* shrubland during his hikes across the Honua'ula parcel. It is unknown how many of his GPS points represent duplicate occurrences of the same plant. The U.S. Fish and Wildlife Service (2009) reported "a few individuals at Palauea-Keahou" [including the Property] based upon information received from Altenburg (2007) and Hank Oppenheimer (Plant Extinction Prevention Program, pers. comm.).
During the SWCA botanical survey of Honua'ula in 2008 (SWCA 2009a), the project botanists found only five (5) individual *'āwikiwiki* (*C. pubescens*) plants on the Property. All *'āwikiwiki* (*C. pubescens*) were flowering and fruiting at the time of the survey; however, no seedlings were detected. The plants appeared to be healthy with no signs of damage or disease.

Canavalia pubescens Hook. & Arnott was described by Wagner et al. (1999) as "...uncommon in open dry sites such as lava fields, kiawe thickets, and dry forest, 15-540m, on Ni'ihau, Kaua'i (Nāpali Coast), Lāna'i, and leeward East Maui." Extant populations of *'āwikiwiki* (*C. pubescens*) on Maui are listed in Table 4. Both historical and current populations of the species on Maui are illustrated in Figure 7.

Table 4. Extant populations of Canavalia pubescens on Maui.

Site Name	No. of Individuals	Reference/Source
Honua'ula (Palauea-Keauhou)	5	SWCA (2009a).
Pu'u O Kali Forest Reserve	100+	A. Medeiros, pers. comm.
'Ahihi-Kina'u Natural Area Reserve	16-21	J. McDonald, pers. comm.
Papaka Kai (La Perouse)	6	USFWS (2008a).
Southeast Pohakea	1	USFWS (2008a).

In 1997, the species was added as a candidate species by the U.S. Fish and Wildlife Service (USFWS). The most recent USFWS (2009) information on the species includes the following:

"Habitat/Life History
Canavalia pubescens is found on dry, open lava fields and in dryland forest. On Kauai, *C. pubescens* was found in open, moist forest and in dry scrub forest at elevations between 180 to 2,900 feet (ft) (55 to 884 meters (m)). On Niihau, this species was last seen growing on an exposed basalt ledge at 300 ft (91 m) in elevation. On Lanai, *C. pubescens* was observed growing among sun-scorched lava rocks along a coastal trail at 50 ft (15 m) elevation with *Cordia subcordata* (kou) (H. Oppenheimer, PEP Program, pers. comm. 2007). On Maui, *C. pubescens* is found on recent lava flows in *Erythrina* (wiliwili) lowland dryland forest and shrubland with the following native species: *Capparis sandwichiana* (malapilo), *Chamaesyce celastroides* var. *lorifolia* (akoko), *Dodonaea viscosa* (aalii), *Ipomoea* spp. (no common name), *Morinda* spp. (noni), *Sida fallax* (ilima), *Rauvolfia sandwicensis* (hao), and *Waltheria indica* (uhaloa); at elevations between 80 to 400 ft (24 to 122 m) (Wagner and Herbst 1999, p. 654; Hawaii Biodiversity and Mapping Program (HBMP) 2008)."

"Historical Range
Historically, *Canavalia pubescens* was wide ranging in the coastal dryland forest and shrublands of southeastern Maui, Lanai, northwestern Kauai, and Niihau (HBMP 2008). It was historically recorded from one population on Niihau at Haao Valley; from six populations ranging from Awaawapuhi to Wainiha on the northwest coast of Kauai; from six populations ranging from Keokea to Wailaulau-Pahihi on Maui; and from four populations on Lanai, from Ka'ena Point to Huawai Bay (HBMP 2008)."

"Current Range/Distribution
Currently, *Canavalia pubescens* is found on the island of Maui (HBMP 2008; H. Oppenheimer, Plant Extinction Prevention Program, pers. comm. 2006; F. Starr, U.S. Geological Survey, Biological Resources Discipline (USGS-BRD), pers. comm. 2006). No plants were observed at the last known location of this species on Lanai in 2007; however, it could possibly be found there again (H. Oppenheimer, pers. comm. 2007). There were a few individuals at Palauea-Keahou, but this area is currently undergoing development (Altenburg 2007, pp. 12-13; H. Oppenheimer, pers. comm. 2007)."

"Population Estimates/Status
Five populations are known on Maui: Keokea and Puu o Kali with "hundreds" observed; southwest Kalua o Lapa with two individuals; Papaka Kai with six individuals; Ahihi-Kinau with a few individuals; and southeast Pohakea, with at least one individual (HBMP 2008; F. Starr, pers. comm. 2006; H. Oppenheimer, pers. comms. 2006, 2007). These populations total a little over 200 individuals, with the majority ("hundreds") in one population (Puu o Kali)."

Altenberg (2007), F. Starr (pers. comm.), and H. Oppenheimer (pers. comm.) apparently presumed that the remaining *'āwikiwiki* (*C. pubescens*) at Palauea-Keahou [Honua'ula] have "... likely been destroyed by development" (as cited in USFWS 2008a and 2009). Contrary to this pessimistic outlook, all five individuals on the Honua'ula Property continue to thrive. No construction or other development related activity other than recent fence building to keep cattle from the *kiawe-wiliwili* shrubland has been conducted in that area. Honua'ula Partners, LLC is committed to the Maui County Council conditions to insure that all five *'āwikiwiki* (*C. pubescens*) plants within the Property are protected and managed to help ensure their conservation.

The Species Assessment and Listing Priority Assignment Form (USFWS 2009) notes that the USFWS has "promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed" and determined that the species "does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process."

The USFWS (2009) states that the primary threat to remaining *'āwikiwiki* (*C. pubescens*) on Maui are grazing by feral goats (*Capra hircus*) and axis deer (*Axis axis*). Feral ungulates are known to graze on native plants, degrade and destroy habitat, disrupt topsoil leading to erosion, and facilitate the establishment and spread of non-native plants. Land development is also listed as a threat to certain populations of *'āwikiwiki* (*C. pubescens*). The USFWS determined that *'āwikiwiki* (*C. pubescens*) is also highly threatened by competition and habitat degradation from non-native plant species, and wildfires (USFWS 2008a).

Non-native plant species that are reported to be threats to *'āwikiwiki* (*C. pubescens*) by USFWS (2008a) include: *kiawe*, *koa haole*, natal redtop, and buffelgrass at Keokea; buffelgrass and *kiawe* at Pu'u O Kali and Palauea-Keauhou; natal redtop and *koa haole* at Papaka Kai; and *koa haole* and air plant (*Kalanchoe pinnata*) at southwest Kalua o Lapa population in the Ahihi-Kinau NAR (Altenberg 2007; HBMP 2008; F. Starr, pers. comm. 2006).

A single *Chamaesyce celastroides* var. *lorifolia* was observed within the *kiawe-wiliwili* (*Prosopis pallida – Erythrina sandwicensis*) shrubland by Altenberg (2007) and SWCA (2006). Only about four feet in height, this plant appeared to be stunted and subject to intense grazing pressure. Someone also had attempted to wrap protective material around its blossoms and/or seeds. This tree had died by the SWCA March 2008 survey.

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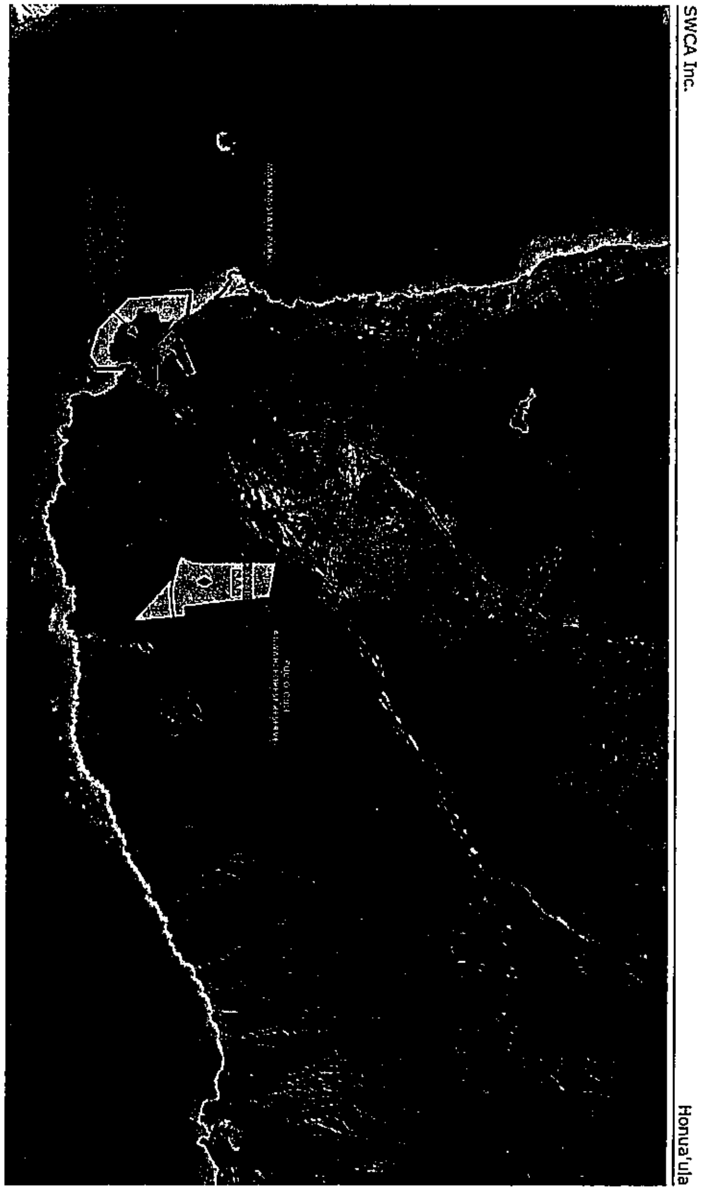

Legend

- ♦ Extant *Canavalia pubescens* Populations
- ◊ Historical *Canavalia pubescens* Populations
- Honua'ula Boundary
- Reserves with Extant *Canavalia pubescens* Populations
- Reserves

Figure 7
Canavalia pubescens Locations in South Maui

Image Source: State of Hawaii (LANDSAT)
Reserves and Management Units Source: State of Hawaii
Boundary Source: PBR Hawaii
Species Source: HBMP

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5.0 OTHER HAWAIIAN DRY FOREST AND SHRUBLAND RESTORATION EFFORTS

Numerous dry forest restoration efforts have been initiated throughout the State to save these degraded ecosystems. Several small-scale projects have been successful in restoring dry forest fragments by excluding ungulates, planting seedlings, and reducing grass competition via grass removal (Cabin et al. 2002a, Brooks et al. 2009). However, these efforts have proven that restoring Hawai'i's dry forests, even at a small-scale, can be challenging and expensive (Leonard Bisel Associates, LLC and Geometrician Associates 2008). Private developments and State and Federal protected areas in Hawai'i where active management activities are underway to protect native dry forest ecosystems and rare native plants are listed in Table 5. Figure 8 illustrates protected and managed natural areas in south Maui in relation to the location of Honua'ula. A more detailed description of existing dry forest restoration efforts, especially those on Maui, is provided in the following paragraphs.

5.1 Dry Forest and Shrubland Restoration Efforts

5.1.1 Auwahi Forest Reserve, Maui

On November 29, 2009, the Maui Coastal Land Trust entered into a historic land preservation agreement with the Erdman Family of Ulupalakua Ranch ensuring over 11,000 acres along the leeward slopes of Haleakala will continue as a working ranch and wildlife habitat. Although the purpose of this perpetual easement is to assure the roughly 6,000 acres of land are always protected for agricultural uses, corollary benefits include the permanent protection of one of Maui's most iconic views and the entire `Auwahi ahupua`a.

`Auwahi is a 5,328 rectangular parcel running lengthwise from the ocean shore up the mountain to 6,000 ft. elevation. The mauka portion of this ahupua`a is home to the Auwahi Habitat Restoration Project, and is part of the Leeward Haleakala Watershed Restoration Partnership. The Auwahi Forest Reserve lies within this area and includes a remnant native dry forest on the south slope of East Maui at 900-1,200 m (3,937 ft) elevation (Medeiros 2006). The forest at Auwahi, with a very high diversity of native tree species, is generally considered the floristically richest dryland forest area in the State of Hawai'i (Medeiros, personal communication). A 4 ha (10 ac) site has been undergoing intensive restoration efforts since 1997 under a partnership between landowners, government agencies and scientists. Auwahi has a rich plant diversity including 50 native tree species, at least five of which are endangered (Medeiros 2006).

5.1.2 Kanaio Natural Area Reserve, Maui

Established in 1990, the Kanaio Natural Area Reserve located to the south of the project area encompasses 354 ha (876 ac), portions of which include *wiliwili*. The reserve is situated between 335 to 850 m (1100 to 2780 ft) elevation on leeward East Maui. The substratum at Kanaio is similar to the southern portion of Honua'ula and consists of broken 'a'ā lavas estimated to be less than 10,000 years old (Medeiros et al. 1993). The reserve contains representatives of three native vegetation types: *'a'ali'i* (*Dodonea*) lowland shrublands, *lama* (*Diospyros*) forest, and *wiliwili* (*Erythrina*) forest.

Nearly 38% of the vegetation in Kanaio is native with about 14% indigenous and 24% endemic. Twenty-two species of Hawaiian dry land forest trees are found in Kanaio, over 35% of the total number of native species in the area (Medeiros et al. 1993). Primary threats to the native dry forest community at Kanaio include the activities of feral goats, invasion of weed species, wildland fires, and the small population sizes of rare native plants. Management activities at Kanaio have focused on exclusion of feral ungulates, alien plant control, and propagation of native species.

5.1.3 Pu'u O Kali Forest Reserve, Maui

Pu'u O Kali Forest Reserve is a remnant *wiliwili* forest on the slopes of east Maui above Kīhei. The Pu'u-o-kali lava flows support some of the most diverse and intact lowland dryland forest ecosystems remaining in the Hawaiian Islands and comprise, by far, the best remnant of lowland dryland forest vegetation on Maui (Medeiros, personal communication). As Monson (2005) quoted A.C. Medeiros, "*Pu'u-O-Kali* is the only place on this whole side that looks like it did in ancient times... It's the only place where a Hawaiian from long ago would look around and say, 'Oh, I know where I am.' They wouldn't recognize the rest of South Maui."

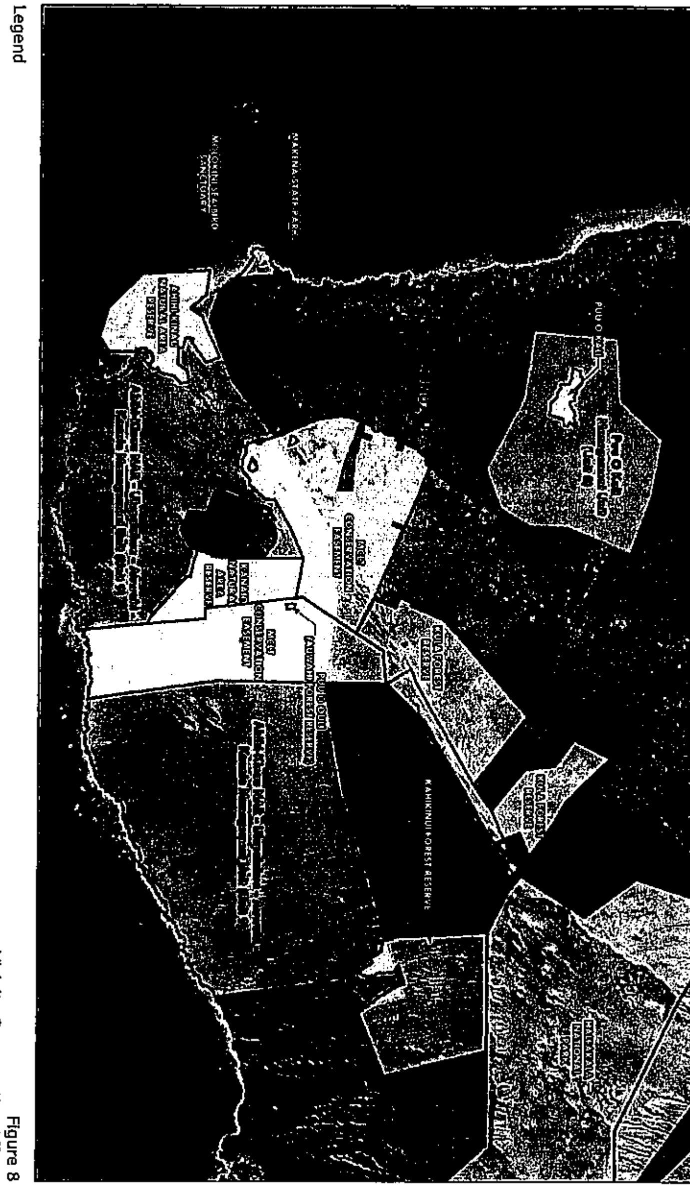
5.1.4 'Ahihi-Kina'u Natural Area Reserve, Maui

The 'Ahihi-Kina'u Natural Area Reserve is located on the southwest corner of the Island of Maui and was the first established in 1973. Its 501 ha (1,238 ac) contain extensive nearshore coral reef communities, rare and fragile anchialine ponds, and lava fields from the last eruption of Haleakala 200-500 years ago. Native plant communities include *naio*, *wiliwili*, and *ma'o* (*Gossypium tomentosum*) in kipukas.

Table 5. Protected and managed dry forests and shrublands in Hawai'i.

Project/Protected Area	Island	Total Preserve Size	# of Native Plants	Owner/ Manager
'Ahihi-Kina'u Natural Area Reserve	Maui	501 ha (1,238 ac)	21 taxa, 3 rare	NARS-DLNR
Auwahi Ahupua'a and Forest Reserve (Pu'u Ouli)	Maui	2,120 ha (5,238 ac)	50 taxa, 5 rare	Ulupalakua Ranch/ Maui Coastal Land Trust/Auwahi Restoration Group
Kanaio Natural Area Reserve	Maui	354 ha (876 ac)	66 taxa, 14 rare	NARS-DLNR; Ulupalakua Ranch
Pu'u O Kali Forest Reserve	Maui	96 ha (236 ac)	Unavailable	Dept. of Hawaiian Homelands/ The Maui Restoration Group
Ku'ia Natural Area Reserve	Kaua'i	662 ha (1,636 ac)	160 taxa, 54 rare	NARS-DLNR
Halona Exclosure	O'ahu	1.2 ha (3 ac)	1 rare	U.S. Navy
Kaluakauila Management Unit	O'ahu	42 ha (104 ac)	Unavailable	State of Hawai'i and U.S. Army
Mokulela Forest Reserve	O'ahu	1,352.6 ha (3,342.4 ac)	Unavailable	DOFAW-DLNR
Pahole Natural Area Reserve	O'ahu	266 ha (658 ac)	168 taxa, 18 rare	NARS-DLNR
Kānepu'u Preserve	Lāna'i	239 ha (590 ac)	48 taxa, 11 rare	The Nature Conservancy
Ka'upulehu Preserve	Hawai'i	27.3 ha (67.5 ac)	45 taxa, 22 rare	Kamehameha Schools/ North Kona Dry Forest Working Group
Kipahoehoe Natural Area Reserve	Hawai'i	2,259 ha (5,583 ac)	117 taxa, 4 rare	NARS-DLNR
La'i'ōpua Preserves	Hawai'i	16.8 ha (41.6 ac)	21 taxa, 5 taxa	DHHL
Manuka Natural Area Reserve	Hawai'i	10,340 ha (25,550 ac)	187 taxa, 10 rare	NARS-DLNR
Pālamanui Forest Reserve	Hawai'i	22 ha (55 ac)	27 taxa, 5 rare	Pālamanui, LLC
Pu'u Wa'awa'a Forest Reserve	Hawai'i	15,338 ha (37,901 ac)	184 taxa, 40 rare	DOFAW-DLNR
Waikoloa Dry Forest Recovery Project	Hawai'i	111 ha (275 ac)	2 taxa, 1 rare	Waikoloa Village Chapter of the Outdoor Circle

The native communities were described as the 'A'ali'i Lowland Dry Shrubland, the Mixed Coastal Shrubland/Herbland composed of Coastal Dry Grassland and Naupaka Coastal Dry Shrubland, the 'Akoko Coastal Dry Shrubland and the Low Salinity Anchialine Pool. The 'A'ali'i Lowland Dry Shrubland community is not considered rare in Hawai'i, though some examples are known to contain rare plants.



Legend

Project Boundary

Reserves

Proposed Management Units for the Blackburn's Sphinx Moth

Image Source: State of Hawaii (LANDSAT)
Reserves and Management Units Source: State of Hawaii
Boundary Source: PBR Hawaii

Figure 8
Vicinity Conservation Efforts

N

0 0.5 1 2 Miles

0 1 2 4 Km

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Native components found in this community include *'ilima, 'uhaloa, nalo, naupaka* (*Scaevola sericea*); *alena* (*Boerhavia repens*), and *koali 'awa* (*Ipomoea indica*). The NARS also contains a single site of the 'Akoko Coastal Dry Shrubland community at the western edge of the Kanaio ahupua'a. This extremely rare coastal shrubland dominated by *'akoko* (*Chamaesyce celastroides*). Like all other dry forest and shrublands in Hawai'i, this area is severely imperiled by the encroachment of weeds and feral ungulates.

5.1.5 Ka'upulehu Preserve, Hawai'i

In their research studies conducted at Ka'upulehu dry forest on Hawai'i Island, Cabin et al. (2000a) found that excluding ungulates with fencing is effective in helping the recruitment of some native tree species. However, fencing alone was insufficient to restore native dry forests. In another study at Ka'upulehu, Cabin et al. (2002a) experimentally manipulated micro-site conditions (canopy vs. no canopy), water (ambient vs. supplemental), and weeding (removal vs. non-removal).

They also added seeds of six native species in 64 1m² plots to investigate the regeneration of native dry forest species. The authors suggest that it is possible to restore degraded dry forests in Hawai'i by manipulating the ecological conditions particularly for the fast growing understory species which then create micro-sites more favorable for the establishment of native trees.

Cabin et al. (2002b) investigated how light availability (full vs. 50% shade), alien grass control (bulldoze, herbicide, plastic mulch and trim treatments), and out-planting vs. direct seeding affected the establishment of native plants and suppression of invasive grasses. Their results highlight the fact that restoration can be site specific and hence it is important to examine species and treatment specific responses to these species before attempting large scale conservation efforts. They also suggest that relatively simple techniques can be used to simultaneously suppress invasive grasses and establish populations of vigorous native understory species even at larger scales. Over the term of his studies at Ka'upulehu, Cabin found that 16 non-native plants invaded the preserve, suggesting that management efforts to control non-native grasses and rodent seed predators facilitated invasion of non-native species. This further demonstrates how preserving native vegetation within the Native Plant Preservation Area and other areas designated for native plant protection at Honua'ula will require active management to control non-native species and reintroduce key native species.

5.1.6 Pālamanui Forest Reserve, Hawai'i

A relatively pristine remnant native dry forest occurs at Pālamanui, a 293 ha (725 ac) mixed use residential and commercial development in Kona, Hawai'i. Sixty two plant species have been described from the native forest there, of which 27 are native and 35 are introduced (Hart 2003). Roughly seven percent of the total Pālamanui development parcel consists of a *Diospyros-Psydrax-Santalum* dry forest that has "apparently never received any major disturbance" (Hart 2003, Group 70 International 2004). Three federally listed endangered plant species are found at Palamanui: *uhiuhi* (*Caesalpinia kavalensis*), *'aiea* (*Nothocestrum breviflorum*), and *halapepe* (*Pleomele hawaiiensis*). Several large *'akoko* (*Chamaesyce multiformis*), many of which are larger than have ever been seen before, have been described from Pālamanui (Group 70 International 2004). Protection of at least 22 ha (55 ac) of the dry forest remnant at Pālamanui is an integral part of the overall development proposal. The proposed preserve management plan for Pālamanui (Hart 2003; J. Price, UH Hilo, pers. comm.) are directly relevant to management of the proposed Native Plant Preservation Area at Honua'ula and have been incorporated into our recommendations.

5.1.7 La'i'ōpua Preserves, Hawai'i

Another plant mitigation and preserve restoration plan has been developed for construction of The Villages at La'i'ōpua in Kealakehe, North Kona on the Island of Hawai'i for the Department of Hawaiian Home Lands (Leonard Bisel Associates, LLC and Geometrician Associates 2008). Originally conceived in 1999, the plan addresses the protection of two listed endangered plants, *aupaka* (*Isodendrion pyrifolium*) and *uhiuhi* (*Caesalpinia kavalensis*), as well as 19 associated endemic and indigenous plants. Fifty-five species of introduced plant species have been recorded within or near the proposed preserves at La'i'ōpua. Four preserves are planned for La'i'ōpua, the

largest of which is 10.8 ha (26.6 ac) in size. The other preserves are 4.5 and 1.6 ha (11 and 4 ac) in size, with additional 'mini-preserves' proposed to protect individual trees. As with the proposed Native Plant Preservation Area at Honua'ula, the La'i'ōpua preserves also incorporate archaeological features, and include specific conservation principals, management objectives, and physical plans.

5.1.8 Kānepu'u Preserve, Lāna'i

The Kānepu'u Preserve was established in 1989 to protect and enhance the *olopua/lama* (*Nestegis/Diospyros*) dryland forest. The preserve is comprised of seven disjunct units totaling 239 ha (590 ac). Six federally listed plant taxa have been reported in the Kānepu'u Preserve, although only four of those taxa are currently known to occur in the preserve. The primary goal of the preserve is to maintain and enhance native ecosystems and protect the habitat of rare plants.

The Kānepu'u Preserve is managed by the Nature Conservancy of Hawai'i (TNCH). Additional funding is provided through the State of Hawai'i's Natural Area Partnership Program (NAPP), which provides matching funds for the management of qualified private lands that have been permanently dedicated to conservation (TNCH 2010). Due to budgetary constraints, TNCH has scaled-back on management efforts focusing on protecting fencing, ungulate control, weed control, habitat restoration, and firebreak maintenance. TNCH is actively seeking other entities to assist us with management of the preserve and believes that a community-based organization will provide the best solution for long-term management of the preserve; however, currently no community group has demonstrated the financial, administrative, and management capacity to manage (TNCH 2010).

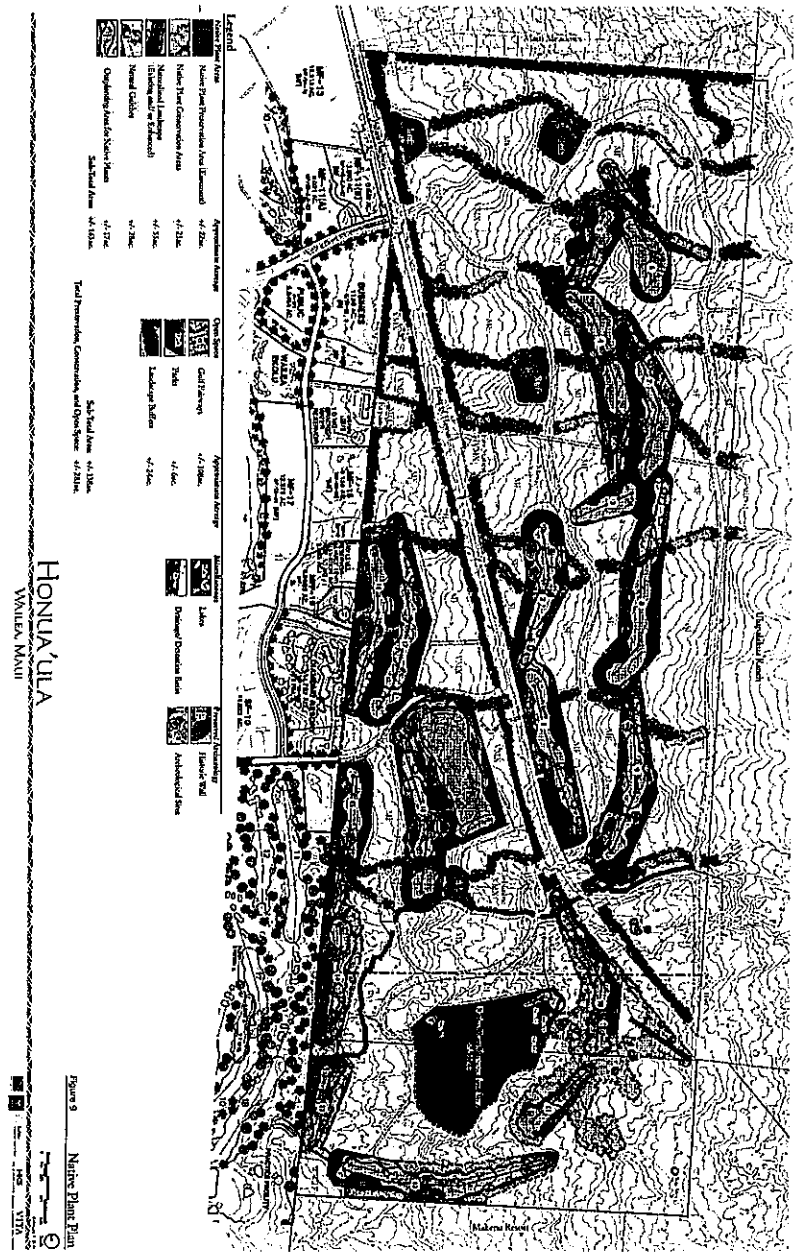
5.2 Lessons Learned

Each of these preserves have in common with Honua'ula the same major threats to dry forest ecosystems in Hawai'i, including the detrimental activities of feral goats, deer, and pigs; wildfires; and the proliferation of weedy species. Like Honua'ula, a growing number of remnant dry forests and shrublands lie adjacent to or within areas proposed for development. The aforementioned projects, as well as other dry forest restoration research (Brooks et al. 2009), has shown that multiple techniques are critical for effective restoration in dry forests. For example, fencing alone is insufficient to restore native dry forests (Cabin et al. 2000a). A combination of techniques may include fencing, herbicide application, manual and mechanical weeding, native species outplanting, seedling shading, broadcast seeding, and supplemental watering.

Other research has stressed the importance of a long-term approach to restoration in Hawaiian dry forests (Thaxton et al. in press). The studies being conducted at these sites, and the studies of Allen (2000), Blackmore and Vitousek (2000), Cabin et al. (2000a, 2000b, 2001); Chang (2000), Chimera (2004), Cordell et al. (2001, 2002); D'Antonio et al. (1998), Henderson et al. (2001), Litton et al. (2004), Merlin and Juvik (1992), Sandquist et al. (2004), Stratton (1998), Tunison (1992) and others give hope that even small restoration efforts consisting of a few hectares can help provide habitat for rare native dry forest species and can subsequently serve as urgently-needed sources of propagules.

This hope is reinforced by the numerous sources of information on successful propagation of rare native Hawaiian plants specifically for landscaping (e.g., TNC 1997, Tamimi 1999, Friday 2000, Wong 2003, Bornhorst and Rauch 2003, Lilleeng-Rosenberger and Chapin 2005, CTAHR 2006). In fact, even mini-preserves consisting of individual trees are being deemed as appropriate and feasible by USFWS and DLNR when managed in combination with adjacent preserve areas, such as at La'i'ōpua on Hawai'i Island.

Community outreach and public support have proven to be a critical factor in the success of dry forest and shrubland restoration efforts in Hawai'i. Due to shortfalls in funding, volunteers are important for these projects. It is important to note that although general lessons can be learned from dry forest restoration project throughout the state, each restoration effort (including Honua'ula) will have site specific issues. As noted by the results of Cabin et al. (2002b), it is important to examine site-specific species and treatment responses. These site-specific issues will only arise once active management begins. Adaptive management can subsequently be initiated.



6.0 DESCRIPTION OF THE PROPOSED HONUA'ULA PRESERVES AND RELATED MITIGATION

Altogether, 57.8 ha (143 ac) are proposed for the preservation, conservation, propagation, and management of native plant species at Honua'ula (Figure 9). Included in this area is an 8.9 ha (22 ac) Native Plant Preservation Area that will be dedicated in perpetuity as a conservation easement for the preservation of the highest density of native dry shrubland plants in the southern portion of the Property. Existing native plants within the Native Plant Preservation Area and the additional 9.3 ha (23 ac) Native Plant Conservation Areas within the *kiawe-wiliwili* shrubland will remain ungraded and protected. In addition to this, 11.3 ha (28 ac) of natural gulch vegetation, and 21.4 ha (53 ac) of existing or enhanced natural landscape will be dedicated for native plants. Table 6 identifies the elements unique to each conservation sub-area. The boundaries of the Native Plant Preservation Area encompass the highest density of uncommon native and indigenous plants found at Honua'ula by SWCA botanists (SWCA 2009a).

The Native Plant Preservation Area and other Native Plant Areas will encompass several archaeological complexes, historic walls, trail systems, and drainage gulches. The trail systems will be enhanced to promote access for management activities, education and outreach, and traditional and customary native Hawaiian practices. An additional 6.9 ha (17 ha) of land will be dedicated as 'outplanting areas' for landscaping with native dry shrubland species characteristic of the project area.

Table 6. The proposed native plant areas at Honua'ula. The approximate geographical extent of each area is illustrated in Figure 9.

Preservation and Conservation Designation	Approximate Area	Management Objective
Native Plant Preservation Area (The Easement)	8.9 ha (22 ac)	Easement protected in perpetuity and managed exclusively for preservation of the existing *kiawe-wiliwili* shrubland association
Native Plant Conservation Areas	9.3 ha (23 ac)	Ungraded conservation areas in which existing native plants are to be protected and managed as natural areas
Naturalized Landscape (Existing and Enhanced)	21.4 ha (53 ac)	Areas for conservation of existing native vegetation
Natural Gulches	11.3 ha (28 ac)	Natural drainage gulches will be left undisturbed and existing native vegetation will remain intact
Outplanting Areas for Native Plants	6.9 ha (17 ac)	Areas dedicated to the propagation of native plants
TOTAL AREA	**57.8 ha (143 ac)**	**Areas set aside for native plants**

6.1 Native Plant Preservation Area

The proposed Native Plant Preservation Area (i.e. the Easement) at Honua'ula will consist of a conservation easement 8.9 ha (22 ac) in area located in the central southern portion of the property. The Native Plant Preservation Area encompasses the highest densities of the rarest elements of the native vegetation within the project parcel (SWCA 2009a), and complies with the 7.3-52.6 ha (18-130 ac) directive imposed by the Maui County Council. The scope of the Native Plant Preservation Area will be set forth in an agreement between Honua'ula Partners, LLC and the County that shall include: 1) a commitment from Honua'ula Partners, LLC, its successors and permitted assigns, to protect and preserve the Native Plant Preservation Area for the protection of native Hawaiian plants; 2) use of the Native Plant Preservation Area will be confined to activities consistent with the purpose and intent of the Native Plant Preservation Area; and 3) no development other than fences, trails, and structures for the maintenance needed will be allowed within the Native Plant Preservation Area.

Title to the Native Plant Preservation Area will be held by Honua'ula Partners, LLC, its successors and permitted assigns, or conveyed to a land trust that holds other conservation easements. Access to the area will be permitted pursuant to an established schedule specified in the Conservation / Preservation Plans to organizations on Maui dedicated to the preservation of native plants, to help restore and perpetuate native species and to engage in needed research. These organizations[2] may enter the Native Plant Preservation Area at reasonable times for cultural and educational purposes only. Native plant species that occur in the preservation area and the estimated number of individuals of each species are listed in Table 7.[3] The goals and management objectives for the Native Plant Preservation Area are found in Section 7 of this document.

Table 7. The number of existing native plants that will be protected in all conservation areas at Honua'ula (2009a). This does not include the number of native plants that can be propagated within the Property.

Species (Hawaiian Name)	Total Number of Individuals Protected (Seedlings + Adults)
GROUP 1	
Argemone glauca (pua kala)	211
Canavalia pubescens ('āwikiwiki)	5
Capparis sandwichiana (maiapilo)	179
Erythrina sandwicensis (wiliwili)	874
Lipochaeta rockii (nehe)	36
Plumbago zeylanica	163
Senna gaudichaudii (kolomona)	12
Sicyos hispidus ('ānunu)	51
Sicyos pachycarpus ('ānunu)	393
GROUP 2	
Doryopteris decipiens ('iwa'iwa)	27
Myoporum sandwicense (naio)	7
GROUP 3	
Boerhavia sp. (alena)	18
Dodonaea viscosa ('a'ali'i)	3
Heteropterus contortus (pili grass)	686
Ipomoea tuboides	1

Regardless of the areal extent of a Native Plant Preservation Area, there is no guarantee that the best possible conservation efforts and best management practices will perpetually protect all plant species in the same numbers currently found within the Property. However, SWCA believes that the immediate management concerns for the Native Plant Preservation Area include: 1) elimination of browsing, grazing, and trampling pressure on native plants by feral ungulates, 2) removal of noxious invasive plant and animal species, and 3) protection against wildland fires.

[2] Organizations wishing access to the easement should apply with the Preserve Natural Resource Manager.
[3] The actual number of individuals of each species within the Native Plant Preservation Area will be determined when the preserve is delineated. Therefore, these numbers may change due to minor design changes or seasonal changes in the plant populations.

6.2 Native Plant Conservation Areas

Native Plant Conservation Areas will be located throughout the Property adjacent to both the golf course and the Native Plant Preservation Area, and will include existing drainage gulches. These areas will not be graded or disturbed so that existing native vegetation can be conserved and integrated as native species landscaping. This will help ensure the long-term genetic viability and survival of the native dry shrubland species and enhance long-term population growth (Groom 2001, Maschinski 2006). The Native Plant Preservation Area and Native Plant Conservation Areas are intended to serve as the seed source for plant propagation efforts on the property. The boundaries are illustrated in Figure 9. Native plants that occur in the conservation areas and the estimated number of individuals of each species are listed in Table 8.

When considered together with the other conservation measures identified for plants and wildlife (SWCA 2009a, 2009B), the Native Plant Preservation Area, the Native Plant Conservation Areas, and the other Native Plant Areas will make an important and valuable contribution to the long-term viability of remnant mixed *kiawe-wiliwili* shrubland associations in southeastern Maui.

7.0 MANAGEMENT OBJECTIVES

The following management objectives were designed to achieve the goals mentioned above.

Management Objective 1: Delineate the Boundaries of the Honua'ula Native Plant Preservation Area and Native Plant Conservation Areas.

Prior to construction, the boundaries of the Native Plant Preservation Area and Native Plant Conservation Areas adjacent to the Native Plant Preservation Area will be delineated with orange plastic construction fencing. This barrier will minimize trampling and damage to native plants during construction activities. Eventually, this fencing will be replaced with stone walls using material from the site to delineate the Native Plant Preservation Area and Native Plant Conservation Areas. In addition, a briefing will be conducted with construction personnel prior to construction activities to emphasize the importance of not entering the fenced areas.

Management Objective 2: Fund and Hire a Natural Resources Manager.

A Natural Resources Manager will be required to properly implement the goals and objectives of the *Honua'ula Conservation and Stewardship Plan* which includes the Animal Management Plan. The Natural Resources Manager will be responsible for implementing the management objectives described in this plan, including but not limited to, conducting public outreach, supporting plant propagation efforts and scientific research, and controlling and eradicating invasive plant species. The Natural Resources Manager will also need to work cooperatively with government and non-governmental conservation agencies including the Maui Invasive Species Council (MISC), Leeward Haleakala Watershed Alliance, DLNR, and other organizations.

The qualifications for the Natural Resources Manager shall include: a) Education: Bachelor's degree from an accredited four (4) year college or university in biological sciences or related field (e.g. Botany, Environmental Sciences, Planning); b) Experience: At least two (2) years of experience dealing with natural resources in Hawai'i; experience should include the organization and supervision of public service groups and the execution of education and outreach programs; c) Knowledge, Skills, and Abilities: Working knowledge of Hawaiian biota and threats from non-native invasive species, including the ability to identify native Hawaiian plants and non-native invasive plants; ability to read maps and aerial photographs; knowledge of herbicide use and weed control techniques; and d) Physical Demands: Ability to lift and carry at least 50 pounds, and work in hot and relatively dry climates.

Management Objective 3: Eliminate Browsing, Grazing, and Trampling By Feral Ungulates.

The entire perimeter of the project parcel has already been fenced to exclude feral ungulates from the *kiawe-wiliwili* shrubland. In accordance with DLNR stipulations, this will be replaced with an ungulate proof fence to exclude non-native deer, goats, and cattle from damaging native plants. The fence will be made of rust resistant, galvanized steel materials and will be approximately 8 feet height with a mesh size of no more than 6 inches. Ungulates trapped within fenced area shall be removed from the project area in a humane manner to allow regeneration of native plants.

Management Objective 4: Remove and Manage Noxious Invasive Plants.

Honua'ula Partners, LLC will implement a program to control and eradicate invasive grasses, weeds, and other non-native plants from the Native Plant Preservation Area and Native Plant Conservation Areas *with the exception of* the non-native tree tobacco (*Nicotiana glauca*), which is a recognized host plant for the endangered Blackburn's sphinx moth. Potential weed control techniques include manual, mechanical, and chemical measures, or a combination of these techniques. Specific species to be targeted include lantana, *koa haole*, guinea grass, and alien fire-prone grasses.

In addition, the Nature Resources Manager will establish a protocol to avoiding the introduction of new invasive plants or spread of existing plants. This protocol may include inspecting plants for outplanting, and making sure clothes and tool are free of weed propagules. The Natural Resources Manager will also collaborate with the landscape designers for the golf course and the residential areas to ensure that the ornamental plants being used for landscaping are not likely to become invasive within the Native Plant Preservation Area or Native Plant Conservation Areas.

Management Objective 5: Protect and Augment All Native Plants Within the Native Plant Preservation Area.

In addition to building features or physical barriers (stone walls, fences, etc) to protect the Native Plant Preservation Area from further disturbance, Honua'ula Partners, LLC will augment existing native populations by seeding, outplanting nursery grown native plants, or transplanting native plants from un-protected areas in the project area.

The Natural Resources Manager will implement a program to translocate scattered rare native plants occurring outside of the Native Plant Preservation Area and Native Plant Conservation Areas (e.g. *nehe*) to appropriate areas within the boundaries of the Native Plant Preservation Area or other Native Plant Areas. The Natural Resources Manager will be responsible for improving habitat conditions, as needed, to augment the health of rare plants in the Native Plant Preservation Area, Native Plant Conservation Areas, and other Native Plant Areas. This may include the use of supplemental shade, watering, mulching, or fertilizer, as deemed appropriate by the Natural Resources Manager.

Furthermore, at the discretion of the Natural Resources Manager, propagated native dry forest plants will be out-planted into the Native Plant Preservation Area and Native Plant Conservation Areas, as appropriate. Because the primary focus of the Native Plant Preservation Area is restoration, not gardening, supplemental shade, watering, mulching, or fertilizer will be primarily limited to the establishment period.

Management Objective 6: Create a Plant Propagation Effort.

The Natural Resources Manager will work with native plant propagators in the community to help facilitate a native plant propagation program. Selective seeds and cuttings will be collected from native plants found within *Honua'ula* to be stored outside the natural environment (i.e. seed banks), and for use in plantings in the project area, as well as at protected areas such as Pu'u O Kali. The success of this effort depends largely on the availability of *fresh, viable* seeds. Proper techniques for cleaning and preparing seeds will be followed to induce dormancy for storage (TNC 1997). The services of native Hawaiian plant experts and nurseries such as Anna Palomino of Ho'olawa Farms and Matt Schirman of Hui Ku Maoli Ola will also be sought to assist with seed banking and propagation efforts. This may require the installation of temporary irrigation systems to facilitate initial propagation efforts.

A multi-species Habitat Conservation Plan (HCP), to include the candidate endangered *'awikiwiki* will be prepared under Section 10(a)(1)(B) of the Endangered Species Act and in collaboration with DLNR and USFWS.

Management Objective 7: Attempt Propagation and Outplanting of Native Host Plants for the Blackburn Sphinx Moth.

Despite its importance to the endangered Blackburn's sphinx moth, the non-native tree tobacco is not an ideal species to maintain within the Native Plant Preservation Area. The Hawaii Weed Risk Assessment gave it a score of 15 indicating that it is a high risk invasive species, primarily due to its prolific seed production, environmental versatility, and toxicity to humans and cattle (http://www.botany.hawaii.edu/faculty/daehler/WRA/full_table.asp).

Because the intent of the Native Plant Preservation Area is to protect valuable native plant species, consideration is being given to propagating native *'aiea* (*Nothocestrum latifolium*) in this area to replace the non-native tree tobacco. The ultimate outcome of this effort is unknown because the project area is lower in elevation than the average distribution reported for the species by Wagner et al. (1999) (Palomino, personal communication). According to Palomino (personal communication) *N. latifolium* has been successfully grown at the Ho'olawa Farms nursery (60 m or 200 ft elevation) until it is about 8 inches in height. However, at this point it is out-planted to higher elevation sites. The lowest elevation at which Palomino (personal communication) is aware that adult *'aiea* thrive is near 457 m (1,500 ft) at Kanaio, so this may not be a valid option for the low elevation Native Plant Preservation Area at Honua'ula.

If *'aiea* becomes established within the Native Plant Preservation Area and is used by the Blackburn sphinx moth, then non-native tobacco trees will be removed. Removal of non-native tree tobacco will only occur in the season when Blackburn sphinx moths are underground. Precautions will be taken to ensure pupae are not harmed (Duvall, personal communication). Expanding existing wild populations of the host plant *'aiea* is a recovery objective of the *Recovery Plan for Blackburn's Sphinx Moth* (2005). The multi-species Habitat Conservation Plan (HCP) discussed in the previous paragraph will also contain the requirements of the endangered Blackburn's sphinx moth and develop long-term management and protection programs aimed at minimizing incidental take and enhancing recovery of the species.

Management Objective 8: Protect Native Plants and Animals Against Wildland Fires.

Honua'ula Partners, LLC will implement a fire control program to help protect the Native Plant Areas to help insure the success of plant propagation and conservation efforts. This program will include the creation of a fire break immediately outside of the perimeter of the Native Plant Preservation Area at least 6 m (20 ft) wide. The proposed golf course which will abut a portion of the Native Plant Preservation Area and Native Plant Conservation Areas will also act as a fire break to protect native plants. In addition, non-native grasses which augment fuel biomass, will be controlled from inside of the area. It will be the responsibility of the Natural Resources Manager to develop and finalize the fire control plan in coordination with resource agencies and fire department officials.

Management Objective 9: Remove and Manage Non-Native Seed Predators.

The Natural Resources Manager will design and implement a predator control program for rats, mice, and other predators within the Native Plant Preservation Area and Native Plant Conservation Areas that prey on native plant seeds and seedlings. This program may include the use of bait stations containing diphacinone or other rodenticides, as well as traps. The program will be developed through coordination with U.S. Department of Agriculture (USDA) Animal Damage Control and DLNR staff. State Department of Health (DOH) best management practices will be implemented.

Management Objective 10: Develop and Implement a Scientific Monitoring Program.

The Natural Resources Manager shall work with the USFWS, DLNR, and others as appropriate to conduct a detailed scientific inventory and monitoring program. The purpose of the monitoring will be to establish an accurate baseline to evaluate the efficacy of management activities, determine if the goals of this plan are being achieved, and identify impending threats to the Native Plant Preservation Area. This program will monitor annual survival rates, natural reproduction, sign of herbivory, abundance of invasive species, and accurately mapping native species, as appropriate.

Management Objective 11: Utilize Appropriate Native Plant Landscaping in Areas Outside the Native Plant Preservation Area and the Native Plant Conservation Areas.

Honua'ula Partners, LLC will landscape common areas with native plant species to the maximum extent practicable. Preference will be given to xeric species (i.e. plants that require minimal irrigation and are tolerant of dry conditions); however, all plants native to the geographic area should be considered as potential species for use in landscaping. Honua'ula Partners, LLC will also conserve as many of the *wiliwili* trees as possible outside the Native Plant Preservation Area and the Native Plant Conservation Areas to be managed as landscaping. This management objective is fully consistent with the spirit of Maui County Council Resolution 00-24: Recognizing the Threat of Invasive Alien Plant Species to the Ecosystems, Native Forests and High Quality Watersheds.

Management Objective 12: Manage the Native Plant Preservation Area With the Cooperation of Stakeholders.

Honua'ula Partners, LLC will attempt to involve a wide range of stakeholders in the management of the Native Plant Preservation Area. The Natural Resources Manager will work with the University of Hawai'i, Maui Invasive Species Council, Leeward Haleakala Watershed Alliance, State DLNR, and others, as appropriate, to conduct detailed scientific inventories and monitoring programs to develop an accurate baseline and ongoing monitoring to evaluate the efficacy of management activities and identify imminent threats to the Native Plant Preserve Area. Honua'ula Partners, LLC will make an effort to continually disseminate useful information to all stakeholders.

Management Objective 13: Develop a Public Education and Outreach Program.

Honua'ula Partners, LLC will implement an education and outreach program open to the local community and the general public at large. This program will be coordinated by the Natural Resources Manager and would involve sponsoring service trips to assist with management activities, field trips for island students, and developing interpretive signage to encourage public cooperation and discourage trespassing through the Native Plant Preservation Area and other Native Plant Areas.

Management Objective 14: Incorporate Adaptive Management Principals.

To accommodate for uncertainty inherit in natural systems, Honua'ula Partners, LLC will adopt an active adaptive management approach. In this approach, information that is gathered during the monitoring program will influence and improve future management practices. According to USFWS policy [see 65 Fed. Reg. 35242 (June 1, 2000)], adaptive management is defined as a formal, structured approach to dealing with uncertainty in natural resources management, using the experience of management and the results of research as an on-going feedback loop for continuous improvement. Adaptive approaches to management recognize that the answers to all management questions are not known and that the information necessary to formulate answers is often unavailable. Adaptive management also includes, by definition, a commitment to change management practices when determined appropriate.

8.0 FUNDING

In accordance with the County of Maui Phase I Conditions, title to the Native Plant Preservation Area will be held by Honua'ula Partners, LLC, its successors and permitted assigns, or be conveyed to a land trust that holds other conservation easements. Honua'ula Partners, LLC shall receive all tax benefits allowable under tax laws applicable the easement (Native Plant Preservation Area) at the time the easement is established. Honua'ula Partners, LLC, its successors and permitted assigns will also apply for additional programmatic funding from existing programs managed by the USFWS and DLNR to share in the conservation of natural resources. These include, but may not be limited to, the Forest Stewardship Program, Forest Land Enhancement Program, Landowner Incentive Program, and Natural Area Partnership Program of the Hawaii DLNR; and the Conservation Partnership Program and Habitat Conservation Planning Assistance programs of the USFWS.

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Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Aspleniaceae						
Nephrolepis multiflora (Roxb.) F.M. Jarrett ex. C.V. Morton	sword fern	X	C	*		*
MONOCOTS						
Agavaceae						
Furcraea foetida (L.) Haw.	*malina*	X	S			*
Cannaceae						
Canna indica L.	indian shot	X	C	*		
Commelineaceae						
Commelina benghalensis L.	hairy *honohono*	X	C, S	*	*	*
Commelina diffusa N.L. Burm.	blue day flower	X	C	*	*	
Liliaceae						
Crinum sp.	crinum	X	C	*		
Yucca sp.	yucca	X	C	*		
Poaceae						
Bothriochloa pertusa (L.) A. Camus	hurricane grass	X	C	*	*	
Brachiara subqudripa (Trin.) A.S. Hitchc	brachiara	X	C	*		
Cenchrus ciliaris L.	buffelgrass	X	C, S			*
Cenchrus echinatus L.	sandbur	X	C	*		

APPENDIX A

CHECKLIST OF PLANTS REPORTED FROM HONUA'ULA

Checklist includes plants reported from Honua'ula by Char and Linney (1988), Char (1993, 2004), Altenberg (2007), and SWCA (this study). Plant names appear alphabetically by family and then by species into each of three groups: Ferns and Fern Allies (Pteridophytes), Monocots, and Dicots. The taxonomy and nomenclature of the flowering plants are based on Wagner et al. (1999), Wagner and Herbst (1999), and Staples and Herbst (2005). Recent name changes are those recorded in the Hawaii Biological Survey series (Evenhuis and Eldredge, eds, 1999-2002). The list includes scientific name with author citation, common English and/or Hawaiian name(s), biogeographic status, and location within the three dominant vegetation types at Honua'ula.

KEY to biographic status:
- E = endemic (occurring only in the Hawaiian Islands);
- I = indigenous (native to the Hawaiian Islands and elsewhere);
- X = introduced or alien (all those plants brought to the Hawaiian Islands after 1778).

KEY to vegetation types:
- KB = *kiawe*-buffelgrass grassland;
- MG = mixed gulch-vegetation;
- KW = mixed *kiawe-wiliwili* shrubland.

KEY to surveys:
- C = Char and Linney (1988), Char (1993), Char (2004);
- A = Altenberg (2007);
- S = SWCA (2008 - this study).

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
PTERIDOPHYTES						
Adiantaceae						
Adiantum capillus-veneris L.	maiden-hair fern	I	C		*	
Doryopteris decipiens (Hook.) J. Sm.	*'iwa'iwa*	E	C, A, S	*	*	*
Pellaea ternifolia (Cav.) Link	*pellaea*	I	C		*	*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Zoysia sp.	zoysia	X	C	*		
DICOTS						
Amaranthaceae						
Amaranthus spinosus L.	spiny amaranth	X	C, S	*	*	*
Asclepiadaceae						
Asclepias physocarpa (E.Mey.) Schltr.	balloon plant	X	C, S	*		*
Stapelia gigantea (N.E. Brown)	zulu giant	X	S			*
Asteraceae						
Ageratum conyzoides L.	*maile hohono*	X	C, S	*	*	*
Bidens cynapiifolia Kunth	beggar tick	X	C, S	*	*	*
Bidens pilosa L.	Spanish needle	X	C, S	*	*	*
Calyptocarpus vialis Less.	straggler daisy	X	C, S			*
Centaura melitensis L.	star thistle	X	S			*
Cirsium vulgare (Savi) Ten.	bull thistle	X	S			*
Conyza bonariensis (L.) Cronq.	hairy horseweed	X	C	*		
Conyza canadensis (L.) Cronq.	horseweed	X	C, S	*		*
Crassocephalum crepidioides (Benth.) S.Moore		X	C, S	*	*	*
Emilia fosbergii Nicolson	red *pualele*	X	C	*		*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Chloris barbata (L.) Sw.	swollen finger grass	X	C, S	*	*	*
Chloris radiata (L.) Sw.	plush finger grass	X	C	*	*	*
Cynodon dactylon (L.) Pers	*manienie*	X	C, S	*		*
Digitaria ciliaris (Retz.) Koeler	Henry's crab grass	X	C	*		
Digitaria insularis (L.) Mez ex Ekman	sour grass	X	C, S	*	*	*
Digitaria radicosa (Presl.) Miq.	digitaria	X	C	*		
Digitaria sp.	crab grass	X	C	*		
Eleusine indica (L.) Gaertn.	goose grass	X	C	*	*	*
Eragrostis cilianensis (All.) Vign. ex Janchen	stink grass	X	C	*	*	
Eragrostis tenella (L.) Beauv. ex R. & S.	love grass	X	C	*		
Eragrostis sp.	eragrostis	X	C	*		
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	*pili* grass	E	C, A, S	*	*	*
Panicum maximum L.	guinea grass	X	C, S	*	*	*
Panicum torridum Gaud.	*kakonakona*	E	C			*
Rhynchelytrum repens (Willd.) Hubb.	natal red top	X	C, S			*
Setaria verticillata (L.) P. Beauv.	*mau'u pilipili*	X	C	*	*	*
Tragus berteronianus J.A. Schultes	goat grass	X	C	*	*	*
Urochloa subquadripara (Trin.) R. Webster	signal grass	X	C	*		

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Cactaceae						
Opuntia ficus-indica (L.) Mill.	*panini*	X	C, S	*	*	*
Pilocereus royenii (L.) Byles & Rowley	Royen's tree cactus	X	S			*
Capparaceae						
Capparis sandwichiana DC.	*malapilo*	E	C, A, S			*
Cleome gynandra L.	spider flower	X	C	*		*
Caryophyllaceae						
Polycarpon tetraphyllum (L.) L.		X	C	*	*	
Chenopodiaceae						
Chenopodium carinatum R.Br.		X	C, S	*	*	*
Chenopodium murale L.	*aheahea*	X	C, S	*	*	*
Convolvulaceae						
Dichondria repens J. R. & G. Forst.		X	C	*		
Ipomoea indica (J. Burm.) Merr.	*koali awahia*	I	C, A, S	*	*	*
Ipomoea obscura (L.) Ker Gawl.	yellow bindweed	X	C, S	*		
Ipomoea tuboides (Degener & Ooststr.)	Hawaiian moon flower	E	C, A, S			*
Merremia aegyptia (L.) Urb.		X	C, S	*	*	*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Galinsoga parviflora Cav.		X	C	*	*	
Gnaphalium cf. *japonicum* Thunb.	cudweed	X	C	*	*	
Hypochoeris sp. L.	cat's ear	X	C	*	*	*
Lactuca serriola L.	prickly lettuce	X	C, S			*
Lipochaeta rockii Sherff	*nehe*	E	C, A, S			*
Parthenium hysterophorus L.	false ragweed	X	S			*
Sigesbeckia orientalis L.		X	C	*	*	
Sonchus asper (L.) J. Hill	spiny snowthistle	X	C	*	*	*
Sonchus oleraceus L.	*pualele*	X	C, S	*	*	*
Sphagneticola trilobata (L.) Pruski	wedelia	X	S			*
Synedrella nodiflora (L.) Gaertn.	node weed	X	C	*	*	*
Tridax procumbens L.	coat buttons	X	C, S	*	*	*
Verbesina encelioides (Cav.) Benth. & Hook	golden crown beard	X	C, S	*	*	*
Xanthium strumarium L. var. *canadense* (Miller)	cocklebur	X	C	*	*	*
Zinnia peruviana (L.) L.	wild zinnia	X	C, S	*	*	*
Brassicaceae						
Cornopus didymus (L.) Sm.	wart cress	X	C	*		

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Chamaecrista nictitans (L.) Moench	partridge pea	X	C, S	*		*
Crotalaria incana L.	fuzzy rattlepod	X	C	*		
Crotalaria pallida Alton	smooth rattlepod	X	C	*		
Desmanthus virgatus (L.) Willd.	virgate mimosa	X	C, S	*		*
Desmodium tortuosum (Sw.) DC.	beggar weed	X	C			*
Erythrina sandwicensis O.Deg.	*wiliwili*	E	C, A, S	*	*	*
Indigofera suffritocosa Mill.	*iniko*	X	C, S	*		*
Leucaena leucocephala (Lam.) de Wit	*koa haole*	X	C, S	*	*	*
Macroptilium lathyroides (L.) Urb.	wild bean	X	C, S	*		*
Prosopis pallida (Humb. & Bonpl. Ex Willd.) Kunth	*kiawe*	X	C, S	*	*	*
Samanea saman (Jacq.) Merr	monkey pod	X	C	*		
Senna alata (L.) Roxb	candle bush	X	C	*		
Senna gaudichaudii (Hook. & Arn.) H.S.Irwin & Barneby	*kolomona*	I	C, A, S		*	*
Senna occidentalis (L.) Link	coffee senna	X	C			*
Lamiaceae						
Ocimum basilicum L.	sweet basil	X	C, S	*		*
Ocimum gratissimum L.	basil	X	C, S	*	*	*
Leonotis nepetifolia (L.) R. Br.	lion's ear	X	S			*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Cucurbitaceae						
Cucumis dipsaceus (Ehrenb. ex Spach	wild cucumber	X	C, S	*		*
Momordica charantia L.	bitter melon	X	C, S	*	*	*
Sicyos hispidus Hillebr.	*'anunu*	E	C, A, S			*
Sicyos pachycarpus Hook. & Arnott	*'anunu*	E	A, S			*
Euphorbiaceae						
Chamaesyce celastroides var. lorifolia (A. Gray) Degener & I. Degener	*'akoko*	E	A			*
Chamaesyce hirta (L.) Millsp.	hairy spurge	X	C, S	*	*	*
Chamaesyce hypercifolia (L.) Millsp.	graceful spurge	X	C	*		
Euphorbia heterophylla L.	*kaliko*	X	C, S	*	*	*
Phyllanthus tenellus Roxb.		X	C, S	*		
Ricinus communis L.	castor bean	X	C, S	*	*	*
Fabaceae						
Acacia farnesiana (L.) Willd.	klu	X	C, S		*	*
Bauhinia blakeana Dunn	orchid tree	X	C	*		
Calopogonium mucunoides Desv.		X	C			*
Canavalia pubescens Hook. & Arnott	*'āwikiwiki*	E	C, A, S			*
Cassia fistula L	golden shower	X	C	*		

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Nyctaginaceae						
Boerhavia coccinea Mill.		X	C	*		
Boerhavia acutifolia (Choisy) J.W.Moore	*alena*	I	S			*
Boerhavia herbstii Fosb.	*alena*	E	A			*
Boerhavia repens L.	*alena*	I	C, S			*
Mirabilis jalapa L.	four-o' clock	X	C			*
Oxalidaceae						
Oxalis corniculata L.	wood sorrel	X	C, S	*	*	
Papavaraceae						
Argemone glauca (Nutt. Ex Prain (Pope)	*pua kala*	E	A, S			*
Argemone mexicana L.	prickly poppy	X	C, S			*
Bocconia frutescens L.		X	S			*
Eschscholzia californica Cham.	California poppy	X	S			*
Passifloraceae						
Passiflora foetida L.	love-in-a-mist	X	C	*		*
Passiflora subpeltata Ort.	passion flower	X	C, S			*
Plumbaginaceae						
Plumbago zeylanica L.	*'ilie'e*	I	C, A, S	*	*	*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Stachys arvensis L.	stagger weed	X	C	*	*	*
Malvaceae						
Abutilon grandifolium (Willd.) Sweet	*ma'o*	X	C, S	*	*	*
Abutilon incanum (Link.) Sweet	hoary abutilon	I	C, A, S	*	*	*
Malva parviflora L.	cheese weed	X	C, S	*	*	*
Malvastrum coromandelianum (L.) Garcke	false mallow	X	C	*	*	*
Sida fallax Walp.	*'ilima*	I	C, A, S	*	*	*
Sida rhombifolia L.		X	C	*		
Meliaceae						
Melia azedarach L.	Chinaberry	X	S			*
Moraceae						
Ficus elastica Roxb.ex Hornem	rubber tree	X	C	*		
Ficus microcarpa L. f.	Chinese banyan	X	C, S	*	*	
Myoporaceae						
Myoporum sandwicensis A. Gray	*naio*	E	C, A, S			*
Myrtaceae						
Psidium guajava L.	guava	X	C	*		

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Sterculiaceae						
Waltheria indica L.	*'uhaloa*	I	C, A, S	*	*	*
Tiliaceae						
Triumfetta semitriloba Jacq.	Sacramento bur	X	C, S			*
Verbenaceae						
Lantana camara L.	Sacramento bur	X	C, A, S	*	*	*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Polygonaceae						
Antigonon leptopus H. & A.	coral vine	X	C	*		
Portulacaceae						
Portulaca oleracea L.	pigweed	X	C, S	*	*	*
Portulaca pilosa L.	*'akulikuli*	X	C, S	*	*	*
Primulaceae						
Anagallis viscosa L.	scarlet pimpernel	X	C	*	*	*
Sapindaceae						
Dodonaea viscosa Jacq.	*'a'ali'i*	I	C, A, S			*
Solanaceae						
Capsicum annum L.	chili pepper	X	C, S	*		
Datura stramonium L.	jimson weed	X	C	*	*	*
Lycopersicon pimpinellifolium (Jusl.)	currant tomato	X	C, S	*	*	*
Nicandra physalodes (L.) Gaertn.	apple of Peru	X	C	*	*	*
Nicotiana glauca R.C. Graham	tree tobacco	X	C, S	*	*	*
Solanum americanum Mill.	*popolo*	I	C, S	*	*	*
Solanum seaforthianum Andrews		X	S			*

APPENDIX B

ANIMAL MANAGEMENT PLAN FOR HONUA'ULA

1.0 BACKGROUND

Located some 3,100 mi (5,000 km) southwest of the nearest continental landmass, the Hawaiian Islands are among the most isolated and youngest islands in the world. The former high islands in the extreme northwestern portion of the archipelago (now seamounts) are perhaps 60-90 million years old, Kaua'i is roughly 5.5 million years old, and volcanism is still building the Island of Hawai'i today (Juvik and Juvik 1998). All of Hawai'i's native biota originated from sources outside the archipelago (Ziegler 2002). Representatives of various taxonomic groups arrived infrequently from diverse regions throughout the Pacific Rim. As a result, the biota is considered disharmonic, that is, it lacks many groups of organisms represented on continental landmasses. Many of the founding populations radiated and diversified over a broad range of ecological niches in a relatively short period of time (Gagne and Christiansen 1985). The uniqueness of the endemic island biota contributed to its vulnerability, particularly to significant habitat disturbances and the impacts of invasive species (Cuddihy and Stone 1990, Clements and Daehler 2007).

Invasive species are non-native species that have an economic and/or environmentally adverse affect on the ecosystems they invade (Pattison et al. 1998). More than 50,000 species of plants, animals, and microbes have been introduced into the United States and some $120 billion in damages and control costs associated with invasive species are incurred yearly (Pimentel 2007). Further, invasive species are responsible for more native species extinctions than any other threat (Pimentel 2007). Inhabited islands are frequently at greatest risk of exposure to invasive species because of the volume of commodities imported and high level of tourist visitation for those seeking the ideal island-getaway (Van Driesche and Van Driesche 2004). Once established, invasive species are costly and difficult (often impossible) to remove. Establishment frequently incurs enormous expense to human enterprises, biodiversity, and ecosystem health (Schofield 1989, Myers et al. 2000). Introductions to islands not adapted to their presence can disturb the predator/prey balance because native plants and animals usually lack suitable defense mechanisms, escalating their vulnerability to predation (Dickman 1996, Fritts and Rodda 1998). Invasive species can also be vectors for pathogens and disease to humans and other wildlife (Geering et al. 1995, Dickman 1996).

The Hawaiian Islands are a notable example of invasion potential and success with the introduction of a large number of non-native flora and fauna over the past century. There are almost 3,000 established, invasive flora and fauna species in the Hawaiian Islands (Vitousek et al. 1997). Maui, situated in the middle of the island chain is certainly not immune to invasive species where they pose serious threats to the island (e.g., Miconia (*Miconia calvescens*), fountain grass (*Pennisetum setaceum*), pampas grass (*Cortaderia jubata*), ivy gourd (*Coccinia grandis*), coqui frog (*Eleutherodactylus coqui*), and veiled chameleon (*Chamaeleo calyptratus*) (MISC 2009).

Domestic goats (*Capra hircus*), were deposited in the Hawaiian Islands by British captains Cook and Vancouver, and were well know in Hawai'i by 1973. By 1910, they were recognized as a serious threat to native vegetation and land cover (Tomich 1986). Axis deer (*Axis axis*) were first released in Hawai'i on Moloka'i Island in January 1868, but were not introduced to Maui until 1959. The release point was located on Pu'u O Kali near 457 m (1500 ft) elevation (Tomich 1986). By 1968, the Maui population was estimated to be 85-90 animals (Kramer 1971). By 1995, the population on the 'Ulupalakua Ranch alone was >500 (Waring 1996). The highest numbers occur nearest the original release site and extend southward around the leeward side of the island. Year-round hunting is now permitted. Small and easily domesticated Polynesian pigs (*Sus scrofa*) were already common throughout Kaua'i in 1778 (Cook 1785). Tomich (1986) suggests that the Polynesian pigs were gradually replaced by stocks of European origins which are considerably larger in size. The first cattle (*Bos taurus*) were released on Hawai'i Island in 1793 by the English navigator George Vancouver.

These four introduced ungulates are among the leading causes for the decline of Hawai'i's natural ecosystems (Reeser and Harry 2005). Their grazing, browsing, wallowing, and rooting result in land erosion; stream and reef siltation; loss of native, threatened, and endangered plant and animal species; and degradation of native species' habitat (Nowak 1999, Reeser and Harry 2005). They can also be vectors for invasive plants (Stone et al. 1992); and their rooting behavior creates shallow basins which, when flooded, provide habitat for mosquitoes (Atkinson et al. 2005). The damage to Hawai'i's unique ecosystems after the arrival of Western man in 1778, led Zimmerman (1970) to his prescient conclusion that Hawai'i's "...mountains are being washed back into the sea whence they came."

There have been no formal studies of the ungulate populations within the Honua'ula area; however, the Division of Forestry and Wildlife (DOFAW) stated that "herds of Axis deer in numbers upward of 100" were found in the vicinity of Wailea 670 (DOFAW 2000).

2.0 PURPOSE OF THE PLAN

This Animal Management Plan (AMP) outlines the options for managing unwanted non-native deer, goats, cattle, and pigs at Honua'ula. The plan focuses on the proposed Native Plant Preservation Area, as proposed to meet the requirements of the Project District Phase 2 Master Plan, December 1, 2009. This area was identified as the priority for ungulate management because it contains within its boundaries the highest priority native plant species documented during extensive botanical surveys (SWCA 2009a). The AMP is also being developed in response to recommendations by the Division of Forestry and Wildlife (DOFAW), Hawaii Department of Land and Natural Resources (DLNR) dated August 3, 2000 and March 31, 2009 for fencing to preclude ungulates from entering the Property (Appendix C) and creating a nuisance to golf courses, residents, and native vegetation.

The intent of this Animal Management Plan is to protect the native plants within the Native Plant Preservation Area by addressing the primary threats to their survival and reproduction, and to reduce the nuisance created by non-native ungulates that stray onto golf courses, private lawns, and commercial spaces, and public parks. The AMP consists of four basic actions: fencing; removal of ungulates from the Native Plant Preservation Area, the Native Plant Conservation Areas, and the areas to be developed; long-term fence maintenance; and occasional removal of ungulates that stray within the Property.

3.0 METHODS OF ANIMAL MANAGEMENT

Fences are constructed as physical barriers to impede ingress and/or egress in an area (Reeser and Harry 2005). Most ungulate fences are designed to inhibit entry to an area, but in some instances the aim is to contain them for easier lethal removal. Tipton (1977) and Katahira et al. (1993) demonstrated that to cause a decline in the number of pigs within an unfenced area with typical ingress rates requires removal of over 70 percent of its population per year.

The most cost effective method of mitigating ungulate impacts at Honua'ula is to fence the northern, eastern, and southern boundaries of the 670 acre property with 7 ft-high deer fences; fence the Native Plant Preservation Area with hog wire, remove the ungulates from all areas, and then carry out restoration activities (i.e. propagation of native plants and removing other harmful alien plants and animals). The hog wire fence around the Native Plant Conservation Area may ultimately be replaced by a tradition lava rock wall. This approach is consistent with the recommendations of DOFAW (2000).

3.1 Fencing

Fencing has been tested as a control measure for feral ungulates, and has proven effective in a variety of locations, including Hawai'i Volcanoes and Haleakala National Parks (Stone 1985, Stone et al. 1992, Jacobi 1979, Katahira et al. 1993). A feral pig eradication program at Hawai'i Volcanoes National Park used containment to enclose nine management areas (total 30 mi^2 (78 km^2)) and successfully eradicated pigs in each (Katahira et al. 1993). In the same park, feral pigs were eradicated from fenced regions 0.4 - 7.3 mi^2 (1 - 19 km^2) in size by professional animal removal crews and snaring (Stone and Anderson 1988). Once boundary and barrier fencing was erected, organized control carried out by volunteers and paid personnel successfully removed 15,000 feral goats from a 100 mi^2 (260 km^2) area between 1970 and 1986 (Stone and Anderson 1988).

A properly constructed fence is humane and highly effective when appropriately maintained. However, no fence can ever be considered completely ungulate-proof. Given the right stimulus, some deer can JAMP an eight-foot fence and pigs can dig under a barrier (Z. Lopez, U.S. Air Force, personal communication). Additionally, not all targeted species can be contained or excluded by a standard or species-specific fence design. Some deer require 10-ft high (3 m) fences, but most are deterred by six to eight-ft (1.8 – 2.4 m) barriers (Barnes 1993, Anderson 1999). Pig fences are at least three-ft (0.9 m) high and require a guard such as barbed wire or an apron net to prevent forcing their way under the barrier (Long and Robley 2004). A woven-wire (hog wire) fence design (2.7 to 3.9 ft (0.8 – 1.2 m)) high, secured close to the ground with barbed wire extending out from the fence at ground level) has been successfully utilized for feral pig control (Stone and Anderson 1988).

In Hawai'i, four-ft (1.2 m) high hog wire has frequently been used for control of feral goats (HIDOFAW 2007). Fencing specifications suggested by Sailer (2006) for feral goats, feral pigs, and deer in Hawaii are outlined in Table 1. The type and condition of fencing material can impact susceptibility of animals to injury. Mesh size can dictate whether a horned animal is more or less likely to become trapped in the fence (Long and Robley, 2004). A damaged fence can not only allow access by species across the barrier, but provide a surface in which individuals can become snagged, caught, or injured. Double fences and plastic mesh can also be used but these may be impractical for Kaua'i's climatic conditions. Although electric fences are widely used in the mainland U.S. and Australia (Littauer 1997) they may not be practical at Honua'ula.

Table 1. Suggested standard fencing specifications for feral goats, feral pigs, and deer in Hawai'i. Adapted from Sailer (2006).

Target species	Minimum fence Height (in)	Graduated meshing	Fence skirting recommended	Electric top wire recommended
Goat	48" (1.2 m) (52" better) Slinky fence useful	Yes (no gaps at ground)	Yes 24"-36" (60-90 cm) as needed	No*
Deer	78" (2 m) (84" better) Slinky fence w/ barbed wire top useful	Yes	Yes	No*
Pig	42" (1.1 m) (48" better) Slinky fence useful	Yes (no gaps at ground)	Yes 24"-36" (60-90 cm) as needed in soft soils	No*

* Maintaining an uninterrupted power supply in remote, wet, stormy, and corrosive conditions decreases fence integrity and increases labor costs to maintain (E. Campbell, U.S. Fish and Wildlife Service, personal communication).

In addition to being effective over a long time period, fences can be cost-effective only if maintained. After the initial population "knockdown", they preclude the need for continuous, labor-intensive control inside a protected area. The lifespan of a fence can be considerably reduced by exposure to salt spray, high rain volume, and hurricanes. Although fencing can be costly and intrusive, most natural resource managers agree that it is necessary for effective feral ungulate control. Corrosion, storms, falling trees, and vandalism can affect the integrity of a fence, and lead to further disintegration. Once a fence is breached, considerable effort is needed to locate animals and restore barrier effectiveness. Ungulate fencing appears to be a viable option for ungulate control at Honua'ula.

In Hawai'i, ungulate fences may last less than five years where they are exposed to sulfur plumes and/or corrosive salt spray, or more than 20 years in open, high elevation slopes (DOFAW 2007). Without protection from ungulates, the abundance of native plants will continue to decline within the Property; while ungulate exclusion will lead to visible native species recovery, provided that competing invasive plants can be controlled or eradicated. At the Kanalo dry forest area on Maui native species have shown signs of recovery in as little as two years after ungulate exclusion (Jokiel and Dumaran 2002).

As of January 2007, the cost of typical ungulate fencing in Hawai'i ranged from $31-$87 per meter ($50,000-$140,000/mile) (DOFAW, 2007). However, prices obtained in 2009 from conservation practitioners for deer fences were higher at $111 per meter ($178,500/mile) (Fern Duvall, pers. comm.). Labor estimates from DOFAW (Fern Duvall, pers. comm.) and West Maui Mountain Watershed Partnership (Chris Brosius, West Maui Mountain Watershed Partnership, pers. comm.) ranged from $42-$84 per meter ($67,590-$135,180/mile), and materials range from $15-$20 per meter ($24,135-$32,180/mile) for goat and pig fencing, and $25-$34 per meter ($40,225-$54,706/mile) for deer fencing. For our purposes, we used $110 per meter ($176,990/mile) for deer fencing and $92 per meter ($148,028/mile) for goat and pig fencing, which includes materials and labor. We erred toward the conservative end of current price estimates, but material prices have been going up every few months so prices are approximate (Chris Brosius, West Maui Mountain Watershed Partnership, pers. comm.; Greg Czar, Feral Animal Removal Experts LLC, pers. comm.). Predator proof fences are also available that can exclude ungulates, cats, mongoose, rats, and mice, but costs may exceed $200 per meter ($321,800/mile). Final costs for fences will depend on specific decisions about materials, and construction methods.

3.2 Animal Removal

Once fences have been constructed it will be necessary to remove feral ungulates from the Property as quickly as possible. Various methods for the removal of feral ungulates have been employed in Hawaii and elsewhere on Pacific islands to protect native ecosystems and control soil loss (DOFAW 2007, SWCA 2009b). These include trapping, population control, population control with dogs or helicopters, driving, aerial control, snares, the use of radio collars (Judas method), and others. A general discussion of the pros and cons of each of these methods is presented in the following paragraphs.

3.2.1 Live Trapping

Live trapping using cage, box or corral traps allows animals to be taken alive. This provides the option of releasing captured individuals elsewhere, giving them away or humanely dispatching them at close range if necessary. Traps used in combination with other methods are useful tools, but as a sole method of control, they have limited success. Trapping has primarily been used for pig control but deer and goats may also be trapped.

By baiting the area around and inside the trap, capture success is greatly increased. If baited trapping can be timed to coincide with low food availability, take can be further increased (Barrett and Birmingham 1994). Pre-baiting allows individuals to freely wander into the traps to forage without getting caught. In Hawai'i, if traps were set during peak breeding seasons, the probability of catching family groups or roaming solitary males was increased (Katahira et al. 1993).

Corral traps work well if the target species congregate in an area. Corral traps need to provide adequate cover, food and water because they are usually deployed for extended time periods. By placing one or two decoy animals in the corral, others are attracted (Barrett and Birmingham 1994). Since corral traps are designed to attract as many individuals as possible and are set in one location for greater periods of time than other traps, the high localization of animals can cause damage to the environment in which the corral traps are set.

Trapping is particularly useful in areas where other methods are considered unsafe or unfeasible. These include urban and residential areas, where discharge of firearms is illegal or unsafe; or where the use of dogs conflicts with other land uses (Debernardi et al. 1995). Because traps are live capture, the animal is usually unharmed by the capture process and non-target animals caught can be released unharmed. If animals are to be being captured for relocation or fitting of radio transmitters, live trapping is necessary.

There are some disadvantages to live trapping. Traps can be logistically challenging and labor intensive to deploy. Even small ungulate traps can be heavy and cumbersome, requiring two or more people as well as trucks to deploy and maneuver. Traps must be checked regularly, cleared and refurbished with bait regularly. As with any trapped animal, there are safety concerns for those checking and releasing individuals. Trapping can be less cost effective than other methods because of higher labor and materials costs. For example, a box trap typically costs around $400.

Some estimates put the cost of trapping at approximately $54.00 per trap check including cost of labor, bait and trap (based on a trap lifespan of one year).

Different regions and species will require different baits. The process of discovering the optimum bait type and conditioning animals to take the bait in the presence of traps can be frustrating and time consuming. They can be less effective when food is plentiful (bait is less attractive). Animals may also escape from even well-built traps if frightened. Finally, there will always be a residual population that will be reluctant to enter traps; therefore, traps alone will not result in a zero population if total eradication is required.

3.2.2 Population Control

Animal population control through the use of firearms or archery to remove wildlife has been employed extensively as an ungulate management tool worldwide. Most animal control programs aim to significantly decrease or totally remove a species from specific areas. Typically animal control measures are carried out using shotguns (with slugs, particularly in small areas bounded by urbanization) and rifles. In sensitive habitats or close to infrastructure and human habitation where use of longer range weapons is undesirable (Kuser and Applegate 1985, Curtis et al. 1995), archery (bows and cross bows) can be utilized. Most often, such control measures are carried out at night using spotlights to detect ungulates. Spotlights have the added advantage of pinpointing individuals at a distance using eye shine (D'Angelo et al. 2007). In addition, the visual system of some species, such as deer, is typically overwhelmed by abrupt increases in light from spotlights and vehicle headlights, rendering the individual motionless and therefore an easy target (D'Angelo et al. 2007).

Public hunting can reduce ungulate populations, but spatial variation in hunting pressure can greatly affect the efficacy of a hunting program (Wright 2003). There is a perception by recreational and some volunteer hunters that aggressively reducing the number of ungulates will impact their ability to successfully hunt these species. Also as game density decreases and hunter effort increases, hunters will more often move to more productive hunting grounds. Coupled with a propensity for some people to 'trophy hunt' (i.e. selectively kill more desirable individuals in a population such as sizable males with large tusks or antlers), the ability to significantly decrease a species' population is even more problematic.

Public, wildlife and hunting safety are non-trivial issues. CASH (2009) reported almost 200 hunting accidents in the U.S. during 2008 and almost 150 in 2007. Hunting accidents occur in the Hawaiian Islands. In August 2001, a man was killed by his son's misfired arrow while hunting wild sheep on the Big Island of Hawai'i (Blakeman 2001). On the island of Moloka'i, a man was shot and killed with a rifle while hunting deer in November 2005 (Honolulu Advertiser Staff 2005). The restriction of access for hunting on private land can lead to increased safety risks. If the whereabouts of poachers is unknown, and if poachers engage in unsafe actions to evade detection and apprehension, hunters not only risk their own lives, but the lives of others. There is always a possibility that military personnel or authorized contractors could be injured or killed by poachers.

Programmatic costs of animal population control can be reduced considerably by decreasing the initial population of the target species rapidly, employing salaried rather than contracted personnel and utilizing other methods in concert with animal control. A professional control program can be costly. Rough estimates of population control of the three species of ungulates is about $121 to $202 per ac ($300 - $500 per ha) (C. Kessler, USFWS, personal communication). Ungulate control on the 605 ac (245 ha) Makaha Ridge facility may cost between $73,204 and $122,210. While this cost does not seem prohibitive, it does not include control of ungulates on the steep sea cliffs and gulches. Since these areas are extremely rough and generally inaccessible by foot, more expensive alternatives would have to be used. Further, due to the proximity of residential and resort areas to Honua'ula, the use of high velocity / long range firearms is not recommended.

3.2.3 Population Control With Dogs

The use of tracking dogs is a cost-effective method to locate ungulates present in steep terrain and dense vegetation. Dogs were used to locate small numbers of goats in remote areas of Hawai'i Volcanoes and Channel Islands National Parks (National Park Service 2004).

Pig population control with dogs proved the most successful option in Volcanoes National Park; after the first six months of control 150 of the estimated 175 pigs taken were taken by shooters with dogs (Katahira et al. 1993). Following aerial control on Sarigan Island, dogs were brought in to locate and chase feral pigs to natural barriers where shooters could eliminate them (Kessler 2002). Dogs were also helpful with eradication efforts on Santa Catalina Island, California (Schuyler et al. 2002) and Santiago Island, Galapagos (Cruz et al. 2005) by locating residue populations that evaded escape by shooters alone.

The safety of the dog and non-target species must be considered. Other considerations such as adequate rest time for the dogs, weather conditions for successful tracking and the use of dogs after dark need to be addressed. It is difficult to determine the cost of using dogs in an ungulate control program because dogs are often accompanied by a professional control team whose cost can vary. In addition, dogs are often brought in to find the remaining animals and thus are utilized primarily in low-density scenarios. Most managers agree that finding the last remaining proportion of a population takes as much effort as it took to get to that point, because capture success declines considerably as animal density becomes low. Dogs on Sarigan were able to locate and corral on average two to four animals per day before the dogs were too fatigued to be effective Kessler (2002).

The recent methods employed by The Nature Conservancy of Hawaii and reported by Allen (2009) are valuable to reference here. This project aimed to reduce non-native ungulate populations within specific management units on Maui and Moloka'i. Each site was divided into a series of "day-size control areas" and culled in a sequence that systematically worked to push any escaping ungulates ahead of the control team rather than into areas just covered. The control team utilized a systematic, dog and helicopter-assisted ground technique to sweep through the specific management units to remove feral ungulates. A team of 4 shooters, each with an experienced dog, moved across the landscape in a line, with each shooter no more than 330 to 500 ft (100 -150 m) apart. The shooters remained in constant communication with each other by FM handheld radios on a simplex frequency.

Short range bailer dogs (dogs that corner subjects rather than grab and hold them) were used; each trained to target feral pigs, and to stay approximately in a 500 – 650 ft (150-200 m) radius around the shooter. When target animals were found, dogs not immediately involved in bailing the target were trained to not join in, and instead maintained the integrity of the line to catch pigs that tried to escape through the line of shooters. Bailed target animals were then humanely dispatched by the nearest shooter and either shared with the community, safety permitting, or left in the field at pre-approved and appropriate locations remote from trails, drainages, and water supplies. A principal limitation of ground control with dogs at Honua'ula is the jagged, clinkery lava within the southern remnant mixed *kiawe-wiliwili* shrubland, and the steep gullies that cross the property.

3.2.4 Driving

DOFAW (2007), Henzell (1984) and Katahira and Stone (1982) found that driving ungulates from newly fenced areas just before the last section of fence is installed can be effective at removing animals. Animals can be driven or herded into open areas for aerial or ground control by shooters on horseback or on foot, or with motorcycles, or together with dogs. Helicopters may also be used more effectively to herd animals in rough terrain (Parkes, et al. 1996). Once driven into holding pens, animals can be dispatched by ground crews, given to interested individuals, or translocated to appropriate areas away from the site of their capture (DOFAW 2007). DOFAW (2007) reported the removal of 100 mouflon hybrid sheep out of a 5,000 acre exclosure area on the island of Hawai'i in 45 minutes time with a helicopter. Similar success with driving was reported in Australia by Parkes, et al. (1996) and Henzell (1984).

3.2.5 Aerial Control

Aerial control has been effective at reducing ungulate populations, particularly in remote or inaccessible areas. On Sarigan, aerial control was successfully used as the initial step in a pig and goat eradication program (Kessler 2002). Nearly 80 percent of the 5,036 pigs dispatched from Santa Cruz Island were achieved from a helicopter over a 15 month period at a cost of approximately $3.9 million (Morrison 2007).

Helicopters were also used on Santa Catalina Island in conjunction with baiting to eradicate pigs (Schuyler et al. 2002). Foraging pigs investigating bait stations after dark were shot from the air. The eradication program was estimated at approximately $3.2 million over a 15-year period (Morrison 2007). Allen (2009) reported over 200 hours of helicopter time flown over a period of one year, combined with ground hunting with dogs, resulted in 819 ungulate dispatched in a combined area of 17,423 ac (7050 ha) on Maui and Moloka'i.

Aerial control has the advantage of not leaving human scent that animals can cue into, or requiring disturbance or destruction for roads or tracks. Like all control methods, aerial control has its own limitations. The method can be expensive depending on flight time. Since the shooter is some distance away from the target and the noise of an aircraft can spook the target, there is a higher risk of non-fatal strike than shooting from the ground (Kessler 2002).

Further, the effectiveness of aerial control in areas covered by thick canopy is reduced because the target animal can disappear from sight under the canopy (Kessler 2002). Aerial control may be useful for decreasing ungulates utilizing the steep gulches within the Honua'ula Property. Careful a priori planning with FAA, FWS, and DLNR personnel would be required to account for local airspace restrictions and safety for area residents and tourist helicopter flights in adjacent airspace. Aerial control is the most cost effective single method of ungulate control after corrals (Allen 2009, Cruz et al. 2009).

3.2.6 Snares

The use of snares has been successful in the removal of ungulates. They are particularly effective in catching pigs, and are often most effective in ingress areas at the edges of fencing or natural barriers. For example, adult and juvenile feral pigs were removed from a remote area of Hawai'i by snares (Anderson and Stone 1993). Snares set between 2 - 8 in (5 – 20 cm) from ground level caught 228 pigs in almost four years. Total eradication of pigs in Haleakala National Park was achieved via a variety of methods including snaring (Van Driesche and Van Driesche 2004). On Sarigan, a locally fashioned snare had limited success but was a low cost method of capturing pigs (Kessler 2002).

Although the actual cost of snares is low ($12 - $20 per snare) the cost of maintenance and monitoring time needs to be considered. Anywhere from 20 to 200 snares can be set and monitored in a day by a single person, but number and placement is dependent on personnel, travel time, suitable placement sites, terrain and setting time. Furbishing a snare with a radio transmitter can increase the cost of snaring considerably (Halstead et al. 1996). Snares can usually be set in a relatively short time and do not require constant monitoring. They can be more effective than hunting to catch residual populations in heavily vegetated, rugged terrain.

Snares are often used in Hawai'i to capture wary individual pigs that have evaded other methods (Katahira et al. 1993, Littauer 1997, Buddenhagen et al. 2006) and are particularly useful in fenced areas. However, "reading" pig sign, and understanding home ranges and dispersal paths is an important factor in determining the placement of snares, particularly if the goal is to catch specific individuals (Anderson and Stone 1993). Time invested for snaring compares well with hunting, e.g. 9-60 hrs/pig versus 7-43 hrs/pig (Anderson and Stone 1993), or 27 hrs/pig (Buddenhagen et al. 2006). The latter two programs, however, were snaring "to extinction" within fenced areas. Initial "knockdown" of a population will be less time consuming and expensive.

Snares are effective but have some disadvantages. They have been criticized as inhumane if they are not checked frequently. Further, there is a heightened risk of death or injury if snares are set on sloping ground that could cause the animal to slip or lose its footing. Alarms or telemetry devices have been used to alert personnel when a snare has been tripped, leading to a quicker reaction time and less chance for injury (Marks 1996).

However, reducing response times may be logistically impractical in isolated areas and cost can be prohibitive. Conversely, the effectiveness of snares can be greatly reduced by frequent checks because of the human scent left behind (Hawai'i Conservation Alliance 2005a). Non-target animals are also susceptible to snares since they are not species specific. Goats, deer, and dogs are the only possible non-target species present at Makaha Ridge.

3.2.7 Other Tools for Control

Because some species of ungulate are highly social animals, an individual equipped with a radio transmitter can lead personnel to locations where the species congregate (Taylor and Katahira 1988, White and Garrott 1990). This technique, called the "Judas" method, was developed by Taylor and Katahira (1988) to find the last remaining goats in Hawai'i Volcanoes National Park. The technique entails the capture of a target animal such as a goat, fitting it with a telemetry collar, and releasing it. Being a gregarious animal, the goat will rejoin its herd, allowing personnel to locate and kill the herd. Usually the Judas animal is left unharmed to escape and find a new herd (Kessler 2002). "Mata Hari" goats (sterilized females induced into long term estrus) have been used in a similar way (Cruz et al. 2007). The Judas method is particularly useful for locating animals on steep slopes and dense underbrush. The method may therefore be a valuable tool for goat (and possibly pig) control at Honua'ula. Prior to fitting the radio transmitter, the animal must be captured and restrained. Capture is often achieved with traps and occasionally darting with a sedative.

The use of bounties to affect animal management and control has generally been found to be ineffective (Latham 1960, Hassall & Associates P/L. 1998, Buddenhagen, personal communication; DOFAW 2007). Many problems defined by Choquenot et al. (1996) include individuals bringing false evidence of kills, deliberate release of breeding animals, and purposefully leaving behind some animals to provide future income. Use of this method at Honua'ula is not recommended.

3.3 Related Management Actions

3.3.1 Disposition and Use of By-Products

Where possible, biological data should be collected on all captured and dispatched animals to obtain valuable demographic information on each target species. Following the successful approach detailed by Allen (2009), animals corralled at Honua'ula should be humanely dispatched by the nearest shooter and either shared with the community, safety permitting, or removed and buried offsite. According to U.S. Department of Agriculture, Food Safety Inspection Service, non-native deer are the only one of the species not covered by mandatory inspection and therefore their meat can be donated if deemed acceptable by local governing officials. Other State restrictions may apply.

3.3.2 Community Outreach and Education

Recreational hunting is an important part of life for many people on Maui, and eradication of goats, deer or pigs may still be misunderstood to many who don't see the threat to the land caused by these animals. Knowledge regarding invasive species and the harm they can cause are relatively low among the general public (Conover 2002). Therefore, it is important that Honua'ula Partners LLC develop a Public Relations Plan for the population management of ungulates on on the Property. The focus of the ungulate control program at Honua'ula should clearly be the restoration of native vegetation and prevention of soil loss which degrades adjacent marine habitats and coastal water quality.

Pro-active outreach can involve making the problem known, informal "talk story" sessions with stakeholders that may be concerned, involving the community in understanding the problem and helping to formulate solutions. Supporters are normally silent, and these stakeholders need to be encouraged to share their views. The plan will be to inform the public why ungulate control is needed, what is currently being done to control ungulate populations, and what is the long-term goal for control on the Property.

There are two primary goals of the public affairs plan: 1) understand the problem; 2) respond to questions and concerns about efforts to address damages to natural resources and facilities caused by feral ungulates, and managing ungulates to protect natural resources; 3) convey key points such as strategies and fundamental components for control as well as cooperating local and federal government agencies; and 4) support the proposed control. Public awareness regarding the ungulate reduction program would be promoted whenever possible. Honua'ula LLC and their Natural Resources Manager would work with community leaders in an effort to maintain communication avenues and resolve any issues should they arise.

Technique	Advantages	Disadvantages
Lethal baits	• Very effective • Cost effective • Modest labor requirements • Can be aerially distributed in remote areas	• Not acceptable for use in Kaua'i • Public relations issues may ensue
Non-toxic Baits	• Can be species specific • Complements other methods such as trapping • May catch animals that avoid other methods • Cost effective • Can rapidly reduce the number of animals • Can take advantage of nocturnal feeding habits	• If used with hunting, wait time can be consuming • Bait may provide a food source for other pest species (e.g., rats) • Some seed bait may germinate and establish • May attract non-target animals
Fencing	• Highly effective at blocking animals • Precludes need for continuous, labor-intensive control • Deters illegal trespass • Cost-effective if maintained • Can create a barrier against which to hunt • May be fitted with one-way gates to allow animals to exit	• Must be used in combination with other methods • Disruption of movement patterns may increase damage to adjacent areas and have negative effects on non-target animals • Expensive to build and maintain • Kaua'i conditions may decrease the longevity of fences • Can be damaged by hurricanes • Can be breached by poachers, particularly in remote areas
Driving	• Highly effective to rapidly move large numbers of animals • Non-lethal when conducted properly • Allows relocation of animals to other areas	• Labor intensive and potentially costly • Heavy vegetation or steep slopes may hamper effectiveness • Limited viability at low population densities • Not effective on some species • May exhaust animals if done improperly or if area is too large
Fertility Control	• Non-lethal • Could be effective if one-time treatment were permanent • May be improved for future application	• Temporary solution • Requires repeated administration • Labor intensive and hence costly • No large-scale oral deliverable methods are available
Radio-telemetry (Judas animal)	• Effective for goats • May potentially be used for pigs • Effective at finding evasive herds • Aerial telemetry can be used to locate herds in remote areas • Can be used in conjunction with live trapping	• Cannot be used for deer • Animal must be captured and restrained using a sedative • Telemetry equipment is costly • Transmitter collars can cause irritation and injury to the animal

Table 2. A summary list of techniques for animal control considered along with their advantages and disadvantages (after DOFAW 2007).

Technique	Advantages	Disadvantages
Ground control	• Capable of removing enough to be effective • Cost per animal relatively low • Effective in accessible areas • Can be undertaken by professional and amateur shooters • Only target animals are taken • Results are immediate • Rapid removal of many animals	• Less effective along steep, rugged and inaccessible terrain • Safety issues
Aerial control	• Effective along steep, rugged and inaccessible terrain • Does not leave human scent • Only target animals are taken • Results are immediate • Rapid removal of many animals	• Undertaken by professionals only • Canopy cover limits effectiveness • High risk • Helicopter time is expensive • Weather conditions affect scheduling
Control with dogs	• Capable of removing enough to be effective • Cost effective • Intensity and duration dictated by the control program • Effective for animals that have evaded other methods • Dogs increase efficiency of shooters	• Well trained dogs are expensive and may be hard to obtain • Dogs may be injured or killed by target animals or firearms • Should only be utilized by professionals • Inadequately trained dogs may take non-target animals • Some concerns regarding humaneness of method • Animal take per day is low compared with some other methods • In unfenced areas, may drive animals into sensitive natural areas
Live trapping (including corrals)	• Multiple animals can be taken at once • May catch animals that avoid to other methods • Non target animals captured can be released unharmed • Allows potential to radio-collar animals for Judas method	• Requires road or helicopter access • Traps are heavy and require multiple personnel to operate • Less effective when food is plentiful (bait is less attractive) • Time needed to find attractive bait or condition animals to take bait • Non- targets may become trapped • Trap shyness may preclude some individuals from capture • Must be checked regularly to reset and add bait • Some concerns regarding humaneness of method
Snares	• Effective for pigs • Relatively inexpensive • Presence of personnel not required • May catch animals that avoid other methods • Effective at low densities • Can catch animals that breach a fence	• Low public acceptance • Potential harm to animal if snared too long • Non-target animals may become snared • Snares must be removed before hunting with dogs can be used • May be less humane than other methods

3.3.3 Ecological Research and Monitoring

Successful long term control of ungulate numbers requires continuous review and refinement of management practices (Gogan et al. 2001). An "adaptive management" strategy or monitoring and assessment of key ecosystem components would be a necessary component of a sustained reduction program for deer, pig, and goats. Pre-reduction surveys for baseline data of ungulate damage should be conducted. This includes damage to vegetation as well as direct (observations) and indirect (e.g., scats, hoof prints and active wallows) evidence of ungulate presence.

Post-reduction surveys of affected areas should be conducted in order to measure reduction in damage due to the control of these ungulates. Tools such as bait stations, and scat and track analysis would allow field personnel to estimate relative population activity at key time periods prior to and following control treatments. Long-term impacts to vegetation would also be monitored. A summary of the pros and cons of each of the ungulate control methods discussed above appears in Table 2.

4.0 ALTERNATIVE STRATEGIES FOR UNGULATE MANAGEMENT AT HONUA'ULA

Alternative strategies are reviewed to accomplish two objectives: 1) protection of the entire Property from incursion by deer, pigs, goats, and cattle; and 2) protection of the Native Plant Preservation Area and Native Plant Conservation Areas.

4.1 Ungulate Management across the Entire 670 Acre Property

One of the conditions promulgated by the Maui County Council and DOFAW was to put in place a perimeter fence around the Property to restrict animal incursions, and protect not only native plants but also golf course features, private residences, public parks, and commercial establishments. Health risks to residents are probably not high, but ungulates could create health and traffic hazards. Ungulates are carriers of several diseases, including Leptospirosis, which is caused by a spirochete bacterium. Leptospirosis infection rates in Hawai'i are higher than anywhere else in the United States (Katz et al. 2002). Cows, pigs, goats, and deer are known vectors of the disease (Katz et al. 2002). Deer-vehicle collisions are unlikely in Hawai'i and have been given a 1 in 9,931 chance in any given year (State Farm 2009), but pig-vehicle encounters are not so uncommon (Robert Preston, Hawaii Department of Transportation, pers. comm.). However, pig densities in dry rocky areas like Honua'ula are not likely to be as high as wet forest areas (Chris Buddenhagen, SWCA, pers. comm.).

DOFAW (1988) recommended fencing the entire Property to preclude ungulates from entering developed areas. A resident of the Maui Meadows development immediately to the north of Honua'ula said he's never seen deer or other ungulates in the residential area and other residents do not view them as a problem (Greg Spencer, First Wind, pers. comm.). However, this statement is refuted by staff of the State Division of Forestry and Wildlife (DOFAW) in a letter dated August 3, 2000 (Appendix C). Golf course areas in Maui sometimes experience problems with pigs and deer. Due to their rooting activity, pigs are the most damaging ungulate for landscaped areas. Hunters are contracted from time to time to control ungulate impacts to the Makena resort's golf courses (Greg Czar, Feral Animal Removal Experts LLC, pers. comm.). Existing fences at Honua'ula do protect the area from some cattle, but other ungulates may need to be managed to meet requirements (see below).

Much of the perimeter of the Property is already fenced with a mix of four strand barbed wire and hog wire with a barbed top wire. Yet none of the existing fences have the base skirting required to keep pigs out. Fence and gate integrity is variable throughout the perimeter, with significant portions in poor repair. Along the upper property boundary, adjacent to 'Ulupalakua Ranch, fencing is of a reasonable standard; however, this area of the fence probably only excludes cattle due to the height and lack of skirting. The four strand barbed wire fences along part of the southern boundary would do little to keep out pigs, goats, or deer.

Fences in the lower perimeter (western side of the property) are mainly designed to keep animals from entering developments below the property. This area has a number of access gates that are designed to exclude vehicular access, but would not prevent animal ingress. Some existing fencing will need replacing or upgrading.

SWCA recommends that Honua'ula Partners LLC upgrade fences along the northern, eastern, and southern boundary of the Property to ensure that they are effective against deer, pigs, goats, and cattle (Table 3, Figure 1). Over the long term, fencing should not be necessary along the lower (western) part of the property because it abuts resorts, residences, and golf courses. Existing and proposed access roads along the boundary with Wailea Resort would reduce fence effectiveness. This partial perimeter fencing option means that areas at a high risk of ungulate ingress are dealt with, but occasional ingress would still be possible along the lower boundaries or via roads.

Feral Animal Removal Experts LLC recommends an eight (8) foot (2.4 m) deer fence with a ground skirt all the way around it (Table 1). The corners should be two and seven eighths (2 7/8) inch (7.3 cm) or larger galvanized pipe. Pipe, or galvanized ten (10) foot (3 m) t-pins, or a combination of both, can be used for in-line posts. One pipe for every ten (10) or twelve (12) pins is the best ratio. It is important to use American made t-pins and wire as they are stronger and last three times as long. It is possible to build this type of fence in any terrain and soil type. Pipes should be pounded in a minimum of 0.9 m (3 ft) in soil or 46 cm (18 in) when drilled in solid rock. Occasional pedestrian gates will be required to access the enclosure.

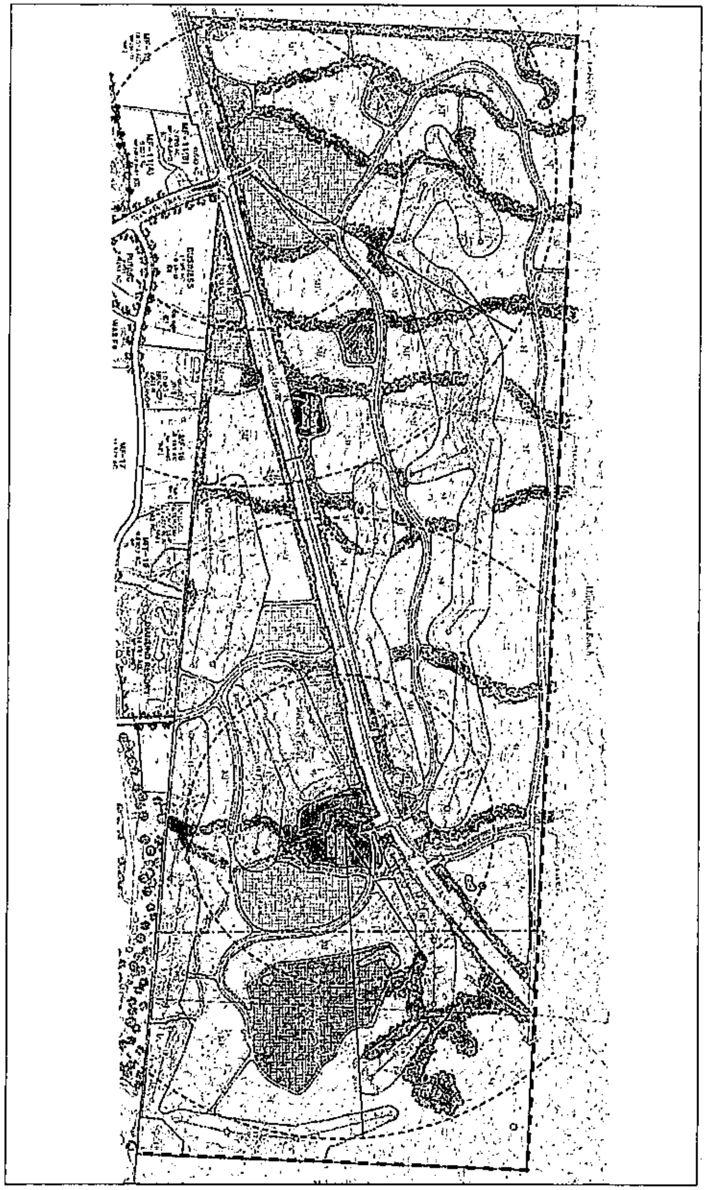
Access is relatively easy at the site, but the lava substrate would require special equipment to put in fence posts. One option is to use a geological core sampling bit on a 2-cycle (chainsaw) motor drive. This works as a "hole saw" and pins can be placed in the hole, but one challenge is that the drill bit needs irrigating with water during drilling. It is best to bulldoze the line as it will improve fence integrity, reduce construction time, and facilitate future maintenance. Care will be needed to ensure that significant cultural sites and native plants are not damaged by bulldozing. The cost of a D-9 bulldozer and operator on Maui is approximately $350 per hour.

Another consideration relates to the aesthetics of the fence, different options may be desirable depending on the visibility of the fence from residential areas. Each gate added for access could cost anywhere from $300 to $3,000 depending on the type of gate. Final costs will need to be determined by a fencing contractor. It is recommended that a single contractor be hired for both fencing and ungulate removal (Greg Czar, Feral Animal Removal Experts LLC, pers. comm.). Where necessary at road crossing, two cattle guards can be placed in succession, approximately 12-16 feet (3.7-4.9 m) wide, to deter all ungulates. Guards are normally only 6-8 feet (1.8-2.4 m) wide for cattle (Anon 2009). Material costs for guards are likely to exceed $5,000. Installation costs vary.

Table 3. Estimated costs for ungulate fencing the Honua'ula Property

Fencing Options	Estimated Fence Length	Estimated Cost (All ungulates)	Estimated Cost (goat-pig-cattle)	Acres Protected
Eastern and Southern Perimeter	3953 (2.46 miles)	$434,830	$363,676	~670
Cost per unit		**$110/meter (~$177,050/mile)**	**$92/meter (~$148,060/mile)**	

After fencing is completed, ungulates will need to be removed from the Property. With the Honua'ula site being so close to residential areas, the option to use shooters may cause concerns in the community. Some people may have permission to hunt on the Property so professional animal removal teams could conceivably shoot animals. However, the best option would be to drive any ungulates out of the area (through a gate) using skirmish lines with people spaced every 33-164 feet (10-50 meters) (Greg Czar, Feral Animal Removal Experts LLC, pers. comm.). Animals would be driven out of the preserve for humane dispatch, capture, or release. Costs for professional animal removal services could be anywhere between $250 and $600 per acre ($618 and $1,483 per hectare) (Greg Czar, Feral Animal Removal Experts LLC, pers. comm.). After animals are removed, the fence would be sealed off and the positive effects of animal removal on the vegetation should become evident over the next 6-24 months.



Legend

- - - Proposed Perimeter Fence

Figure 1 - Fencing Plan for a Perimeter Fence

Honua'ula

Sources:
Topography - PBR
Land Plan - VITA
Cultural Sites - Aki Sinoto

SWCA
ENVIRONMENTAL CONSULTANTS

4.2 Ungulate Management to Protect the Native Plant Preservation Area

The Native Plant Preservation Area must have permanent protection and long-term intensive management to protect its native resources from external threats. To adequately meet this requirement, it should be protected as early in the development of the Property as possible. To estimate costs, two fencing options were mapped in the field by SWCA on December 1, 2009 (Figure 2). SWCA used a Trimble GeoXT Mapping Grade Global Positioning System (GPS) unit with ArcPad8 software to obtain an accurate estimate of the proposed perimeter fence path and length.

One fencing option follows the preserve boundary as proposed in the Project District Phase 2 Master Plan, December 1, 2009, and the other makes adjustments to follow certain landscape features (contours, gullies, and ridges). It includes native species, especially stands of *wiliwili* (*Erythrina sandwicensis*) trees adjacent to the proposed preserve (Figure 2). Following landscape features in this way will make fence construction simpler in some cases, and would often act to make the fence less visible from developed areas. The difference between the two scenarios amounts to a difference of 0.8 ac (0.3 ha) and the inclusive scenario would add approximately 40 more *wiliwili* (*Erythrina sandwicensis*) trees to the preserve (Figure 3), depending on the final fence placement (Table 4).

Table 4. Approximate cost of installing fences around the proposed Native Plant Preservation Area. *Two fence paths are presented based on the preserve area proposed in the Master Plan, and a modified inclusive version that seeks to protect native plants that were just outside the proposed preserve boundary.*

Fencing Option	Estimated Fence Length	Estimated Cost (All ungulates)	Estimated Cost (goat-pig-cattle)	Acres Protected
Current Plant Preservation Area in Master Plan	1,229 meter (0.7636 mile)	$135,190	$113,068	22.3
Inclusive Plant Preservation Area Option	1,315 meter (0.8171 mile)	$144,650	$120,980	23.1
Cost / Unit		**$110/meter (~$177,050/mile)**	**$92/meter (~$148,060/mile)**	

After fencing is completed, ungulates will need to be removed from the preserve using the same methods employed to remove ungulates from the larger Property.

4.3 The Do Nothing Alternative

The last option is to do nothing. Existing fences are probably adequate to protect the area from cattle ingress, although fence repair may be needed from time to time. However, deer, pigs, and goats would likely continue to enter the Property through the existing unskirted, permeable fences. This would increase the level and cost of control required to herd and remove ungulates that threaten invade the Native Plant Preservation Area, Native Plant Conservation Areas, golf course, or developed urban areas. It may also lead to damage or loss of native plant resources unless the ungulates are found and controlled soon after they invade the Property.

Construction activities would probably cause many animals to leave the property; thus, no special effort is likely needed to remove animals unless new fences are put up early during project implementation. Individual animals could be removed humanely as they are found. At some point a concerted effort to remove animals from the property using skirmish lines may be warranted, especially after perimeter fencing is put in place. Costs for professional animal removal services could be anywhere between $250 and $600 per acre ($618 and $1,483 per hectare) (Greg Czar, Feral Animal Removal Experts LLC, pers. comm.).

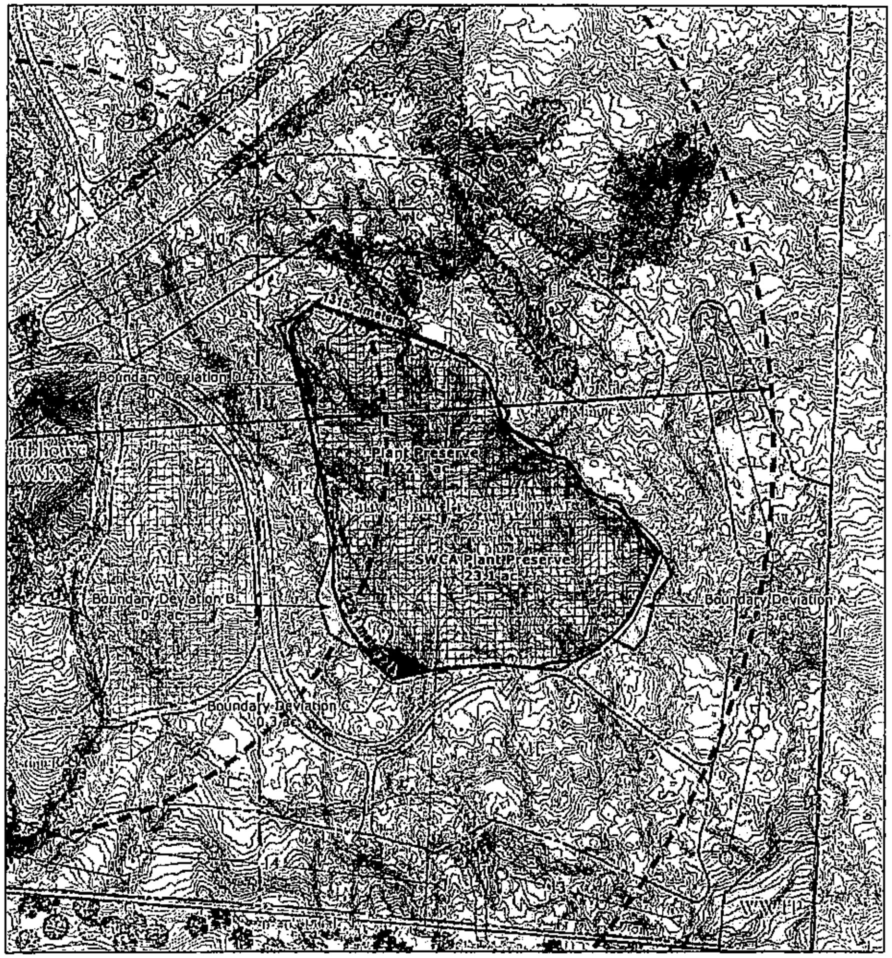


Figure 2
Fencing Plan Options Native Plant Preserve

Figure 3. A wiliwili (Erythrina sandwichensis) tree slated for protection within the proposed Native Plant Preservation Area.

5.0 SUMMARY OF RECOMMENDATIONS

SWCA recommends the implementation of the following measures to preserve elements of the Native Plant Preservation Area and Native Plant Conservation Areas at Honua'ula and mitigate damage to native plants caused by feral ungulates.

- Upgrade the perimeter fence to pig-goat-cattle fencing around the eastern and southern boundaries of the Honua'ula Property to eliminate most ingress by deer, pigs, goats, and cattle or all ungulates except deer.
  - Estimated cost: ~$434,830 (including deer)
  - Estimated cost: ~$363,676 (pigs, goats and cattle)
- Fence the proposed Native Plant Preservation Area with fencing to keep out deer and other ungulates.
  - Estimated cost: ~$120,980.
- Remove ungulates from Native Plant Preservation Area with professional teams.
  - Estimated cost: ~$5,500-$13,200.
- Remove ungulates from the over the remaining property with professional teams.
  - Estimated cost: ~$167,500 - $402,000

In addition, the ungulate control program should also include elements of an outreach program to share information about impacts with cooperators and the community through formal and informal outreach channels. Monitoring of management actions (i.e. control and native plant restoration efforts) will demonstrate management effectiveness, and allow for management methods for animal population control to be adjusted. Changes in ungulate populations and the outcomes will be measured against baseline information and allow successes to be celebrated and any potential problems to be addressed. Monitoring information is used to inform outreach, management and restoration efforts into the future.

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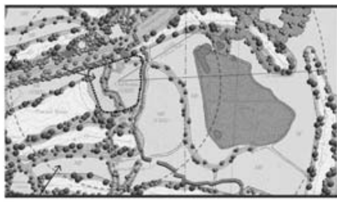
Appendix G

Landscape Master Plan



HONUA'ULA

Landscape Master Plan

March 2010

HONUA'ULA

Landscape Master Plan

PBR HAWAII
& ASSOCIATES, INC.

March 2010

Contributors:

VITA
PLANNING & LANDSCAPE ARCHITECTURE

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INTRODUCTION

The Landscape Master Plan creates an overall landscape concept and establishes principles to guide the design and development of the landscape at Honua'ula, ensuring a cohesive and visually unified landscape throughout the community. Consistent with the Maui County Planting Plan, the Honua'ula Landscape Master Plan is responsive to the botanical resources of the area and the need to limit the use of water for irrigation.

Vision

Perched above the Wailea Resort on the slopes of Haleakalā just makai of 'Ulupalakua Ranch, the lands of Honua'ula are blessed with a multitude of unique physical and visual resources—rocky gulches that provide shelter for wildlife; spectacular mauka views of Haleakalā and panoramic makai views of Molokini, Kaho'olawe, Lāna'i, Moloka'i and West Maui; rugged 'a'ā fields with native vegetation; remnants of pre-contact archaeological sites and paniolo-era stone walls that tell stories of those who came before us. These resources create the spirit of Honua'ula, and it is this spirit that the Honua'ula Landscape Master Plan seeks to embrace through a combination of preservation and respectful development.

Understanding the land and its resources has led to a plan crafted to achieve the following goals:

- Create an informal, naturalistic community-wide landscape that will allow buildings and other improvements to rest graciously upon the land. In this sense, the landscape will dominate the scene.
- Create a memorable experience at Honua'ula by designing landscapes that respect the site's natural and cultural resources, and embrace this unique Hawaiian landscape.
- Preserve, enhance, and protect native landscape and habitat areas by using native plants, whenever possible, to make seamless transitions between the natural landscape and introduced landscapes.
- Concentrate ornamental landscapes around key amenity areas of the Golf Clubhouse, mixed use village areas, and select higher density residential neighborhoods.
- Rehabilitate existing degraded landscapes and restore all disturbed areas affected by grading and construction for infrastructure and community development.
- Use plants and irrigation techniques that are sensitive to water conservation.

1 LANDSCAPE CONCEPT

1.1 SITE CHARACTERISTICS

This section describes the existing characteristics of Honua'ula and how these elements found on-site have led to the creation of the Landscape Master Plan.

Southern Shrubland
The southern quarter of the Property is comprised of an area characterized as a mixed *kiawe-wiliwili* shrubland vegetation. Approximately 70 acres of this area, south of the rock wall, is covered by 'a'ā lava. This somewhat isolated lava field provides a natural habitat for native plants such as wiliwili, nehe, 'āwikiwiki, maiapilo, kolomona, 'ānunu, and pua kala. The lava field has created a natural barrier, protecting these native plants from wildfires, animal grazing, and invasive grasses. Twenty-two acres of this area will be set-aside as a Native Plant Preservation Area, to protect and conserve an area that contains the highest density of representative native plant species within Honua'ula. The areas around and nearby the Native Plant Preservation Area will be augmented with native species to create a transition between it and the more native or ornamental landscapes of the community.

Northern Grasslands
The northern three-quarters of the Property can be described as kiawe-buffelgrass grasslands. In addition to 'a'ā lava, trees, buffelgrass, guinea grass, natal redtop, and sour grass are scattered throughout this portion of the Property. Other plants found in this area include the invasive koa haole, lantana, partridge pea, and cow pea.

Gulches
The vast expanse of kiawe-buffelgrass in the northern three quarters of the Property is bisected from east to west by several gulches. These gulches vary in depth and size, and are characterized by their exposed outcrops of bedrock. Native flora that requires some moisture and protection from the sun (such as 'iwa'iwa fern) can be found in the gulches of the Property.

Rock Walls
Ancient Hawaiian occupancy is evidenced by the remnants of dry stack walls which were used in building temporary shelters. In addition, a larger dry stack rock wall runs in a mauka-makai direction and generally define the ancient 'a'ā lava field. This wall was constructed when the land was used for cattle grazing and served as a means of keeping livestock from roaming onto the rough 'a'ā lava fields.

1.2 KEY ENVIRONMENTAL FACTORS

Geography within Honua'ula varies from 'a'ā lava fields to gulches to grass lands. The 'a'ā lava fields are home to the majority of the native plant species on-site mostly due to the fact the lava has created a natural barrier, protecting native plants from wildfires, animal grazing, and invasive grasses. The gulches provide shade, are a little cooler, and have moisture to help sustain native species that require moisture and protection from the sun. The gulches also provide a natural drainage way for Honua'ula and adjacent properties. The grass land comprises the majority of the site and has been disturbed by numerous jeep trails and unrestricted grazing by axis deer.

As a means of protecting and re-populating the native dryland vegetation, a Native Plant Preservation Area will be established. The Native Plant Preservation Area will be located within the 'a'ā lava field and will encompass an area that contains the highest density of representative native plant species within Honua'ula. No development other than walls/fences, trails, and structures for maintenance will be allowed within the Preservation Area. In addition to the Native Plant Preservation Area, Native Plant Conservation Areas will be located adjacent to both the Native Plant Preservation Area and golf course holes in the southern portion of the Property. These areas will not be graded so that existing native vegetation can be re-established and integrated primarily as restored native species landscaping.

1.3 KEY ARCHAEOLOGICAL FACTORS

In the region of Honua'ula, archaeologists theorize that a pattern of transience existed between coastal and inland areas. Inhabitants of the upland agricultural region may have utilized coastal areas as seasonal bases for expanding the range of resource exploitation. Temporary habitation sites, located along trails linking upland and coastal settlements were used by travelers from upland residences to the coast to gather marine resources. Upland populations exchanged taro, bananas, and sweet potatoes with the coastal populations for ocean resources.

Several archaeological sites within Honua'ula support the theory that Honua'ula, which is located in the mid-elevation zone, was used for temporary transit stops during travel between the coast and inland areas. Remnants of discontinuous steppingstone trails within the 'a'ā lava field indicate a path from the mountain to the sea. Remains of small dry stack walls suggest that Hawaiians built temporary shelters to rest or camp in the area as they travelled from the mountain region to the coastal region of the ahupua'a. There is also evidence of Hawaiians using the site to grow sweet potato, as there are few other agricultural plants that would be able to survive in this dryland area.

As cattle were brought to the islands, ranchers used the land for grazing pasture. Large dry stack walls running in an east-west direction were built to contain livestock and to prevent them from going onto the rough 'a'ā lava fields. These walls may have played a role in the survival of the native plants that exist on the 'a'ā lava fields today.

The intent of the Honua'ula Landscape Master Plan is to weave the archaeological sites, walls, Native Plant Preservation Area, and Native Plant Conservation Areas into the fabric of the community, enabling residents and visitors alike to gain a better understanding of these valuable resources through everyday interaction with them.

2 THE LANDSCAPE CONCEPT PLAN

The following sections outline Honua'ula's Key Landscape Design Elements and Landscape Areas and briefly describe the guiding principles and/or specific design solutions for achieving a cohesive landscape throughout the community.

2.1 KEY DESIGN ELEMENTS

The landscape design—from roadway layout, grading, siting of home building pads to landscape planting—seeks to tie in built features with a restored natural setting. Roadways and homes will be integrated into the site through sensitive grading and careful plant selection. Views and privacy will be maintained and enhanced through judicious planting controlled by design guidelines and codes, covenants, and restrictions (CC&Rs).

The Honua'ula Landscape Master Plan draws inspiration from the geographical characteristics and native vegetation found on-site and in the area.

<u>The Lava Flows</u>
Lava stone found on-site will be incorporated into the landscape as a thematic element. On-site rocks and boulders will be used in the landscape to make grade transitions from built to natural and will also be incorporated into the landscape as a landscape feature. Lava will be used as an alternative to grass or groundcover plantings to minimize irrigation usage and as a design feature to retell the history of native plants stemming from the lava fields.

<u>Native Plant Palette</u>
Honua'ula's primary plant palette reflects the area's dry lowland scrub/forest zone. The dominant tree species would include koai'a (Acacia koaia), native wiliwili (Erythrina sandwicensis), kolomana (Senna gaudichaudii), and kou (Cordia subcordata), and would be designed to mimic a natural landscape with informally-spaced plantings. Other native plants such as ehe, pili, naio, maiapilo, and 'āwikiwiki will be used throughout the site and incorporated into common areas, the golf course, open space, streetscape, parks, and buffer zones as much as possible.

<u>Lava Rock Walls</u>
Dry stack rock walls similar to the existing historic and ranch era walls found on-site will be incorporated into the landscape as both a functional and aesthetic design element. In built areas such as residential or commercial zones, stone walls utilizing locally harvested rocks will be used. These walls will be incorporated throughout the site, becoming an important identity element of the Honua'ula landscape.

<u>Gulches</u>
Gulches will remain natural. Transition areas between gulches and built zones will incorporate boulders found on-site with native plantings.

<u>Community Landscaping</u>
Plantings within individual lots will include a combination of native, Polynesian heritage, and select ornamental plants. This landscape zone will be designed and installed by each homeowner under the guidance of the CC&Rs. Ornamental non-native plants may be used selectively near homes to maximize their effect. Further from homes, and utilizing the remainder of the lot, the informal massing of native and/or heritage trees, shrubs, and groundcover will anchor the home into the restored landscape. Clusters of native trees will help to screen adjacent homes from each other and frame views. Groupings of mixed shrubs will create informal hedges, screens, and massing, and will blend with tree groupings.

The vegetation will consist mainly of native drought-tolerant plants, which will be planted in a manner that will mimic how these plants would grow in their natural state. All planting areas will be irrigated using non-potable water. Soil building and erosion control plantings of shrubs and groundcover will help hold the soil on steeper slopes. Tree selection and placement are critical to avoid view obstruction while still appearing natural.

2.2 THE LANDSCAPE MASTER PLAN AND LANDSCAPE AREAS

The design proposals contained in the Honua'ula Landscape Master Plan are driven by the Honua'ula Conservation and Stewardship Plan. This plan recommends proactive stewardship actions to manage and propagate native plants within Honua'ula with the overall goal of protecting native plants. The objective is to create a naturalized native landscape palette which requires minimal irrigation and will, after establishment, require minimal maintenance.

The Honua'ula Landscape Master Plan identifies 13 key landscape areas or components that combine to create the framework for the overall landscape concept (Figure 1). Below is a listing of these areas along with the key design features of each:

1. Entries/Gateways – Define entries and gateways with boulders, rock walls, signs, canopy trees and/or vertical palms, specimen trees, native plants and subtle lighting.
2. Roadways – The landscape treatment along roadways and trails will consist primarily of informal clusters of native plants.
3. Pi'ilani Highway Extension – With the exception of a few strategically located view corridors, most of the Pi'ilani Highway extension within Honua'ula will be planted with informal clusters of native and or ornamental plants to create a dense buffer between the highway and adjacent uses.
4. Golf Course – Native vegetation will be planted in informal clusters to transition from golf course landscaping to open spaces.
5. Clubhouse – A combination of native plant materials, at the periphery or in low impact areas, and ornamental landscaping, close to the club buildings and in high impact areas, will create a varied yet naturalistic landscape.
6. Native Plant Preservation Area and Native Plant Conservation Areas – Protection of existing native plants will be the primary objective for these areas.
7. 'A'ā Lava Flows – Lava and rocks will surround native plant clusters propagated from the site.
8. Grass Lands – Native shrub vegetation will be used to landscape the area.
9. Maui Meadows Landscape Buffer – A mixture of medium-sized canopy trees, large native shrubs, and small trees will function as a landscape buffer. In addition, portions of the buffer could be utilized for community parks and gardens.
10. Utility Buffers – Canopy trees and dense understory plantings will surround water tanks and utility features to create a dense visual screen.
11. Gulches – Re-established native plants will provide natural landscape treatment.
12. Parks – Landscape will include turf grass, canopy trees, and native shrubs and groundcovers.
13. Village – Within the higher density village mixed use areas, a more ornamental slandscape is appropriate, using canopy trees and shrub massing to mitigate the visual and micro-climate impacts of buildings.

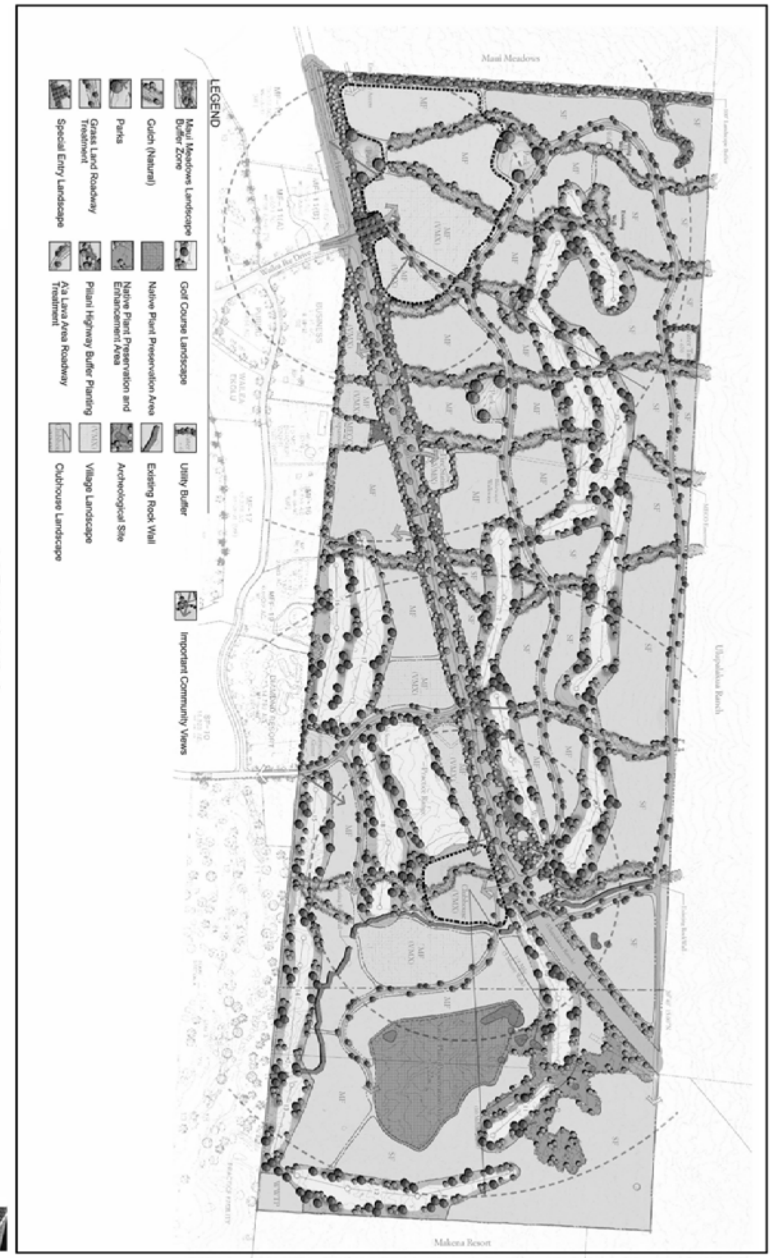


Figure 1 - Landscape Master Plan

HONUA'ULA

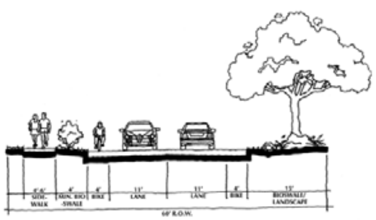
The following are more detailed landscape concepts for each area.

Entries/Gateways

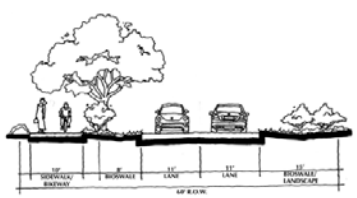
- Define entries and gateways to and within Honua'ula with boulders and stone walls with signs. Boulders shall be locally harvested, and stone walls will be similar in character and material to the existing dry stack walls found on-site.
- At village mixed use entries, tall palms and/or large canopy trees willl be used at the main entrance, including medians, to give a sense of arrival and to allow views to retail uses.
- Groves of wiliwili, or other native/distinctive, trees will be used on both sides of the main Honua'ula entrance and major intersections to give a sense of identity and scale to these important locations within Honua'ula.
- Landscape plantings will contain a mixture of native and non-native plants that complement the rock outcroppings.

Roadways

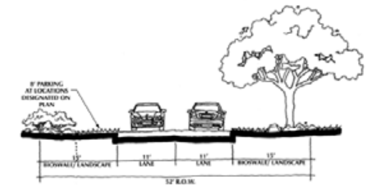
- The landscape treatments of Honua'ula's roadway corridors have been greatly influenced by the fact that irrigation supply is very limited. Native dryland vegetation will be primarily used throughout Honua'ula along with non-native, non-invasive species.
- Landscape treatment along roadways within Honua'ula will consist of primarily endemic and indigenous species planted in informal clusters as to preserve mauka-makai view corridors and mimic the natural landscape. In select neighborhoods or where densities are higher, non-native species may be used.



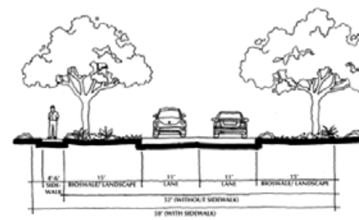
Collector Road Option 1



Collector Road Option 2

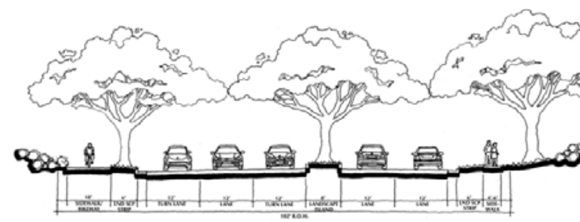


Cul-de-sac

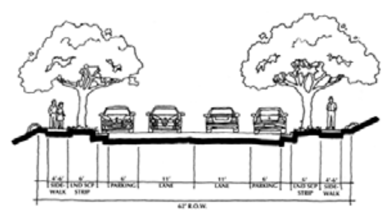


Minor Street

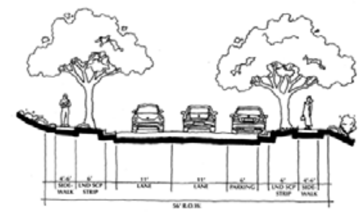
- Locally harvested rocks and boulders will be incorporated into the landscape planting wherever possible to make grade transitions.
- Where pedestrian trails are adjacent to roadways, a landscape buffer of native trees and shrubs will be encouraged to provide separation.
- Landscape buffer zones along collector roads and local streets within Honua'ula will consist of native trees and shrubs planted in informal clusters. Locally harvested boulders and rocks will be incorporated into the landscape wherever appropriate.



Parkway



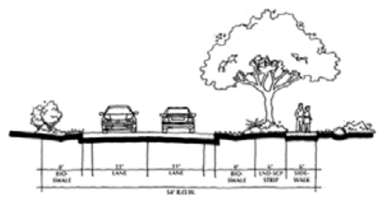
Village Street 1



Village Street 2

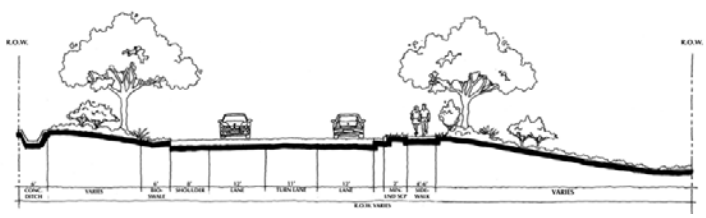
Pi'ilani Highway Extension

- Landscape treatment along the Pi'ilani Highway extension into Honua'ula will be distinguishable through the use of native vegetation. The thematic tree for this corridor would be the kou with accent groups of wiliwili. In select areas, non-native species will be used as accents, buffers, or to frame views.
- Landscape buffer treatment along the Pi'ilani Highway extension shall consist of a mixture of both native and non-invasive plantings.

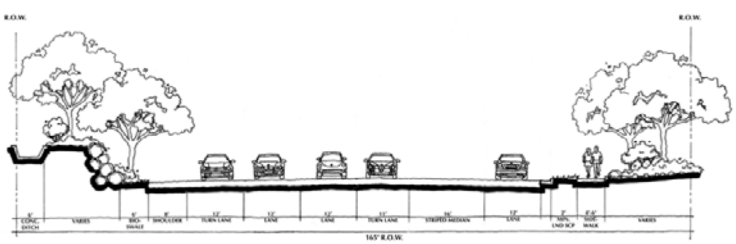


Pi'ilani Highway Extension (Private)

- The landscape along the Pi'ilani Highway extension shall be densely planted as to screen unsightly views of traffic and buffer road noise.
- Berms along with densely planted shrubs will be used to screen views of traffic and buffer road noise. The landscape berms along the highway will be at different heights to create visual interest.



Pi'ilani Highway Extension (State)



Pi'ilani Highway Extension at Wailea 'Ike Intersection

Golf Course

- Where the golf course is adjacent to roadways and residences, the landscape treatment will allow for views into the course from surrounding uses.
- Transitions from golf course landscaping to open spaces will use native vegetation sparsely planted in informal clusters while maintaining mauka-makai view corridors.
- The golf course plant palette will contain a mixture of natives and non-natives.
- Depending on the type of terrain that the golf course traverses, the landscape treatment will vary. The intent is that the new landscape blends with the surroundings and uses species from the adjacent undisturbed areas.

Clubhouse

- A combination of native and non-native plant materials will be used around the clubhouse to create a gracious setting in which the club will be located. In this sense, the building will recede into its surroundings and the landscape will dominate the scene.
- Use of ornamentals will be focused around the building and the higher impact areas of the amenities.
- Dry stack rock walls will be a major "theme" element of the clubhouse landscaping, relating it back to the historic walls found on-site.

Native Plant Preservation Area and Native Plant Conservation Areas

- With the Native Plant Preservation Area and the Native Plant Conservation Areas, the landscape will be left natural other than the propagation of the endemic and indigenous natives found on-site.
- Non-native and invasive species will be removed from the Native Plant Preservation Area and the Native Plant Conservation Areas.
- Dry stack walls similar in character to the walls found on-site will be used to define the boundary of the Native Plant Preservation Area and the Native Plant Conservation Areas.

'A'ā Lava Flow (Southern area of property)

- The landscape treatment within public areas of the 'a'ā flow area will be relatively sparse, mostly due to the fact that irrigation water is very limited.
- The landscape treatment will primarily be comprised of native flora propagated from the site. The dominant tree will be the wiliwili, though other native trees will also be used.

- Informal plant clusters will be surrounded by re-naturalized lava and rocks harvested on-site, creating a dramatic backdrop to showcase native vegetation.

- Boulders found on-site will be used to make grading transitions from natural to built forms.

Grass Lands (Northern area of property)

- Similar to the landscape treatment of the ʻaʻā lava flow areas, the Grass Lands will be conservatively planted.

- The landscape will consist primarily of native shrub vegetation along with informal clusters of native and non-native trees.

- Dry stack walls will be used as a landscape feature and will serve as both a functional and aesthetic design element.

- When needed, larger retaining or building walls, consisting of the same stones used on the dry stack walls but with mortar joints, will be used in the higher density built areas.

Maui Meadows Landscape Buffer

- The landscape treatment for the Maui Meadows buffer will consist of a mixture of native and non-native medium canopy trees informally planted.

- Large native shrubs/small trees will be used as an understory and will function as a physical barrier between the two properties.

- Portions of the buffer area may be utilized for community garden plots for surrounding homeowners.

Utility Buffer

- Landscape buffer treatment around water tanks and other utility features shall consist of a mixture of both native and non-native plantings.

- Medium to large canopy trees shall be used along with dense understory plantings of shrubs and groundcovers to ensure a visual screen.

- Berms may also be used along with boulders to soften the grading transition. Trees along utility entrances shall be selectively pruned to ensure proper vehicular clearance.

Gulches

- Landscape treatment within the gulches will be minimal other than the possible re-establishment of natives from the site. Because gulches are isolated from disturbance, they provide an opportunity for conservation teams to restore and rehabilitate existing native flora.

- Landscape treatment along gulches will be comprised predominately of native plants. Informal clusters of trees and shrubs, along with locally harvested boulders and rocks will help soften the transition from the natural to the built environment. Native groundcovers to help stabilize soil will be used wherever the terrain exceeds a 30 percent slope.

- The Clubhouse site is bisected by a gulch. The architectural and site design concept is to integrate the gulch into the plan so that portions of the building and/or bridges may span the gulch and lanais will have views into the gulch.

Parks

- Recreational parks will be one of the only areas, other than the golf course, where turf grass will be utilized in large expanses. The selected turf shall be non-invasive, drought tolerant and able to withstand brackish water irrigation.

- The character of the parks shall be open with both native and non-native medium/large canopy trees clustered at the perimeter to provide shade.

- A mixture of native and non-native shrubs shall be used along with native groundcovers.

Village

- Within the village mixed use areas, the landscaping will be more ordered and/or formal, with regular street tree planting and ornamental shrubs and groundcovers.

- A variety of medium to large canopy trees will be used to provide shade to streets and mitigate the heat island effect of parking lots and roof tops.

- Tall palms may be used as an accent at open spaces, entrances or other public spaces.

3 LANDSCAPE MATERIALS

Landscape materials used throughout Honua'ula will reflect the landscape concept by using quality materials that are durable and proven in similar applications. Whenever possible, natural materials that weather gracefully—lichen covered stone, metals with a pleasant, subdued patina or aged, naturally colored wood--will be employed over "man-made" or "industrial" materials. The overall objective is for all hardscape materials to recede and blend into the newly established naturalized landscape.

3.1 LANDSCAPE LIGHTING

The landscape lighting for Honua'ula will reinforce the overall rural ambience by:

- *Using low intensity, indirect light sources to the extent required for safety and subtle drama.*
- *Using down lighting to the greatest extent possible, preserving the dark sky ambiance.*
- *Providing appropriate levels of light and fixture types for individual neighborhoods—i.e. lighting requirements within the higher density and/or village mixed use areas will be different than within lower density residential neighborhoods.*

Fixtures will be stylized with a touch of detail and have subtle colors to blend with the surroundings. Landscape or accent lighting will be used to highlight key locations, trail nodes, colorful landscape, or art features. All landscape lighting will be in compliance with Chapter 20.35, Maui County Code.

3.2 WALLS & FENCES

Example of dry stack wall wich will be used in public and open spaces

Walls used throughout public and open spaces around Honua'ula will be comprised of locally harvested stone and will be dry stacked similar in style to those found on-site. Larger walls or those associated with buildings will use the same weathered native stone as a facing material, ensuring a visual consistency with Honua'ula's historic walls.

Fences used throughout Honua'ula will be two-rail pasture fences constructed of either natural wood or split rail. Natural wood fences may be used in open and public spaces, split rail fences are more appropriate closer to buildings or in denser areas.

3.3 PLANT MATERIAL

Groundcover

Nehe
(Wollastonia integriolia)
Residential, VMX, Open Space/Buffer, Parks, Golf Course

Naio Papa
(Myoporum sandwicense)
Residential, VMX, Parks, Golf Course

Dwarf Naupaka
(Scaevoia coriacea)
Residential, VMX, Open Space/Buffer, Parks, Golf Course

'Akoko
(Chamaesyce celaroides)
Residential, VMX, Open Space/Buffer, Parks, Golf Course

Hinahina
(Heliotropium anomalum)
Residential, Open Space/Buffer, Parks, Golf Course

Hunakai
(Ipomoea imperati)
Residential, Open Space/Buffer, Parks, Golf Course

Black Coral 'Ilima
(Sidax fallax)
Residential, VMX, Open Space/Buffer, Parks, Golf Course

'Ākia
(Wilkstroemia uva-ursi)
Residential, Open Space/Buffer, Parks, Golf Course

'Ala'alawainui
(Peperomia blanda)
Residential, Open Space/Buffer, VMX, Parks, Golf Course

Groundcover (cont.)

Pā'ū o Hi'iaka
(Jaquemontia ovalifolia)
Residential, Open Space/Buffer, Parks, Golf Course

Pōhinahina
(Vitex rotundifolia)
Residential, Open Space/Buffer, Parks, Golf Course

'Āhinahina
(Achyranthes splendes)
Residential, Opten Space/ Buffer, Parks, Golf Course

Pōhuehue
(Ipomoea pes-caprae)
Residential, Open Space/ Buffer, Parks, Golf Course

Ahu'awa
(Mariscus javanicus)
Parks, Golf Course

'Ōhai
(Sesbania tomentosa)
Residential, Open Space/ Buffer, Parks, Golf Course

'Ilie'e
(Plumbago zeylanica)
Residential, Open Space/Buffer, VMX, Parks, Golf Course

'Ihi
(Portulaca molokiniensis)
Residential, VMX, Parks, Golf Course

Shrubs

Maiapilo
(Caparis sandwichiana)
Residential, Open Space/Buffer, Parks, Golf Course

'Āweoweo
(Chenopodium oahuense)
Residential, Open Space/Buffer, Parks, Golf Course

Croton
(Codiaeum variegatum 'Norma')
Residential, VMX,

Nā'ū
(Gardenia brighamii)
Residential, VMXt

Tiare
(Gardenia taitensis)
Residential, VMX, Golf Course, Parks

Ma'o
(Gossypium tomentosa)
Residential, VMX, Open Space/Buffer, Golf Course, Parks

Pīkake
(Jasminum sambac)
Residential, VMX

Kulu'i
(Nototrichium sandwicense)
Residential, VMX, Open Space /Buffer, Parks, Golf Course

Alahe'e
(Psydrax odorata)
Residential, Open Space /Buffer, Parks Golf Course

Shrubs (cont.)

Hau
(Hibiscus tiliaceus)
Residential, VMX, Open Space/Buffer, Golf Course, Parks

Ha'o
(Rauvolfia sandwicensis)
Residential, Open Space /Buffer, Parks Golf Course

Naupaka
(Scaevola sericea)
Residential, VMX, Open Space /Buffer, Parks Golf Course

'A'ali'i
(Dodonaea viscosa)
Residential, VMX, Open Space/Buffer, Parks, Golf Course

Emerald Green Ti
(Cordyline 'Emerald Green')
Residential, VMX,

Koki'o 'Ula'ula
(Hibiscus kokio)
Residential, VMX

Trees

True Kou
(Cordia subcordata)
Residential, VMX, Open Space/ Buffer, Parks, Golf Course

Koai'a
(Acacia koai'a)
Residential, Open Space /Buffer, Parks, Golf Course

Kukui
(Aleurites moluccana)
Residential, VMX, Parks, Golf Course

Wiliwili
(Erythrina sandwicensis)
Open Space/Buffer, Parks, Golf Course

Beach Heliotrope
(Messerschmidia argentea)
Residential, VMX, Open Space/Buffer, Parks, Golf Course

Noni
(Morinda citrifolia)
Residential, Parks

Mānele
(Sapindus saponaria)
Residential, Open Space /Buffer, Parks, Golf Course

Milo
(Thespesia populnea)
Residential, Open Space /Buffer, Parks, Golf Course

Hong Kong Orchid
(Bauhinia blakeana)
Street Tree, Residential, VMX, Parks

Trees (cont.)

Dwarf Poinciana
(Caesalpinia pulcherrima)
Residential, VMX, Open Space/ Buffer, Parks, Golf Course

Rainbow Shower
(Cassia javanica x. C. fistula)
Street Tree, Residential, VMX, Parks

Monkey Pod
(Samanea sam)
VMX, Parks, Golf Course

Hala
(Pandanus tectorius)
Residential, Open Space/Buffer, Parks
Golf Course

Lonomea
(Sapindus oahuensis)
VMX, Open Space/Buffer, Parks
Golf Course

Koa
(Acacia koa)
Open Space/Buffer, Parks,
Golf Course

Plant List

Honua'ula Landscape Plant List

Trees	Residential	VMX	Buffer	Parks	Golf Course	Nature Preserve	Street
Koa *(Acacia koa)*	•		•	•	•		
Koai'a *(Acacia koai'a)*	•		•	•	•		
Kukui *(Aleurites moluccana)*	•	•		•	•		
Wiliwili *(Erythrina sandwicensis)*			•		•	•	
'Ōhi'a *(Metrosideros polymorpha)*			•	•	•	•	
Hong Kong Orchid *(Bauhinia blakeana)*	•	•					•
Dwarf Poinciana *(Caesalpinia pulcherrima)*	•	•	•	•	•		
Rainbow Shower *(Cassia javanica x. C. fistula)*		•		•	•		•
Silver Buttonwood *(Conocarpus erectus var. Argentea)*	•	•		•	•		•
True Kou *(Cordia subcordata)*	•	•	•	•	•	•	•
Beach Heliotrope *(Messerschmidia argentea)*	•	•	•	•	•		
Noni *(Morinda citrifolia)*	•			•			
Madagascar Olive *(Noronhia emarginata)*	•	•		•			•
Hala (Pandanus tectorius)	•	•		•	•		
Lonomea *(Sapindus oahuensis)*		•	•	•	•		
Mānele *(Sapindus saponaria)*	•		•	•	•	•	
Milo *(Thespesia populnea)*			•	•	•		
Be-Still *(Thevetia peruviana)*			•	•	•		
Monkeypod *(Samanea saman)*				•	•		
Shrubs	**Residential**	**VMX**	**Buffer**	**Parks**	**Golf Course**	**Nature Preserve**	**Street**
Maiapilo *(Capparis sandwichiana)*	•		•	•	•	•	
'Āhinahina *(Achyranthes splendes var. rotunda)*	•		•	•	•	•	
'Akoko *(Chamaesyce celastroides var. lorifolia)*	•		•	•	•	•	
'A'ali'i *(Dodonaea viscosa)*	•	•	•	•	•	•	
'Uhaloa *(Waltheria indica)*							
Hāpu'u *(Cibotium glaucum)*	•	•					
Croton *(Codiaeum variegatum 'Norma')*	•	•					
Emerald Green Ti *(Cordyline 'Emerald Green')*	•	•			•		
Maui Beauty' Red Ti *(Cordyline 'Maui Beauty')*	•	•			•		
Queen Emma Spider Lily *(Crinum augustum)*	•	•			•		
Na'u *(Gardenia brighamii)*	•	•			•		
Tiare *(Gardenia taitensis)*	•	•			•		
Ma'o *(Gossypium tomentosum)*	•		•	•	•		
Parrot's Heliconia *(Heliconia psittacorum)*	•	•					
Koki'o 'Ula'ula *(Hibiscus kokio)*	•	•			•		
Hau *(Hibiscus tiliaceus)*	•		•	•	•		
Ixora *(Ixora spp.)*	•	•			•		
Pīkake *(Jasminum sambac)*	•	•					
Mock Orange *(Murraya paniculata)*	•	•	•	•	•		
Kulu'i *(Nototrichium sandwicense)*	•	•	•	•	•	•	
'Ūlei *(Osteomeles anthyllidifolia)*	•		•		•	•	
Alaha'e *(Psydrax odorata)*	•		•	•	•	•	
Ha'o *(Rauvolfia sandwicensis)*	•		•	•	•	•	
Naupaka *(Scaevola sericea)*	•	•	•	•	•	•	
'Ilima *(Sida fallax)*	•	•	•	•	•	•	
Ground Cover	**Residential**	**VMX**	**Buffer**	**Parks**	**Golf Course**	**Nature Preserve**	**Street**
Nehe *(Wollastonia integrifolia)*	•	•	•	•	•		•
Golden Duranta *(Duranta repens aurea)*	•	•		•	•		
Naio Papa *(Myoporum sandwicense)*	•	•		•	•	•	•
Wheeler's Dwarf *(Pittosporum tobira)*	•	•		•	•		
Dwarf Naupaka *(Scaevola coriacea)*	•	•	•	•	•	•	
Purple Heart *(Tradescantia pallida 'Purpurea')*	•	•		•	•		
Pōhinahina *(Vitex rotundifolia)*	•	•	•	•	•	•	•
'Āhinahina *(Achyranthes splendens var. rotundata)*	•		•	•	•	•	
Aechme *(Aechmea spp.)*	•	•					
'Akoko *(Chamaesyce celastroides)*	•	•	•	•	•	•	
Hinahina *(Heliotropium anomalum)*	•	•	•	•	•	•	
Day Lily *(Hemerocallis aurantiaca)*	•	•					
Hunakai *(Ipomoea imperati)*	•		•	•	•		•
Pōhuehue *(Ipomoea pes-caprae)*	•		•	•	•		•
Pau o Hi'iaka *(Jaquemontia ovalifolia)*	•		•	•	•		•
Ahu'awa *(Mariscus javanicus)*					•		
Ala'alawainui *(Peperomia blanda)*	•	•	•	•	•	•	
'Ilie'e *(Plumbago zeylanica)*	•	•	•		•	•	
'Ihi *(Portulaca molokiniensis)*	•	•		•	•	•	
'Ohai *(Sesbania tomentosa)*	•		•	•	•	•	•
Black Coral 'Ilima (Sidax fallax)	•	•	•	•	•	•	•

Ground Cover	Residential	VMX	Buffer	Parks	Golf Course	Nature Preserve	Street
‘Āwikiwiki *(Canavalia pubescens)*	•		•		•	•	
Maiapilo *(Capparis sandwichiana)*	•		•		•	•	
‘Ānunu *(Sicyos pachycarpus)*	•		•		•	•	
Pua kala *(Argemone glauca)*	•		•		•	•	
Konakona *(Panicum torridum)*	•		•		•	•	
Pili *(Heteropgan contortus)*	•		•		•	•	
Ipomea *(Ipomoea tuboides)*	•		•		•	•	•
Iwa'iwa *(Doryopteris decipiens)*	•		•		•	•	
Alena *(Boerhavia herbstii)*	•		•		•	•	
Koali awahia *(Ipomoea indica)*	•		•		•	•	
Pellaea *(Pellaea ternifolia)*	•		•		•	•	
Maidenhair fern *(Adiantum capillus veneris)*	•		•		•	•	

Appendix H

Wildlife Surveys

Wildlife Survey – Honuaʻula

Wildlife Survey of Honua'ula (Wailea 670) Kīhei, Maui

Prepared for

Honua'ula Partners, LLC
381 Huku Li'i Place, Suite 202
Kīhei, Maui 96753

Prepared by

SWCA Environmental Consultants
201 Merchant Street Suite 2310
Honolulu, HI 96813

January 2009
Updated February 2010

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1.0 BACKGROUND AND PURPOSE OF THE STUDY

SWCA Environmental Consultants (SWCA) was tasked to conduct botanical and wildlife surveys within the 271 hectare (ha) or 670 acre (ac) Honua'ula (Wailea 670) Property (hereinafter referred to as the 'Property') in Kīhei, Maui. This report documents the results of the wildlife surveys conducted by SWCA within the Property. Specific objectives include documenting the presence and relative abundance of birds, mammals, amphibians, and reptiles at the Property; and, determining the presence and abundance of any protected species including migratory shorebirds, waterbirds, federally and state listed endangered or threatened species, and 'species of concern'.

The study supplements prior surveys of the same parcel by Bruner (1988, 1993, and 2004), and satisfies Condition 9 of the Maui County Council for Project District II Zoning approval. This report also satisfies the requirements of Hawai'i Revised Statutes Chapter 343 for description of natural resources, and will be cited in the Environmental Impact Statement (EIS) being prepared for Honua'ula. A companion document addressing vegetation issues was prepared by SWCA and is being submitted under separate cover (SWCA 2009).

This report was authored by Ling Ong, Ph.D., Stephen M. Mosher, M.S., Tiffany Thair, (M.S. candidate), and Ryan Taira, B.A. of SWCA. Peer review was provided by Michelle Christy, Ph.D. and John Ford, M.S. of SWCA. Field work was conducted by Dr. Ong and Mr. Mosher with assistance from Dr. David Preston of the Bishop Museum Department of Entomology, Betsy Gagne of the Natural Area Reserve System, Hawai'i Department of Land and Natural Resources-Division of Forestry and Wildlife (DLNR-DOFAW), and biologist James Kwon of the U.S. Fish and Wildlife Service (USFWS) Division of Ecological Services, Honolulu.

2.0 DESCRIPTION OF THE PROPERTY

Honua'ula (Wailea 670) encompasses 270 ha (670 ac) on the southeastern slope of Mt. Haleakalā, Maui, between approximately 89 m (290 ft) and 220 m (720 ft) elevation (Figure 1). Approximately 200 ha (500 ac) in the northern portion of the parcel is underlain by older lavas of the Kula Volcanic Series. The remaining 70 ha (170 ac) on the south side of the Property is underlain by relatively younger Hana Volcanic Series lavas. This area is characterized by an extremely rough surface composed of broken 'a'ā lava. Weathering led to the formation of a thin layer of soil over the northern 200 ha, but since the southern portion is derived from younger volcanic eruptions, less weathering of the 'a'ā in this region has led to presence of little or no soil (PBR Hawaii 1988).

Twenty-six (26) native plant species and 120 non-native plant species were described by SWCA (2009) and other investigators in three distinct vegetation types that provide habitat for wildlife within the Property (Figure 2). The three vegetation types within the Property are the *kiawe*-buffelgrass (*Prosopis pallida-Cenchrus ciliaris*) grassland, mixed gulch vegetation, and remnant mixed *kiawe-wiliwili* (*Prosopis pallida-Erythrina sandwicensis*) shrubland. About 75% of the northern portion of the Property is characterized by an extensive grassland comprised primarily of *kiawe* (*Prosopis pallida*) *and* buffelgrass (*Cenchrus ciliaris*).. The *kiawe*-buffelgrass grassland is bisected from east to west by several gulches that carry flood waters to the sea. The gulch vegetation is comprised of various species of ferns, native *Pili* grass (*Heteropogon contortus*), and other species. The third vegetation type is limited to the 'a'ā lava flow in the southern quarter of Property and consists of scattered groves of large-stature *wiliwili* (*Erythrina sandwicensis*) and co-dominant *kiawe* trees (*P. pallida*) (SWCA 2009).

Axis deer (Axis axis) and feral goats (Capra hircus hircus) have had unrestricted access throughout the Property and pose a serious threat to native plant species and to the integrity of the remnant mixed kiawe-wiliwili shrubland. Many of the wiliwili trees on the Property have been recently infested by the invasive gall wasp (Quadratichus erythrinae) which also threatens the entire ecosystem. Historically, the Property has been exposed to cattle grazing.

SWCA Inc. Honua'ula

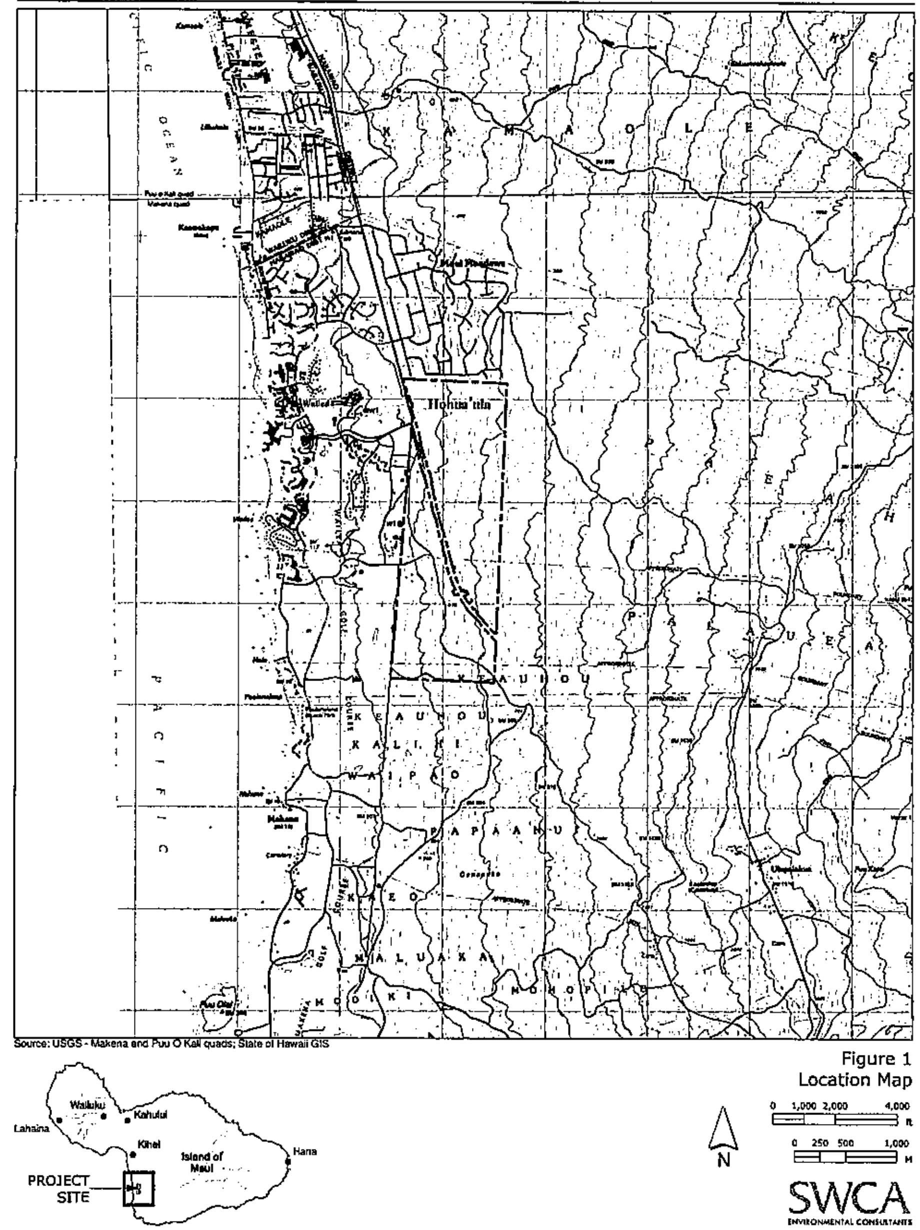
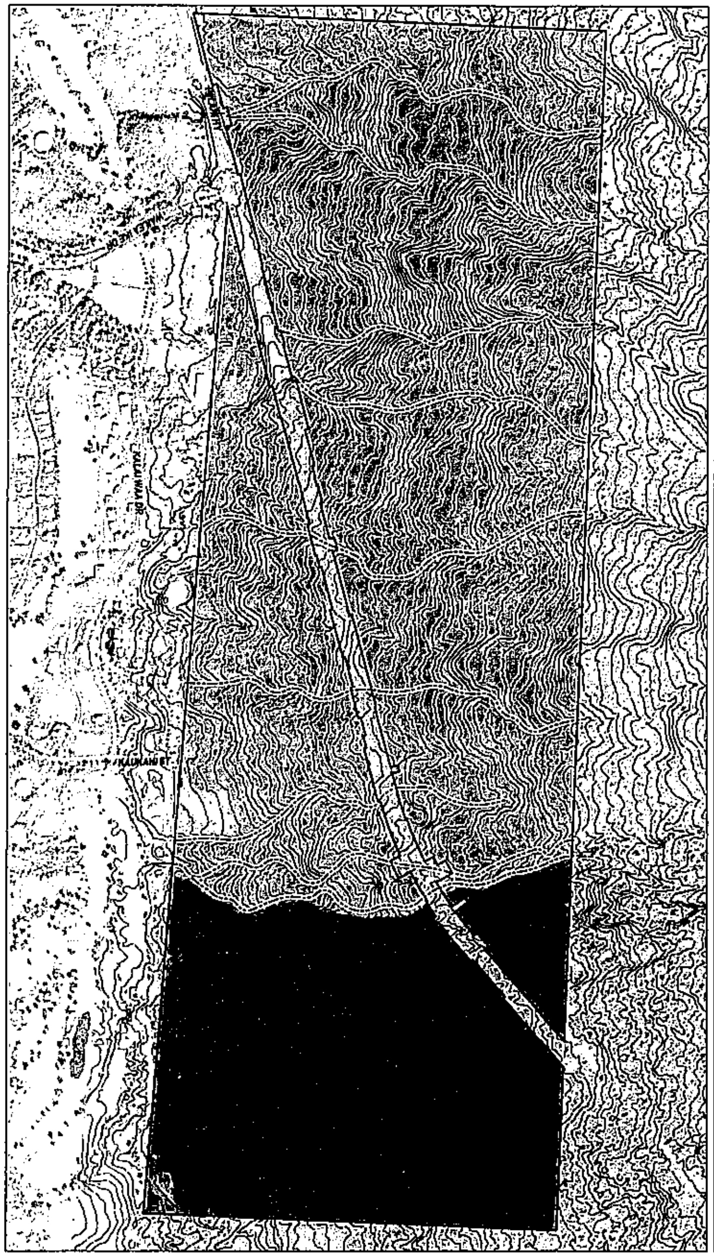


Figure 1
Location Map

SWCA Inc. Honua'ula



Legend
Project Boundary
Vegetation Types
Kiawe-buffel Grass Grassland
Kiawe-wiliwili Shrubland
Mixed Gully, Kiawe-Guinea Grass Vegetation

Boundary Source: PBR Hawaii
Aerial Source: PDC (Pacific Disaster Center)

Figure 2
Vegetation Types

N
0 250 500 1,000 ft
0 50 100 200 M

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Small portions of the northern *kiawe*-buffelgrass grassland are infrequently grazed by cattle belonging to 'Ulupalakua Ranch under agreement with Honua'ula Partners, LLC. Honua'ula Partners, LLC constructed a cattle fence bisecting the parcel to prevent cattle from entering the remnant *kiawe-wiliwili* shrubland in the southern portion of the Property. There is no evidence of other agricultural activity having occurred previously (PBR Hawaii 1988); however, the area was used during the Second World War as a training and maneuver area for armored vehicles (Erdman, Ulupalakua Ranch, pers. comm.).

3.0 METHODS OF STUDY

SWCA initially conducted a literature review of natural resources within the region that encompasses the Property, and considered the comments and concerns expressed by resource agencies and the Maui County Council in prior correspondence.

3.1 Avian Survey Methods

Point count surveys were conducted by SWCA biologists Ling Ong, Ph.D. and Stephen Mosher, M.S. on May 27-29 and September 19-21, 2008. Twenty-eight (28) point count stations were established throughout the Property in all habitat types (Figure 3). The location of each point count site was confirmed with a GPS receiver and two observers were present at each point count. Visual observations of birds were conducted with 10 x 50 binoculars with a 6.5 degree field of vision; and aural observations were also conducted by listening for vocalizations.

The relative densities of species were estimated using five-minute 200 m (656 ft) radius point counts conducted during peak bird activity periods (0600 - 1100 and 1600 - 1900). Five minute point counts maximized the likelihood of detecting new species during the survey (Lynch 1995). Bird density data and species composition from the study were compared with the findings of Bruner (1988, 1993, and 2004). Mammals and reptiles seen or heard during the point count surveys were also recorded as incidental sightings. Rare or previously unrecorded bird, mammal, reptile, or amphibian species seen between count stations were also noted.

Line transect surveys were conducted by SWCA biologists Ling Ong, Ph.D. and Stephen Mosher, M.S. from September 19-21, 2008 to determine the presence and density of the two owl species known to inhabit the Property: the barn owl (*Tyto alba*) and the Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*) (Figure 4). Twelve transects between 900-1000 m (2,952-3,280 ft) long were oriented east-west across the entire length of the parcel. These transects were at least 250 m (820 ft) apart. An additional eight transects of 250 m (820 ft) were oriented north-south at the eastern and western boundaries of the property. Total transect length in *kiawe*-buffelgrass grassland habitat was 8.6 kilometers (5.4 miles), and 5.0 kilometers (3.1 miles) in the remnant *kiawe-wiliwili* shrubland portion of the Property.

Two observers were present on each transect survey. Owls observed along transects were identified to species and recorded, along with perpendicular distance between transect and owl. The density of owls present on site was calculated using the DISTANCE 5.0 program. As the resulting sample size was small, data from both species were pooled to obtain a combined owl density. Pueo densities were calculated by determining the ratio of pueo to barn owl sightings and adjusting the calculated owl density from the DISTANCE 5.0 program proportionately. Due to habitat differences, owl densities within the *kiawe*-buffelgrass area were analyzed separately from the remnant *kiawe-wiliwili* shrubland habitat.

3.2 Nocturnal Surveys for Hawaiian Hoary Bats

Surveys for endangered Hawaiian hoary bats (*Lasiurus cinereus semotus*) were conducted at the Property between 1830 and 0000 from September 19-21, 2008 by SWCA biologists Dr. Ling Ong and Stephen Mosher. These surveys were conducted under ideal weather conditions using night vision goggles (Morovison PVS-7 Ultra) and an Anabat detector (Titley Electronics, NSW Australia).

Anabat detectors assist in the identification of bats by recording their echolocation calls. The device also produces real-time audible output for humans to hear of the ultrasonic sounds the bat generates. Bat point count stations were established at 14 locations at least 400 m (1,312 ft) apart on jeep roads within the Property, and surveyed for five minutes each (Figure 3). The detection distance for bats using night vision goggles was estimated to be 30 m (98 ft) radius at each point count station.

3.3 Surveys for the Blackburn's Sphinx Moth

Surveys for endangered Blackburn's sphinx moths (*Manduca blackburni*) were conducted within the Property on March 13, 2008, May 27-29, 2008, and November 11, 2008. The March and May surveys were conducted by Bishop Museum entomologist David Preston, Ph.D. and Betsy Gagné, M.S. of the Hawai'i Division of Forestry and Wildlife, accompanied by SWCA biologist John Ford, M.S. Dr. Preston and Ms. Gagné were accompanied by biologist James Kwon of the USFWS. These surveys focused on host plants used by the various life stages of Blackburn's sphinx moth (*Manduca blackburni*) that are known to occur within the Property. Leaves and stems were examined carefully for the presence or sign of moths, including frass (fecal matter), cut stems and leaves, and eggs.

4.0 RESULTS

4.1 Endangered Species

Although not detected during pervious wildlife surveys by Bruner (1988, 1993 and 2004), endangered Blackburn's sphinx moth (*Manduca blackburni*) caterpillars and sign, as well as a single endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), were found within the Property during this study. Details of the sightings are presented in the following sections.

4.1.1 Blackburn's Sphinx Moth (*Manduca blackburni*)

The Blackburn's sphinx moth (Family: Sphingidae) was listed as federally endangered in February 2000 and was the first Hawaiian insect to be listed as an endangered species. It is the largest native insect in Hawai'i, with a wing span of up to 120 millimeters (5 inches) and long, narrow forewings (Figure 5). It is primarily grayish brown, with black bands across the top margins of the hind wings and five orange spots along each side of the abdomen. The body is thick and spindle shaped, tapering at both ends (USFWS 2003, Black 2005, and USFWS 2005). The caterpillar has two color morphs: bright green (Figures 6) or gray. White speckles are scattered throughout the caterpillar's back and a horizontal white stripe is present on the side of each segment (Black 2005). Characteristic of other hornworms, the caterpillar has a horn-like protrusion on the last abdominal segment (USFWS 2005). The species is often confused with the non-native potato hornworm (*Agrius cingulata*) which has also been recorded in the Hawaiian Islands.

The Maui Nui Recovery Unit for the Blackburn's sphinx moth consists of seven management units comprising approximately 22,788 ha (56,305 ac; USFWS 2002, 2003, 2005). Of these, approximately 45,867 ha (18,564 ac) located in four units are on Maui. The closest management units to the Property are Pu'u O Kali (Unit 8) and the Ahihi-Kinau NAR – Ulupalakua – Auwahi – Kanaio Management Unit (Unit 9), located roughly 2.5 and 4 km (1.6 and 2.5 miles) from the Property, respectively (Figure 7).

On March 13, 2008 in the early afternoon, Dr. Preston found a small Blackburn's sphinx moth caterpillar feeding on leaves of a non-native tree tobacco (*Nicotiana glauca*) in the southeastern corner of the Property (Figure 8). On that same day, he found evidence of feeding (cut stems and leaves, and the presence of frass) by Blackburn's sphinx moth caterpillars on tree tobacco plants at numerous other locations within the Property (Figure 10), and recorded the location of each with a GPS receiver. No Blackburn's sphinx moth caterpillars were recorded during the May survey, however, grazing damage was evident and recorded (Figure 10).

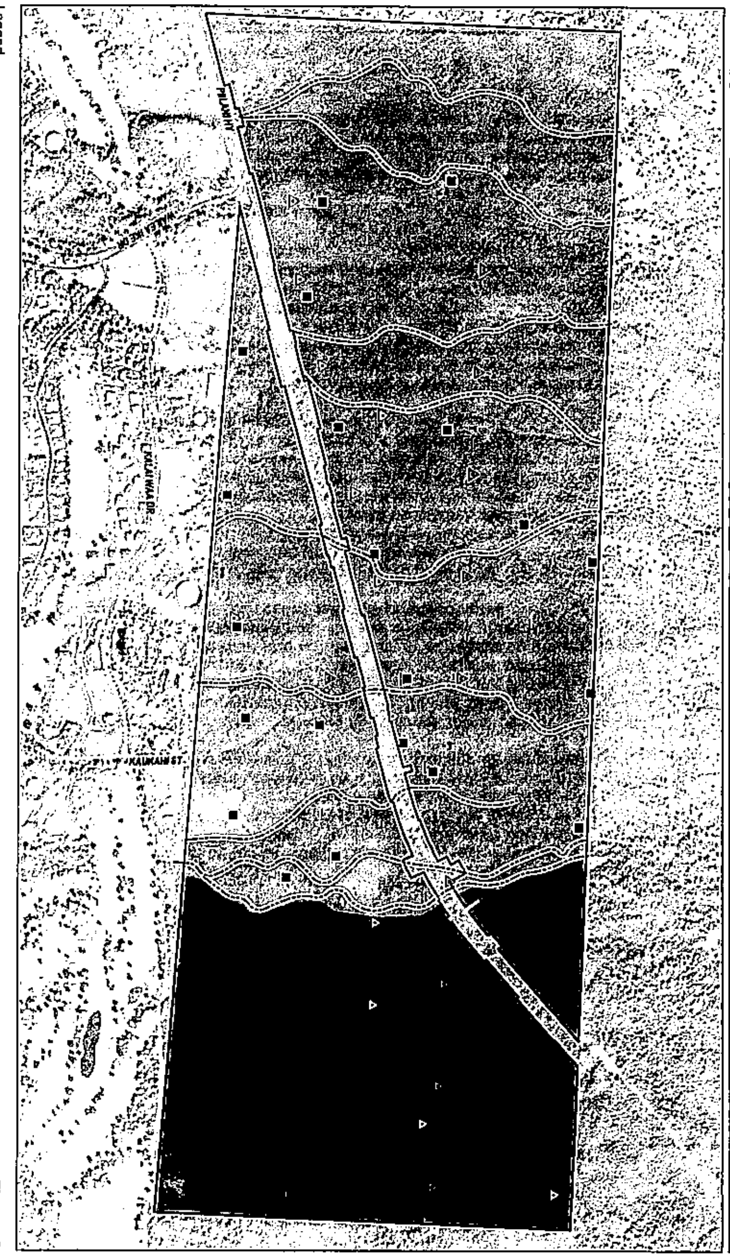
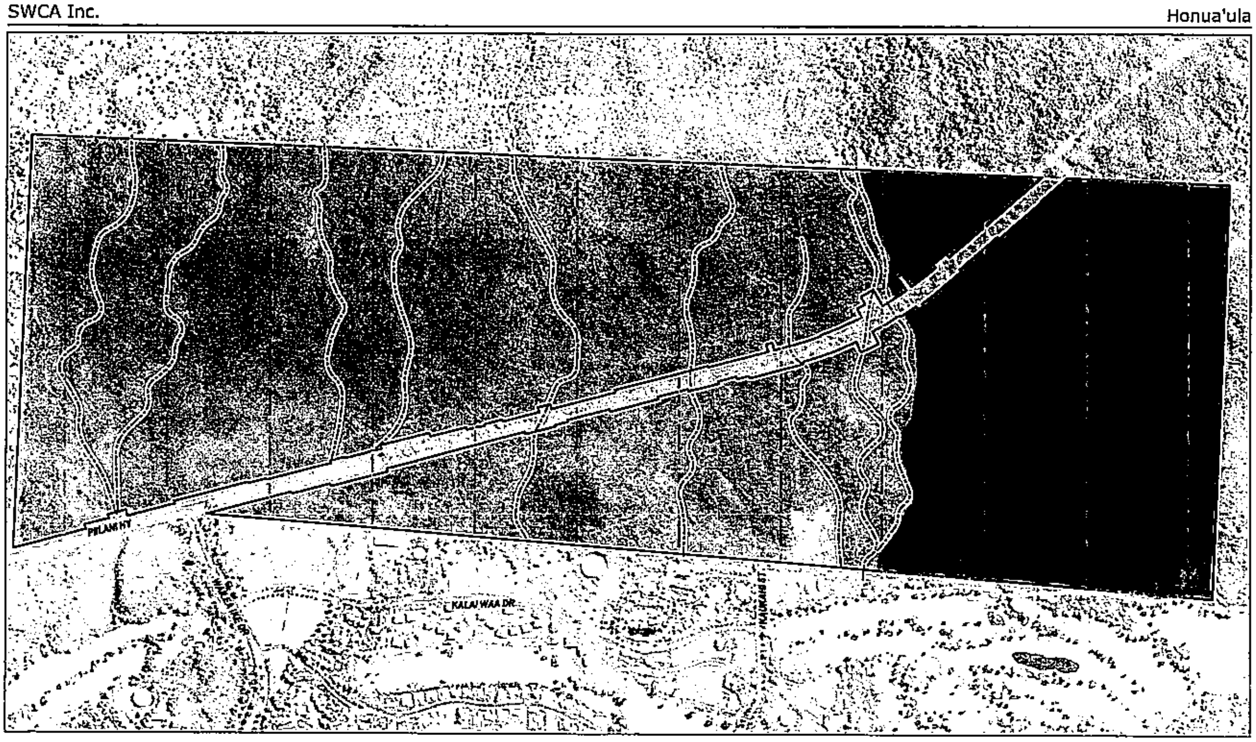


Figure 3
Bird and Bat Point Count Stations

Figure 5. An adult endangered Blackburn's sphinx moth. Photo by W.P. Mull.

Figure 6. This large green morph caterpillar of *M. blackburni* was photographed at Honua'ula on November 11, 2008 by SWCA staff.



Legend

- ☐ Project Boundary
- — Transect

Vegetation Types

- Kiawe-buffel Grass Grassland
- Kiawe-wiliwili Shrubland
- ---- Mixed Gully, Kiawe-Guinea Grass Vegetation

Figure 4
Pueo Transects

0 250 500 1,000 ft
0 50 100 200 M

Boundary Source: PBR Hawaii
Aerial Source: Pacific Disaster Center (PDC)

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Figure 8. This young M. blackburni caterpillar was photographed by Dr. David Preston (Bishop Museum) feeding on a non-native tree tobacco leaf (Nicotiana glauca) on March 13, 2008 in the southeastern portion of the Property.

On November 11, 2008, two large Blackburn's sphinx moth caterpillars were observed on the stems of tree tobacco plants within the Property by Dr. Preston and Ms. Gagne. The larger of the two caterpillars, approximately 100 mm (4 in) in length, was found about 30 m (100 ft) inside the Property from the Diamond Resort gate. The smaller caterpillar, approximately 50 mm (2 in) in length, was seen near the southern boundary of the Property (Figure 11).

Other non-native host plants of the Blackburn's sphinx moth caterpillars include *Solanum melongena* (eggplant), *Lycopersicon esculentum* (tomato), and possibly *Datura stramonium* (Jimson weed). These species have not been found within the Honua'ula Property in any previous study (Char 1988, 1993, 2004; SWCA 2009). However, adult moths are known to feed on nectar of the native *koali awahia* (*Ipomea indica*), and *halapepe* (*Pleomele auwahiensis*) plants, and possibly upon the native *maiapilo* (*Capparis sandwichiana*) and *'ilie'e* (*Plumbago zeylanica*) (USFWS 2005). The native *koali awahia*, *maiapilo*, and *'ilie'e* are widespread throughout the Honua'ula Property (SWCA 2009).

4.1.2 Hawaiian Hoary Bat (*Lasiurus cinereus semotus*)

SWCA biologists Ong and Mosher sighted a single endangered Hawaiian hoary bat at the southern boundary of the Property flying seaward at 18:44 hours on September 19, 2008. A single call from this individual was simultaneously recorded on the Anabat detector. No other sightings of bats were made during the period of study. The location of the bat sighting is illustrated on Figure 10. *Kiawe* which is abundant on the Property has been documented as roost trees for the Hawaiian hoary bat, thus, while it was not observed, it is possible that Hawaiian hoary bats roost within the Property.

4.2 Endemic Birds

No Hawaiian short-eared owls or *pueo* (*Asio flammeus sandwichensis*) were recorded during the wildlife surveys by Bruner (1988, 1993, and 2004). However, pueo were observed within the Property during the line transect surveys (Figure 4 and Figure 10). Neither the *pueo* nor barn

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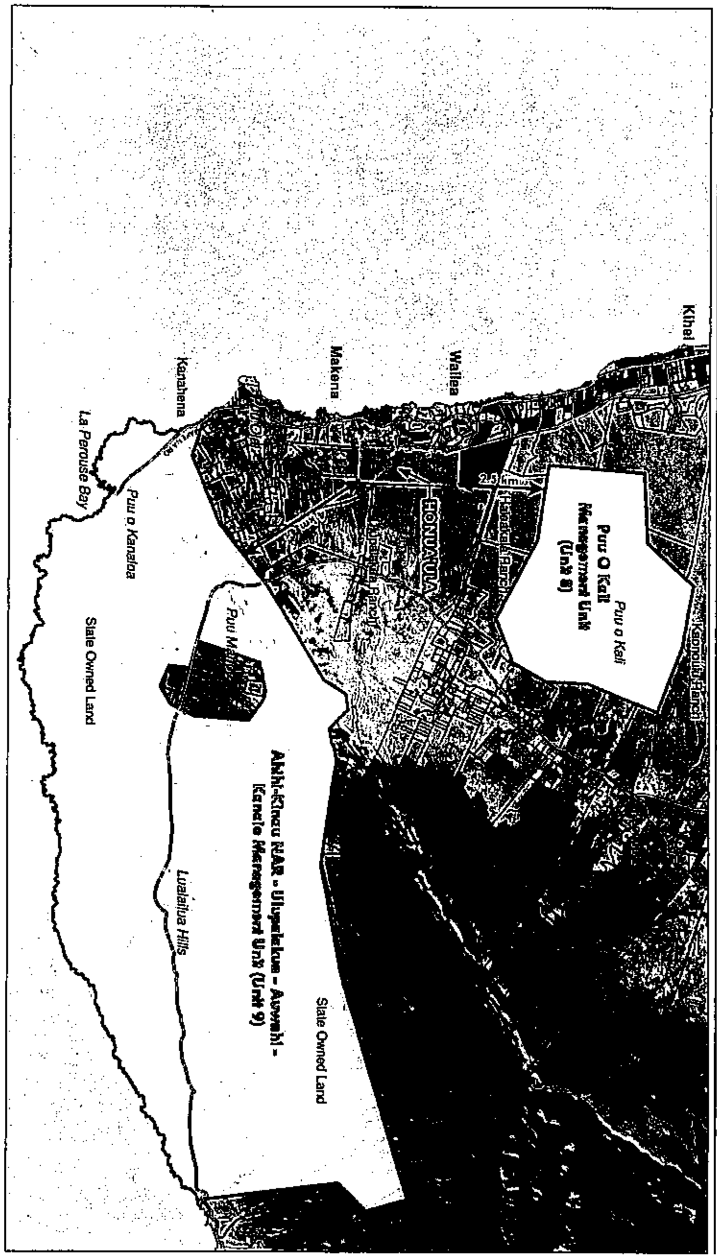


Legend
- Project Boundary
- Management Units

Figure 7
Management Units for Blackburn's Sphinx Moth in South Maui

Boundary Source: PBR Hawaii
Base Data Source: State of Hawaii GIS

owls were observed during the bird point counts. Twelve (12) barn owls, six *pueo*, and six other unidentified owls were sighted in grassland habitat. The ratio of barn owl sightings to *pueo* sightings in grassland was estimated at 2:1. No pueo or barn owls were sighted in the southern remnant *kiawe-wiliwili* shrubland portion of the Property. No owl nests were found. Based on these surveys, the estimated density of owls in the grassland was 13.3 ± 3.7 SE individuals per km^2 (or 34.5 ± 9.1 individuals/$mile^2$). The estimated number of owls property-wide was 26.0 ± 0.3 SE (95% confidence interval: 14 - 46 owls). This results in an estimate of eight individual pueo (95% confidence interval: 5 – 15 individuals) present on the Property. These individuals are likely to occur within the *kiawe*-buffelgrass grassland habitat. The grasslands present at the Honua'ula Property are likely to provide good foraging, and nesting habitat for *pueo*. However, these nesting habits increase the species vulnerability to predation by rats (*Rattus* spp.), cats (*Felis catus*), and the small Indian mongoose (*Herpestes auropunctatus*), all of which are present in the area.

4.3 Indigenous Birds

No confirmed sighting of native birds occurred within the Property during the point count or transects surveys. No native birds had been recorded in or flying over the Property during the wildlife surveys by Bruner (1988, 1993, and 2004). Hawai'i DLNR-DOFAW biologist Betsy Gagné and SWCA biologist John Ford sighted a native black-crowned night heron (*Nycticorax nycticorax hoactli*) roosting in and flying among *kiawe* trees adjacent to a jeep road near an elevation of 150 m (500 ft) on the southern border of the Property. On the same day, the biologists also observed a flock of perhaps five to seven great frigatebirds or 'iwa (*Fregata minor palmerstoni*) hovering above and swooping down to feed or drink in one of the golf course ponds at the Wailea Resort, immediately west of the Honua'ula Property boundary. This suggestive that the Honua'ula golf course, once completed, will also serve to attract additional bird species.

Seabirds forage over the ocean, but many species return to nest inland. Seabirds that may be seen over the Property during the day include the great frigatebird or 'iwa (*Fregata minor palmerstoni*) and tropic birds (*Phaethon* spp.). The USFWS suggested that seabirds may fly over the Property at night to and from nesting sites at higher elevations on the slopes of Haleakalā. These seabirds include the endangered Hawaiian petrel (*Pterodroma sandwichensis*) and threatened Newell's shearwater (*Puffinus auricularis newelli*). While seabirds may traverse the area at night, they do not nest on the Property. Neither of the latter two species was observed during any of the wildlife surveys cited herein.

4.4 Migratory Birds

SWCA biologists have seen Pacific golden plovers (*Pluvialis dominica*) on golf cart roads and greens on adjacent golf courses on several occasions during winter months in past years. Dr. Phil Bruner also recorded one Pacific golden plover within the Property during his February 1988 survey. Some migratory birds overwinter in Hawai'i, most appearing in late August or September and leaving in May (Hawaiian Audubon Society 2005).

In a chance sighting in March 2006, SWCA biologist John Ford, M.S. observed a Northern harrier (*Circus cyaneus*) flying east to west, then back again and low over *wiliwili* trees in the southern portion of the Honua'ula Property near an elevation of 150 m (500 ft). Sightings of this relatively recent arrival to the islands have also been reported by others near Hosmer's Grove and over the Paliku end of the Haleakalā Crater floor and the surrounding hills, on the Island of Hawai'i over the Saddle Road, and on Kawailoa Ridge above Hale'iwa, O'ahu. That no other migratory birds were observed during this study could be a result of surveying at the start of the migration season.

4.5 Alien or Introduced Birds

In his most recent survey of the Property, Bruner (2004) found Japanese white-eye (*Zosterops japonicus*), house finch (*Carpodacus mexicanus*), black francolin (*Francolinus francolinus*), and zebra dove (*Geopelia striata*) to be the most abundant non-native birds at Honua'ula, followed by the nutmeg manikin (*Lonchura punctulata*), northern cardinal (*Cardinalis cardinalis*). He reported

no substantive change in the composition or abundance of alien bird species he described from the Property over a span of 16 years (Bruner 1988, 1993, and 2004).

SWCA biologists observed 16 species of introduced birds within the Property during this study. Japanese white-eye (*Zosterops japonicus*), nutmeg manikin (*Lonchura punctulata*), zebra dove (*Geopelia striata*), and northern cardinal (*Cardinalis cardinalis*) were found to be the most abundant (Table 1). African silverbills (*Lonchura cantans*) and red-crested cardinals (*Paroaria coronata*) were common along the southern border of the Property. Four additional introduced birds not reported by Bruner (1988, 1993, and 2004) were recorded during this study. Cattle egrets (*Bubulcus ibis*) were seen flying overhead on several occasions. Mourning doves (*Zenaida macroura*) were only heard in the 'a'ā section of the Property. Chestnut munias (*Lonchura atricapilla*) were seen on one occasion and Erckel's francolin (*Francolinus erckelli*) were heard once.

Table 1. Bird species and relative abundance observed on the Honua'ula Property during bird surveys in May and September 2008.

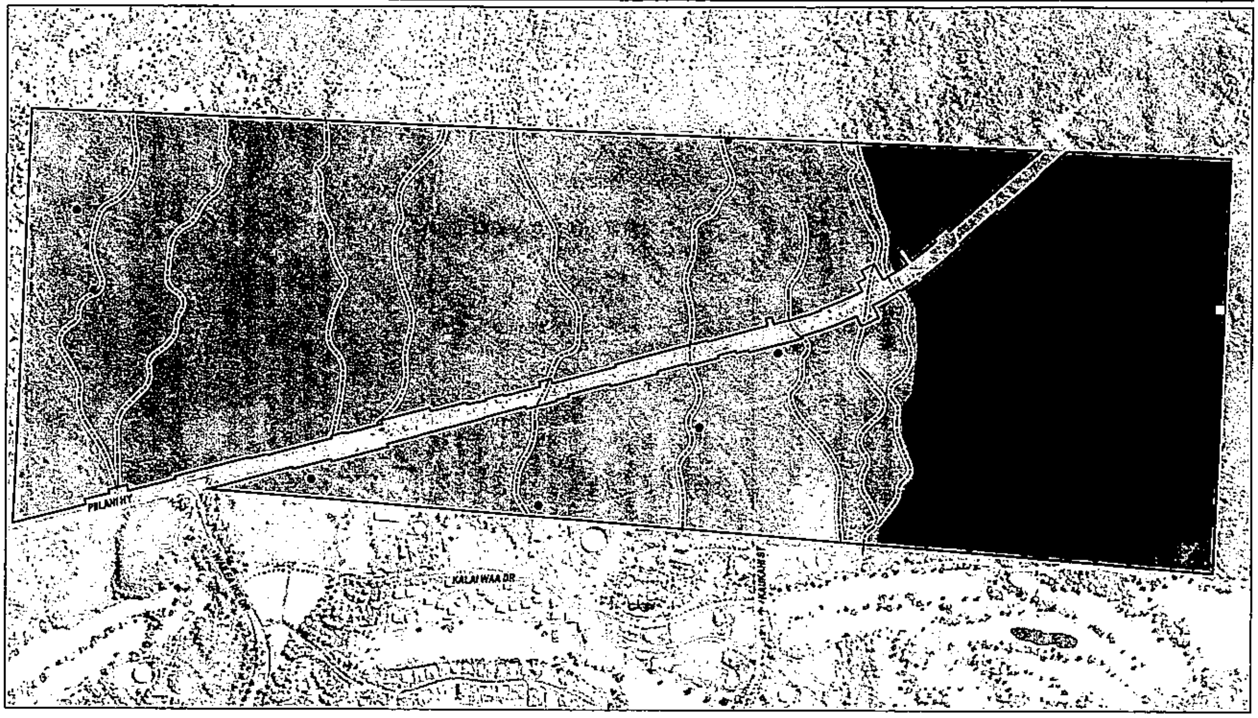
Species	Common Name	Status	Birds per point count (n=30)	Abundance Rank
Asio flammeus sandwichensis	Pueo	N (NR)	x	-
Bubulcus ibis	Cattle Egret	I (NR)	x	-
Zenaida macroura	Mourning Dove	I (NR)	0.03	12
Francolinus erckelli	Erckel's Francolin	I (NR)	0.03	12
Francolinus pondicerianus	Gray Francolin	I	0.23	9
Francolinus francolinus	Black Francolin	I	0.73	5
Streptopelia chinensis	Spotted Dove	I	0.30	7
Geopelia striata	Zebra Dove	I	1.70	3
Tyto alba	Barn owl	I	x	-
Zosterops japonicus	Japanese White eye	I	3.50	1
Mimus polyglottos	Common Mockingbird	I	0.03	12
Acridotheres tristis	Common Myna	I	0.07	11
Cardinalis cardinalis	Northern Cardinal	I	1.3	4
Carpodacus mexicanus	House Finch	I	0.23	9
Lonchura punctulata	Nutmeg Mannikin	I	3.03	2
Lonchura atricapilla	Chestnut Munia	I (NR)	x	-
Lonchura cantans	African Silverbill	I	0.67	6

I = introduced, N = native NR = new record since 2004
X= observed outside point counts

4.6 Mammals

The Hawaiian hoary bat (see 5.1.2) was the only native mammal observed on the Property. The small Indian mongoose (*Herpestes javanicus*) was observed within the Property, but was uncommon. Small herds of four to 12 axis deer (*Axis axis*) were commonly seen. Deer scat, tracks, and evidence of buck rubs (rubbing of antlers on trees) were evident throughout the entire parcel. Mongoose and deer were previously reported by Bruner (1988, 1993 and 2004). Goats (*Capra hircus*) have also been seen by others in the Property; however, none were observed during this study.

Domestic cattle (*Bos taurus*) are grazed infrequently within the northern portion of the Property and regularly to the east on lands owned by 'Ulupalakua Ranch; however, no cattle or evidence of cattle were observed within the boundaries of the Property during this study.



Legend

- Project Boundary
- • *Asio flammeus sandwichensis* (Pueo) Sighting
- □ *Lasiurus cinereus semotus* (Hoary Bat) Sighting

Vegetation Types

- Kiawe-buffel Grass Grassland
- Kiawe-wiliwili Shrubland
- ---- Mixed Gully, Kiawe-Guinea Grass Vegetation

Figure 10
Pueo and Bat Sightings

0 250 500 1,000 ft
0 50 100 200 M

Boundary Source: PBR Hawaii
Aerial Source: Pacific Disaster Center (PDC)

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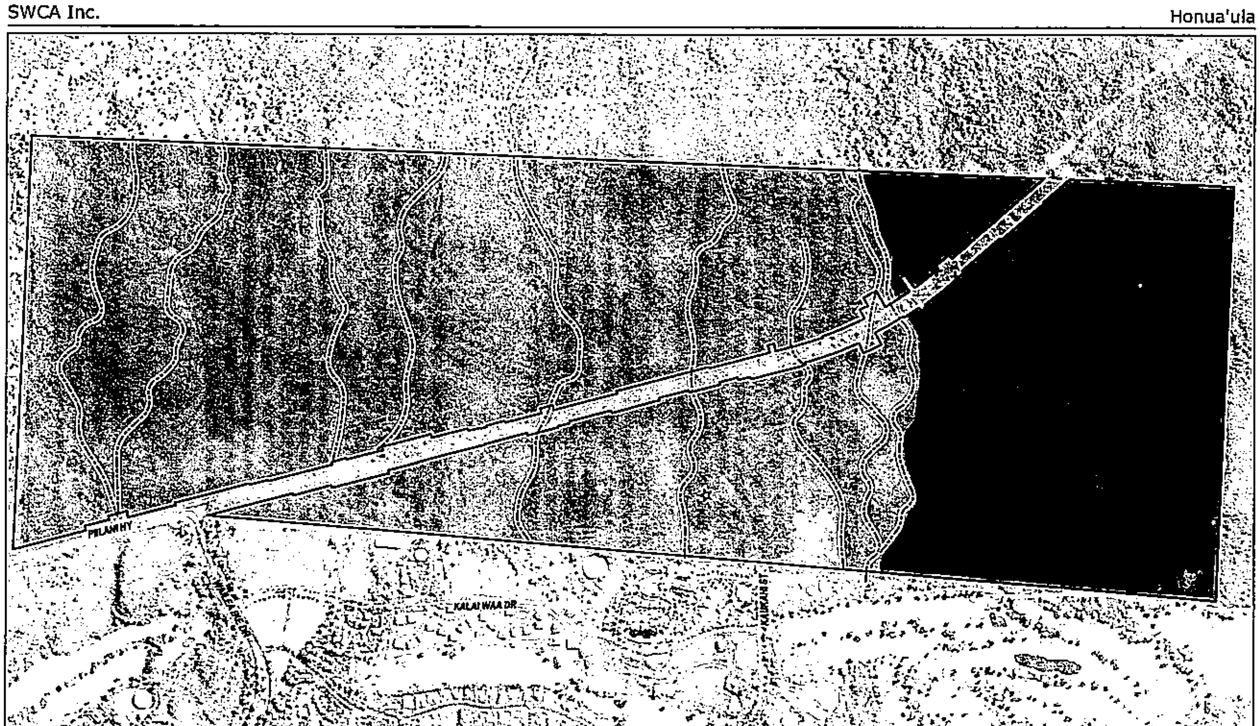

Legend

- Project Boundary
- ☆ *Manduca blackburni* (Blackburn's Sphinx Moth) Caterpillar Sighting March 13, 2008
- ☆ *Manduca blackburni* (Blackburn's Sphinx Moth) Caterpillar Sighting Nov 11, 2008
- \+ *Manduca blackburni* (Blackburn's Sphinx Moth) Sign Observed May 27-28, 2008

Vegetation Types

- Kiawe-buffel Grass Grassland
- Kiawe-wiliwili Shrubland
- ---- Mixed Gully, Kiawe-Guinea Grass Vegetation

Figure 9
Locations of Blackburn Sphinx Moth Caterpillars and Sign Locations

0 250 500 1,000 ft
0 50 100 200 M

Boundary Source: PBR Hawaii
Aerial Source: Pacific Disaster Center (PDC)

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Following this study; however, cattle were allowed to graze within the northern *kiawe*-buffelgrass lands within the Property. Cats (*Felis catus*), rats (*Rattus* spp.) and mice (*Mus*), while not observed, are expected to be present within the Property due to its proximity to the Maui Meadows subdivision and the Wailea Resort. Rat and mouse remains were detected in owl pellets found on the Property.

4.7 Reptiles and Amphibians

There are no native reptiles or amphibians in Hawai'i (McKeown 1996). Geckos (Gekkonidae) were heard calling, but not seen during avian point counts. Geckos were also heard but not seen along jeep roads on the southern border of the Property. No skinks (Scincidae) were observed during avian point counts. No amphibians were seen within the Property.

5.0 DISCUSSION

Two endangered animal species and one species of concern have been documented by SWCA biologists on the Property: the endangered Blackburn's sphinx moth (*Manduca blackburni*), the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), and the pueo (*Asio flammeus sandwichensis*), respectively.

Of particular interest is the surprising number of endangered Blackburn sphinx moth (*Manduca blackburni*) sightings (caterpillars and sign) within the Property. All sightings were associated with non-native tree tobacco plants (*Nicotiana glauca*). These are aggressive weedy plants that grow opportunistically in open, arid, disturbed locations (Wagner et al 1999) and are commonly found along road grades in the northern portion of the Property and throughout the *kiawe-wiliwili* shrubland. The USFWS's Recovery Plan for this species (USFWS 2005) identified conservation and recovery activities, including protection, management, and restoration of habitat and the species' host plants, specifically the native *'aiea* (*Nothocestrum* spp.), and a captive breeding and translocation program. While *'aiea* is not found within the Property and is not known to thrive at low elevations in areas like Honua'ula, the non-native tree tobacco is common here and is apparently frequented by the moths. The removal of non-native tobacco plants during construction will likely result in the loss of non-native feeding habitat for the caterpillar. The potential loss of food plants for the adult moths also exists as some other native plants are removed in portions of the Property.

Three recovery units encompassing 13 management units were identified in the Blackburn Sphinx Moth Recovery Plan (USFWS 2005) as necessary for the long-term survival and recovery of the species. The Pu'u O Kali Management Unit (Unit 8) and the Ahihi-Kinau NAR – Ulupalakua – Auwahi – Kanaio Management Unit (Unit 9) in South Central Maui are closest to Honua'ula (Figure 8). Designated critical habitat is found within Units 8 and 9, and within Kanaha Pond – Spreckelsville Management Unit (Unit 7) located near the Kahului Airport on Maui's north central coastline.

The pueo is most likely to be affected during the construction phase of the project on the site. Construction through grassland habitat will potentially disturb roosting and nesting pueo and is likely to permanently displace pueo from the Property due to the loss of grassland habitat.

No evidence of roosting or foraging by endangered Hawaiian hoary bats was observed by Bruner (1988, 1993, 2004) or SWCA (2009). Definitive conclusions about habitat use cannot be made on existing evidence. The removal of *kiawe* trees during construction may result in the loss of roosting habitat; however, many large stature trees suitable for roosting will be preserved and others propagated for landscaping as the site is developed.

Upon construction of the residential community and golf course at Honua'ula, water features and open fairways associated with the golf course will attract a number of endangered species to the Property. These include the *koloa* (*Anas wyvilliana*), *ae'o* (*Himantopus mexicanus knudseni*), 'alae ke'oke'o (*Fulica alai*), *'alae 'ula* (*Gallinula chloropus sandvicensis*), and *nēnē* (*Branta sandvicensis*).

In addition, there is the potential for lighting present on the Property to present an attraction hazard to juveniles of the threatened Newell's shearwater (*Puffinus auricularis newelli*) and endangered Hawaiian petrel (*Pterodroma sandwichensis*).

The native migratory *kolea* (*Pluvialis fulva*) which are protected under the Migratory Bird Species Act, frequently uses roads and open spaces when over-wintering in Hawai'i and may be displaced if construction occurs during the migratory season. However, it is anticipated that the construction of open spaces, gardens and lawns on the Property will provide additional habitat that kolea can utilize.

6.0 PROPOSED MITIGATION MEASURES

The Maui County Council promulgated 28 specific conditions in granting a Phase I project district zoning approval. Their specific conditions related to wildlife within the Property include:

> *7. That Honua'ula Partners, LLC, its successors and permitted assigns, shall prepare an animal management plan that shall be submitted during Project District Phase II processing and approved by the Department of Land and Natural Resources prior to submittal of Project District Phase III processing. Said plan shall include procedures for the management of animal intrusions including, but not limited to, construction of boundary or perimeter fencing, wildlife control permits, and rodent and feral cat control.*
>
> *Honua'ula Partners, LLC, its successors and permitted assigns, shall implement the approved animal management plan. The Department of Land and Natural Resources may require periodic updates of the plan.*
>
> *9. That Honua'ula Partners, LLC, its successors and permitted assigns, shall prepare an assessment of the owl (Pueo or Hawaiian Short-eared Owl) and the Hawaiian Hoary Bat in coordination with the Department of Land and Natural Resources, and, if appropriate, mitigative measures shall be incorporated into Kihei-Makena Project District 9. Said assessment shall be prepared prior to submittal of Project District Phase II processing.*

Honua'ula Partners, LLC is proposing to implement the following measures to conserve elements of the remnant *kiawe-wiliwili* shrubland and to protect the native plants and animals within the Property.

- To help provide habitat for Blackburn sphinx moths (*Manduca blackburni*), a Native Plant Preservation Area encompassing a contiguous area within the remnant *kiawe-wiliwili* shrubland will be dedicated in perpetuity to protect as much of the remnant *kiawe-wiliwili* shrubland plant community as possible. The protected area will meet the 7.3-52.6 ha (18-130 ac) directive imposed by the Maui County Council, and will ultimately be subject to approval by the Council. The Native Plant Preservation Area will encompass the highest densities of the rarest elements of the native vegetation within the project parcel. The only non-native species that will be allowed to remain in this area will be the tree tobacco (*Nicotiana glauca*) so as to provide food and habitat for endangered Blackburn's sphinx moths (*Manduca blackburni*). This may enhance the geographic connectivity between the two recovery units; and may also provide a source of sphinx moth caterpillars for the translocation program which has been identified as a desirable recovery activity (USFWS 2005).
- Conversely, non-native tree tobacco (*Nicotiana glauca*) plants will be removed from the property outside the Native Plant Preservation Area prior to construction. This will be done in consultation with biologists from DLNR-DOFAW and the USFWS to prevent accidental take of the Blackburn's sphinx moth (*Manduca blackburni*) caterpillar.
- Construction operations will be closely monitored to prevent accidental take of the various Blackburn's sphinx moth (*Manduca blackburni*) life stages. Should sphinx moths be found,

host plants will be marked for protection and not removed until deemed appropriate by DLNR-DOFAW and USFWS biologists.

- Upon completion of the proposed project, restrictions on landscaping and gardening will be enacted to prevent propagation of any plant in the Solanaceae (Nightshade) family that may attract Blackburn's sphinx moths (*Manduca blackburni*).
- A translocation program for Blackburn's sphinx moth (*Manduca blackburni*) caterpillars will be developed and implemented through preparation of a Habitat Conservation Plan (HCP), particularly for caterpillars found in landscaped areas of the Property, in consultation with DLNR-DOFAW and the USFWS.
- Intensive wildlife surveys will be continued from November – May through construction of the proposed project to look for signs of endangered Blackburn sphinx moths (*Manduca blackburni*) within the Property, to distinguish any signs found as the Blackburn sphinx moth (*Manduca blackburni*) and not other more common horn worm species, and to protect individual moths from destruction.
- Additional Hawaiian hoary bat (*Lasiurus cinereus semotus*) point count surveys will be conducted prior to construction to document the changes in abundance and determine habitat utilization of these species during the wet and dry seasons.
- A qualified wildlife biologist will monitor the Property for bats (*Lasiurus cinereus semotus*) during construction. Should bats (*Lasiurus cinereus semotus*) be found at the site during construction, assistance will be requested from the USFWS office in Honolulu.
- Clearing of habitat during construction will be monitored to reduce the potential take of non-volent juvenile bats (*Lasiurus cinereus semotus*) (Hart 2003).
- Propagation of native tree species will be conducted during landscaping to provide suitable bat (*Lasiurus cinereus semotus*) roosting habitat to mitigate for the loss of possible roosting trees during construction.
- Potential impacts to seabirds will be minimized by shielding outdoor lights in compliance with Chapter 20.35 (Outdoor Lighting) of the Maui County Code, avoiding night-time construction, and providing all project staff with information regarding seabird fallout. All project lights will be shielded so the bulb can only be seen from below. This is a common and successful mitigation measure employed throughout the Hawaiian Islands.
- Construction around areas found with pueo (*Asio flammeus sandwichensis*) nests will be delayed until the chicks have fledged.
- The entire perimeter of the Property has already been fenced to discourage feral ungulates and grazing cattle from entering the remnant *kiawe-wiliwili* shrubland; however, the fence is porous. Fencing requirements will be reviewed and updated as establishment of the Native Plant Preservation Area construction begins. An animal management plan will be implemented by the Natural Resource Manager to insure that goats, deer, pigs, and stray cattle are removed in a human manner from the proposed for native plant protection on the Property
- A Natural Resource Manager will be employed by Honua'ula Partners, LLC to develop and implement specific conservation programs to help insure the protection of native plants and animals within the Native Plant Preservation Area and other areas designated for native plant protection on the Property.
- An Animal Management Plan is being prepared under separate cover in cooperation with DLNR-DOFAW and USFWS during Project District Phase II processing.

- A Conservation and Stewardship Plan is also being prepared under separate cover to implement a natural resource management plan for the Native Plant Preservation Area and other areas designated for native plant protection on the Property.
- Finally, a multi-species Habitat Conservation Plan (HCP), to include the candidate endangered *'āwikiwiki* (*Canavalia pubescens*) is being prepared under Section 10(a)(1)(B) of the Endangered Species Act and in collaboration with DLNR and USFWS.

Taken together with the mitigation measures identified in the Botanical Survey of Honua'ula (Wailea 670) (SWCA 2009), these actions fully satisfy the objectives and the intent of the special Project District Phase II conditions promulgated by the Maui County Council.

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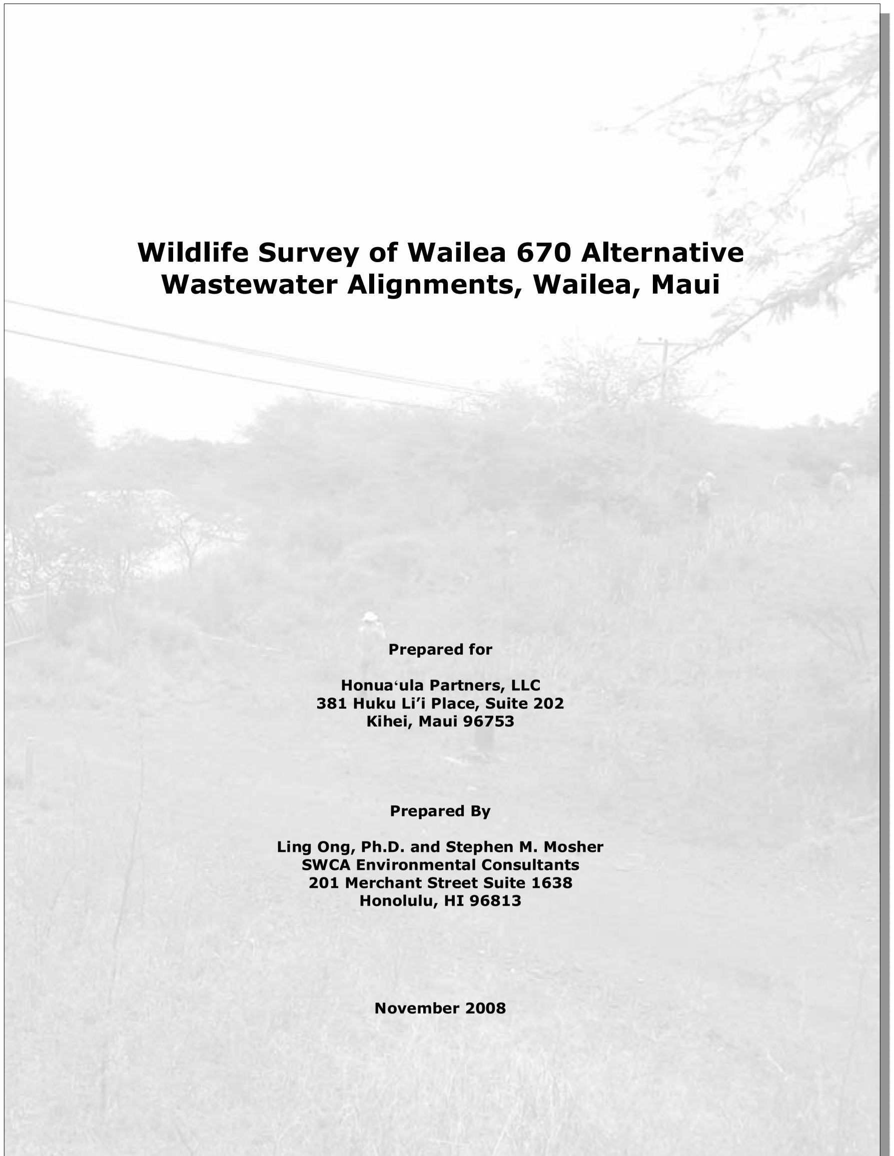
Wildlife Survey – Wastewaterline



Wildlife Survey of Wailea 670 Alternative Wastewater Alignments, Wailea, Maui

Prepared for

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November 2008

1.0 INTRODUCTION

As part of development efforts for Honuaʻula (Wailea 670), Honuaʻula Partners LLC is required to develop a strategy for site wastewater collection, treatment and disposal. Makena Resort, located south and adjacent to the project site has a fully developed wastewater treatment facility which will be used to treat wastewaters from the Honuaʻula development. Three alternative sewer line routes between the project site and the treatment facility were proposed for the conveyance of wastewater and return of treated, non-potable water for irrigation use (Figure 1). In April 2008, R.M. Towill Corporation conducted a feasibility study for conveyance of wastewater from Honuaʻula to the existing Makena Resort Wastewater Reclamation Facility (MRWRF), for treatment and disposal. This study by R. M. Towill investigated the following four alternative wastewater conveyance routes from Honua'ula to MWWRF on the Makena property.

Alternative A – pump directly to MWWRF
Alternative B – pump to a high point and gravity flow to MWWRF
Alternative C – gravity flow to MWWRF
Alternative D- gravity flow to the Makena Wastewater Pump Station (MWWPS) "MU"

R. M. Towill Corporation determined that Alternative C was infeasible because the elevation difference did not allow for gravity flow from the Project Site to the MRWRF (R. M. Towill Technical Memorandum, 2008). SWCA conducted wildlife surveys along the three feasible alternative routes A, B and D between the Project site and MRWRF for the conveyance of wastewater and the return of treated water for non-potable re-use at Honuaʻula. This report summarizes the findings of a two-day (August 14-15, 2008) wildlife survey performed by SWCA of the Wailea 670 alternative wastewater alignments, Wailea, Maui, Hawaiʻi. The main objectives of this wildlife survey were to:

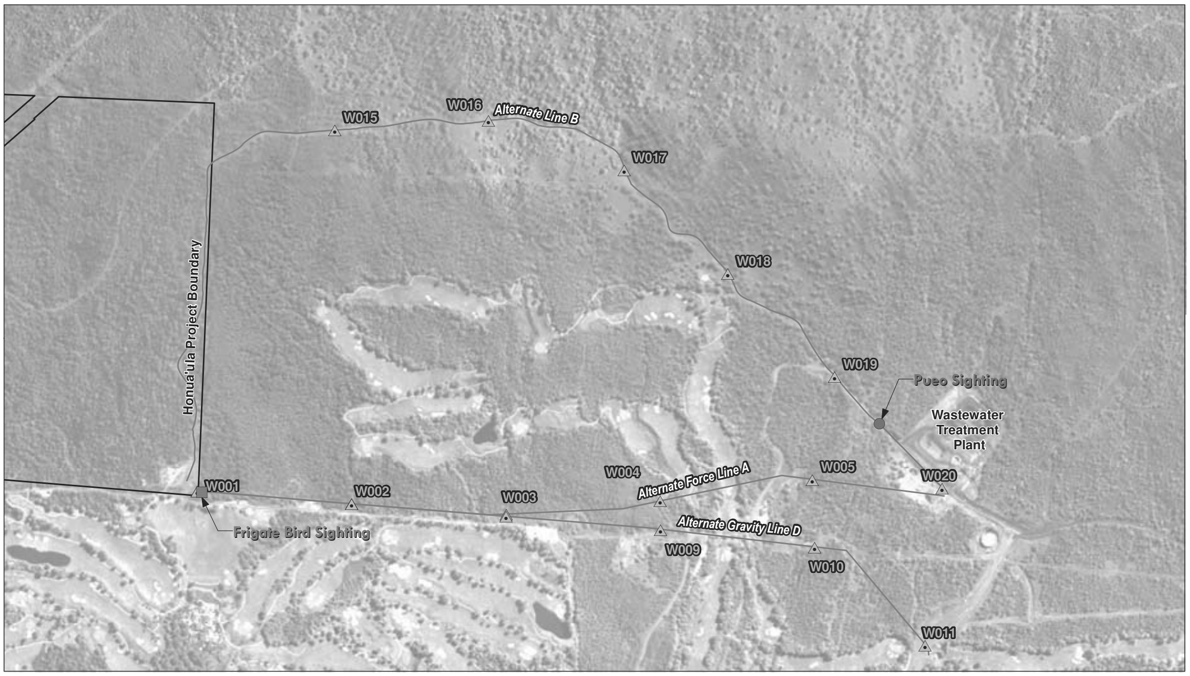
- To identify and document the wildlife species found within a 20 m-wide corridor along the three alternative wastewater line alignments;
- To map any State or Federally listed candidate, threatened or endangered species, species of concern and/ or rare (either locally or Statewide) species within the study area.
- To recommend mitigation measures as appropriate to minimize impacts to wildlife.

1.1. General Site Description

The three alternative wastewater line alignments extend south from the southern boundary of the Honuaʻula (Wailea 670) Property across similar terrain to the existing Makena Wastewater Treatment Facility. One line parallels the boundary between the Makena and Wailea Resorts, another passes the northern portion of the Makena golf course, and a third lies between the two (Figure 1). Kiawe (*Prosopis pallida*) was the dominant canopy species along all three alternative routes. Some of the common herbs and shrubs included golden crown beard (*Verbesina encelioides*), *Bidens* species, false ragweed (*Parthenium hysterophorus*), klu (*Acacia farnesiana*), sweet basil (*Ocimum basilicum*), koa haole (*Leucena leucocephala*) and tree tobacco (*Nicotiana glauca*). Common grasses found across the alternative conveyance routes include buffel grass (*Cenchrus ciliaris*), guinea grass (*Panicum maximum*), natal red top (*Melinus repens*) and sour grass (*Digitaria insularis*). A detailed vegetation survey of the alternative wastewater alignments was prepared by SWCA (2008).

2.0 METHODS

Three wastewater alignment alternatives were surveyed 'Alternate "B" route', 'Alternate "A" force main' and 'Alternate "D" gravity line'. Weather during the wildlife survey was warm and sunny with temperatures ranging from 73 to 90 °F and winds from the northeast at average speeds of 10-16 mph. Field observations of birds were made with 8 x 42 (6.3°) binoculars, and by listening for vocalizations. The relative densities of species were estimated using a total of 14 five-minute 200 m radius point counts conducted during peak bird activity periods from 6 - 11 AM and 4 - 7 PM (Figure 2). Points were at least 400 m apart to avoid recounting of the same individuals, and of five-minute duration to maximize the likelihood of detecting new species during the survey (Lynch 1995).



Legend
Project Boundary
Wastewater Alignment Bird & Bat Point Counts

Figure 2
Wasterater Alignment Alternatives and Location of Point Counts

0 250 500 1,000 ft
0 50 100 200 M
N

Boundary Source: PBR Hawaii
Wastewater Alternatives Source: R.M. Towill Corporation
Aerial Source: PDC (Pacific Disaster Center)

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Source: USGS - Makena and Puu O Kali quads; State of Hawaii GIS

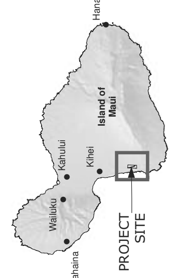

Figure 1
Location of Honua'ula Project Site

0 1,000 2,000 4,000 ft
0 250 500 1,000 M
N

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Gecko abundance (visual observations and listening for vocalizations) was also recorded during the point count sessions. Six point count stations were located on each wastewater alignment alternative. Between count stations, rare or previously unrecorded bird, mammal, reptile or amphibian species were also noted. Mammals were recorded using visual observations, listening for vocalizations as well as evidence in the form of tracks and scat. No attempts were made to trap mammals to obtain data on their relative abundance. SWCA biologists searched for the Hawaiian hoary bat (*Lasiurus cinerus semotus*) along the wastewater alignment alternatives on the evening of 14 August, 2008 (between 7 pm and 12 am). The same point count stations for the avian fauna survey were used and each count station sampled for five minutes. The 50 m radius point counts were surveyed visually for hoary bats using night vision goggles (Morovison PVS-7 Ultra) and an Anabat SD1 ultrasonic bat detector, simultaneously, to detect bats. Non-native tree tobacco plants (*Nicotiana glauca*) found along the wastewater alignment alternatives were also examined for cut stems, frass, eggs, and caterpillars of the endangered Blackburn's sphinx moth (*Manduca blackburni*).

3.0 RESULTS

3.1 Endemic Birds

One pueo or Hawaiian short-eared owl (*Asio flammeus sandwichensis*) was observed at 11:00 PM, standing on the roadside along wastewater alignment alternative "B" approximately 70 m north-west of the Makena Wastewater Reclamation Facility (waypoint W020). The pueo is an endemic subspecies of the globally distributed short-eared owl (*Asio flammeus flammeus*) and is listed by the US Fish and Wildlife Service (USFWS) as a 'species of concern'. This endemic subspecies occurs on all main Hawaiian Islands, but is most common on Kauaʻi, Maui, and Hawaiʻi. It is also listed as by the State of Hawaiʻi as endangered on Oʻahu (Mounce 2008). The most common prey of the pueo includes mice, birds and rats (Mounce 2008); large insects are also taken (Snetsinger et al. 1994; Mostello 1996). Pueo occupy a variety of habitats, including wet and dry forests, but are most common in open habitats such as grasslands, shrublands, and montane parklands, including urban areas and those actively managed for conservation (Mitchell et al. 2005). Little is known about the breeding biology of the ground nesting Hawaiian short-eared owl, but it is believed to nest throughout the year. Nests are constructed by females and consist of simple scrapes in the ground lined with grasses and feather down (Mitchell et al. 2005). The grasslands around wastewater alignment alternative "B" are likely to provide good foraging, and nesting habitat for the pueo. However, these nesting habits make them increasingly vulnerable to predation by rats (*Rattus* spp.), cats (*Felis catus*), and the small Indian mongoose (*Herpestes auropunctatus*), all of which are present in the surrounding area (see below).

3.2 Native Birds

One great frigate bird or ʻiwa (*Fregata minor*) was seen soaring above point count W01 (Figure 1). The location of this point count is along the shared wastewater alignment alternative of "A" and "D". Greater frigate birds forage over the ocean, but nest in colonies on trees as much as 5-8 km inland (Metz and Schreiber 2002). However, it is unlikely that construction along the wastewater alignment will affect habitat of the great frigate bird.

3.3 Migratory Birds

Numerous migratory shorebirds winter in Hawaiʻi from August until April or May. The Pacific golden plover or kolea (*Pluvialis fulva*) is expected to occur on all three wastewater alignment alternatives during the migratory season. None were observed within the alignments during our study; however, some were seen elsewhere within South Kīhei. Habitat utilized by kolea are varied and can include cultivated fields, beaches, grassy borders of airport runways, parks, residential lawns, golf courses, roadsides, wetlands, open pastures and clearings (Mitchell et al. 2005). Kolea show high site fidelity to winter feeding grounds (Johnson et al. 1981, 1989, Johnson and Connors 1996) and probably return yearly to the same area. The Pacific golden plover feeds primarily on terrestrial invertebrates (Johnson and Connors 1996).

3.4 Introduced Birds

Sixteen species of introduced birds were recorded on the three wastewater alignment alternatives (Table 1). The most abundant birds on all three wastewater alignment alternatives were the zebra dove (*Geopelia striata*) and common myna (*Acridotheres tristis*). Black francolin (*Francolinus francolinus*) were locally common around wastewater alignment alternative "B", while African silverbills (*Lonchura cantans*) were common around wastewater alignment alternatives "A" and "D". The red crested cardinal (*Paroaria coronata*) was also common on the wastewater alignment alternative "D". From previous surveys in similar habitat in Wailea, other species not recorded but could occur in the area include wild turkey (*Meleagris gallopavo*), ring-necked pheasant (*Phasianus colchicus*), Erckel's francolin (*Francolinus erckelli*), mourning doves (*Zenaida macroura*) and chestnut munias (*Lonchura atricapilla*) (Bruner 2004, SWCA 2008).

3.5 Mammals

Axis deer (Axis axis) and rats (*Rattus* spp.) were observed on site, as well as deer scat. Feral goats (*Capra hircus*) have also been observed from time to time within the area encompassed by the wastewater alignments. The small Indian mongoose (*Herpestes javanicus*) and feral cats (*Felis catus*) were also observed along the shared wastewater alignment alternative of "A" and "D". Rats, mongoose, and cats are potential predators of the eggs and nestlings of the ground-nesting native pueo. Axis deer were also observed and heard in nearby areas. All these species probably are present on all wastewater alignment alternatives. No sightings of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) were recorded at any of the point count stations along all the wastewater alignment alternatives. Kepler and Scott (1990) suggested that bats found on Oʻahu, Maui, and Molokaʻi may be migrant or vagrant individuals; however, more recent data suggest that bats are resident on Maui (Duvall and Gassmann-Duvall 1991). Bats are also regularly seen at Haleakala National Park (NPS 2008). It is possible that hoary bats occur in the general area of the wastewater alignment alternatives as recent sightings of bats on Maui (1976-1996) have included areas around Wailea (USFWS 1998).

3.6 Reptiles and Amphibians

There are no native reptiles or amphibians in Hawaiʻi (McKeown 1996). Geckos (Family Gekkonidae) were heard calling but not seen during avian point counts and were present along all wastewater alignment alternatives (Table 1). No skinks (Family Scincidae) were observed during avian point counts. No amphibians were seen and are unlikely to occur at due to the lack of permanent sources of freshwater.

3.7 Blackburn's Sphinx Moth (*Manduca blackburni*)

No Blackburn's sphinx moths or their caterpillars or eggs were found on any of the wastewater alignment alternatives. Tree tobacco (*Nicotiana glauca*), a favored host plant of larval Blackburn's sphinx moths (USFWS 2005), were found at waypoint W020, along wastewater alignment alternative "B" westward of waypoint W015 and westward of W03 along the shared wastewater alignment alternative of "A" and "D". Only tree tobacco plants westward of W03 showed substantial leaf damage that could be possibly attributed to the Blackburn's sphinx moth caterpillar (Preston pers. comm.). Maiapilo (*Capparis sandwichiana)*, presumed to be a host plant for adult Blackburn's sphinx moths, were also seen between waypoints W01 and W03. Blackburn's sphinx moth caterpillars have been recorded feeding on tree tobacco in Wailea, Maui (SWCA 2008) and it is possible that all tree tobacco plants along the wastewater alignment alternatives are potential food sources for the Blackburn's sphinx moth caterpillar.

4.0 CONCLUSIONS

The area encompassed by the alternative alignments for the sewerline from Honuaʻula (Wailea 670) all lie within heavily disturbed shrublands that have been altered by invasive non-native vegetation, decades of cattle grazing, former military activities during WWII, and unrestricted grazing by deer and goats. The areas are characterized by non-native species. Migratory kolea may frequent roads and open areas as over-wintering habitat in Hawaiʻi and may be displaced if construction occurs during the migratory season. The construction of the wastewater alignment however, may result in the increase in open spaces, which may provide additional habitat that kolea can utilize post-construction. It is also expected that pueo will return to the area once construction is completed.

Table 1. Bird Species Observed During Survey

Species Name	Common Name	Biogeographic Status	Birds/Point Count (n=14)	Abundance Rank
Fregata minor	Greater Frigate bird	Native	0.07	15
Bubulcus ibis	Cattle Egret	Introduced	0.50	12
Francolinus pondicerianus	Gray Francolin	Introduced	1.71	5
Francolinus francolinus	Black Francolin	Introduced	0.86	9
Pluvalis fulva	Pacific Golden Plover	Migratory	-	-
Streptopelia chinensis	Spotted Dove	Introduced	1.07	8
Geopelia striata	Zebra Dove	Introduced	5.43	1
Tyto alba	Barn Owl	Introduced	-	-
Asio flammeus sandwichensis	Pueo	Native	-	-
Zosterops japonicus	Japanese White eye	Introduced	2.29	3
Mimus polyglottos	Common Mockingbird	Introduced	0.21	14
Acridotheres tristis	Common Myna	Introduced	2.43	2
Cardinalis cardinalis	Northern Cardinal	Introduced	1.14	7
Paroaria coronata	Red crested Cardinal	Introduced	1.43	6
Carpodacus mexicanus	House Finch	Introduced	0.29	13
Lonchura punctulata	Nutmeg Manikin	Introduced	0.79	10
Lonchura atricapilla	Chestnut Munia	Introduced	-	-
Passer domesticus	House sparrow	Introduced	0.57	11
Lonchura cantans	African Silverbill	Introduced	2.00	4
Gallus gallus	Domestic Chicken	Introduced	0.07	15

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Appendix I

Archaeological Inventory Surveys

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
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LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

September 8, 2010

Aki Sinoto
Aki Sinoto Consulting
2333 Kapiolani Blvd., No. 2704
Honolulu, Hawaii 96826

LOG NO: 2010.1666
DOC NO: 1009MD04
Archaeology

Dear Mr. Sinoto:

SUBJECT: Chapter 6E-42 Historic Preservation Review –
Revised Archaeological Inventory Survey Report of 700 Acres with 12 New Sites
Paeahu, Palauea & Keauhou Ahupua'a, Makawao District, Island of Maui
TMK: (2) 2-1-008:056 and 071

This letter reviews the aforementioned revised report (Sinoto, Pantaleo and Titchenal March 2010; *Revised Archaeological Inventory Survey: Supplemental Archaeological Procedures, Proposed Honua`ula Development Area, Paeahu, Palauea, & Keauhou Ahupua`a, Makawao District, Maui Island, TMK 2-1-08: 56 and 71; ASC080724*), which we received on March 23, 2010. We apologize for the delay in our reply.

A site visit was conducted at the request of a number of community members concerned about this project. The visit was attended by SHPD staff archaeologist Morgan Davis and cultural historian Hinano Rodrigues on August 26, 2010. At that time no significant unrecorded sites were noted, although stated concerns from the public regarding the detail of the maps included in this AIS report were considered.

This report presents a comprehensive summary of past archaeological work in this area and nicely incorporates previous surveys in the discussion of current findings. We are requesting editorial revisions to the current version of the report as detailed in the attachment to this letter.

We look forward to reviewing your revised report. If you have questions about this letter please contact Morgan Davis at (808) 243-5169 or via email to: morgan.e.davis@hawaii.gov.

Aloha,

Theresa K. Donham
Acting Archaeology Branch Chief
State Historic Preservation Division

ATTACHMENT

1. Page 7, Land Tenure During the Historic Period, first paragraph: Please correct the date(s) 1854 (the date Chiefess Miriam Kekauonohi was awarded her LCAw.) and/or 1851, the year reported as her death.

2. Figure 3, page 9: Please clearly indicate the areas of previous archaeological work either by shading the different survey areas in different colors, or by using different markings – it is unclear where the work survey areas were conducted on this map.

3. Page 10, Regional Studies, first paragraph: WWII is described as recent yet early historic extends to 1950; consider revising/clarifying.

    a. Sixth line down, "The prehistoric occupation of site…" – which site, 2012 or 2013?

    b. If the 'site' in (a) above is referring to 2013, please explain why it is dated earlier than the two Historic burials found in it?

4. Page 11, Previous Studies within the Project Area, fifth line from the bottom: please correct typo "Siote."

5. Page 13, Current Phases of Archaeological Work…, sixth line from the bottom: the text indicates that sites recommended for preservation were [re]located, all but one. Were these sites recommended for preservation in the 2000 and 2001 surveys? Which one was it that could not be relocated?

    a. Figure 4: Please indicate survey area blocks by color or pattern to show the relative locations of respective surveys; the arrows do not indicate the scale of the area.

6. Page 16, Methods, first paragraph: Please document the total number of man-hours for this survey.

    a. Second paragraph: please correct the scale of controlled manual excavations; they were either natural layers or arbitrary 5cm levels but can't be both. Do you mean arbitrary levels within natural layers, which is the standard approach.

7. Page 17, first paragraph: what was the spacing of the transects for the amendment survey?

    a. Was a plan/report created/required for the two monitoring projects that occurred for the water tank access road and firebreak clearing projects?

    b. Third paragraph: please note that we require SIHP numbers (as opposed to temporary numbers) for all sites in the final report documentation. If you still have not received your site numbers please contact Morgan Davis at morgan.e.davis@hawaii.gov.

8. Page 18, Results of Survey: for all Site records, please change "SITE" (indicating formal SHPD-assigned site numbers) to "SIHP"; this will avoid confusion with the temporary ASC numbers which are also referred to as "SITE" numbers.

9. Page 19, Figure 5: Please indicate the location of SIHP 200, the wall, which is indicated on the Figure heading. If it is supposed to be the yellow line to the south of the map please change the

Key to show that this is the wall.

10. Please provide a plan map of the survey area with all the sites and features clearly plotted; while the satellite view can be helpful it is too vague to fulfill the requirements of HAR §13-276.

11. Page 67, Table 2: For recommendations of those sites previously recorded, please indicate whether there was a previous recommendation/determination of significance, and if so whether the one(s) presented in this table are different. If different, that should be addressed in the text.

12. Page 75, Figure 52: please replace map, the site numbers are illegible.

13. Page 76, Bibliography: Please carefully review all citations and listings in the Bibliography and ensure they appear correctly in the text; for some the year is incorrect, or else the citations are not all appearing in the Bibliography. The Bibliography does not include all the works cited in the text.

Archaeological Inventory Survey – Honuaʻula

ASC080724

REVISED ARCHAEOLOGICAL INVENTORY SURVEY:
Supplemental Archaeological Procedures
Proposed Honua`ula Development Area
Paeahu, Palauea, & Keauhou *ahupua`a*
Makawao District, Maui Island
TMK 2-1-08: 56 and 71

July 2008
Updated March 2010
Revised March 2011
and March 2012

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ASC080724

REVISED ARCHAEOLOGICAL INVENTORY SURVEY:
Supplemental Archaeological Procedures
Proposed Honua`ula Development Area
Paeahu, Palauea, & Keauhou *ahupua`a*
Makawao District , Maui Island
TMK 2-1-08: 56 AND 71

by

Aki Sinoto

Jeffrey Pantaleo

and

Paul Titchenal

for

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July 2008
Updated March 2010

Revised March 2011
and March 2012

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ABSTRACT

At the request of Honua`ula Partners, LLC (formerly WCPT/GW Land Associates, LLC), Aki Sinoto Consulting of Honolulu completed revised archaeological inventory survey procedures for the proposed Honua`ula development area, formerly known as Wailea 670, located on the southwestern slopes of Haleakala in East Maui. In order to facilitate historic preservation review by the State Historic Preservation Division (SHPD), the current revision, covering the total development area, incorporates the results of two previous undertakings completed in May 2000 and June 2001 together with the results of additional fieldwork conducted during a number of separate procedures during August 2003, June 2008, and February 2012.

The project area that encompasses 700 acres, ranges in elevation from approximately 320 to 720 feet amsl, and includes portions of three *ahupua`a*; Paeahu, Palauea, and Keauhou. The Honua`ula property is located in the modern district of Makawao on Maui Island. Topographically, the project area can roughly be divided in to two distinct areas, the northern two-thirds and the southern one-third. The Northern Section comprises a grass-covered area that exhibits compounded prior disturbance. The Southern Section, under high tree cover, primarily of *kiawe* and intermittent stands of *wiliwili* has expansive areas of open, relatively young aa flows in between older pahoehoe ridges and plateaus. A large wall, trending east to west, demarks a physical division between the two areas.

All of the afore-mentioned phases of fieldwork have resulted in the documentation of forty (40) sites comprised of some sixty (60) component features in the total 700-acre project area. The Northern Section yielded only one single-feature site, a natural overhang shelter in a seasonal gulch. Contrastingly, the Southern Section produced a total of 39 sites with 59 component features. The occurrence of two multiple feature complexes along with a relatively high frequency of larger platform sites were unexpected based on the location, topography, climatic conditions, and the marginal nature of previously known sites resulting from studies in similar elevations in the neighboring properties.

Of the total 40 sites, 16 have been recommended for *in-situ* preservation, 18 for intensive data recovery, and the remaining 6 warrant no further work. Comprehensive preservation and data recovery plans shall be forthcoming shortly in conjunction with progressive phases of development planning.

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INTRODUCTION

As requested by the Owner, Honua`ula Partners, LLC (formerly WCPT/GW Land Associates, LLC), Aki Sinoto Consulting of Honolulu completed revised archaeological inventory survey procedures for the proposed Honua`ula development area, formerly called Wailea 670, located on the southwestern slopes of Haleakala in East Maui. To facilitate historic preservation review by the State Historic Preservation Division (SHPD), the current revision, covering the total development area, incorporates the results of two previous undertakings completed in May 2000 and June 2001 (Sinoto & Pantaleo 2000 & 2001) together with the results of additional fieldwork conducted separately during August 2003, June 2008, and February 2012.

PROJECT AREA

The development area for the proposed Honua`ula Project (hereafter called the "project area"), encompassing approximately 700 acres (ca 670-acres plus the proposed Pi`ilani Highway extension easement and a Maui Electric substation exclusion that total ca 30-acres), is located along the southwestern slopes of Haleakala, within the *moku* (traditional district) of Honua`ula, currently subsumed into the Makawao District, on Maui Island (Fig. 1). Occupying elevations ranging between approximately 320 and 720 feet amsl, the project area (TMK: (2) 2-1-08: POR 56 & 71) conjoins portions of three *ahupua`a*, from Paeahu in the north, Palauea in the middle, to Keauhou in the south (Fig. 2). The project area is bordered on the north by the existing Maui Meadows residential subdivision; on the east by a barbed wire fence-line along its boundary with Ulupalakua Ranch lands; on the south by a paved utility road and another barbed wire fence-line along its boundary with Makena Resort lands; and on the west by portions of three Wailea golf courses, other developments within Wailea Resort, and the existing southern terminus of Pi`ilani Highway. Roughly three-fourths of the northern section of the project area is located within Paeahu *ahupua`a* with the remaining forth in Palauea *ahupua`a* and roughly half of the southern section is Palauea and the other half a portion of Keauhou 1 *ahupua`a* (Fig. 2).

ENVIRONMENT

Two relatively distinct topographic characteristics separate the northern two-thirds and the southern third of the project area. The northern section generally consists of grass-covered, moderately-sloping, rocky terrain dissected by several large, east/west trending dry gulches. The soil is Keawakapu extremely silty clay loam, developed in volcanic ash. This soil occurs in the low uplands on slopes between 3 to 25% and is characterized by moderate permeability, slow to medium runoff, and with slight to moderate erosion hazard (Foote et al. 1972:68). Bulldozed

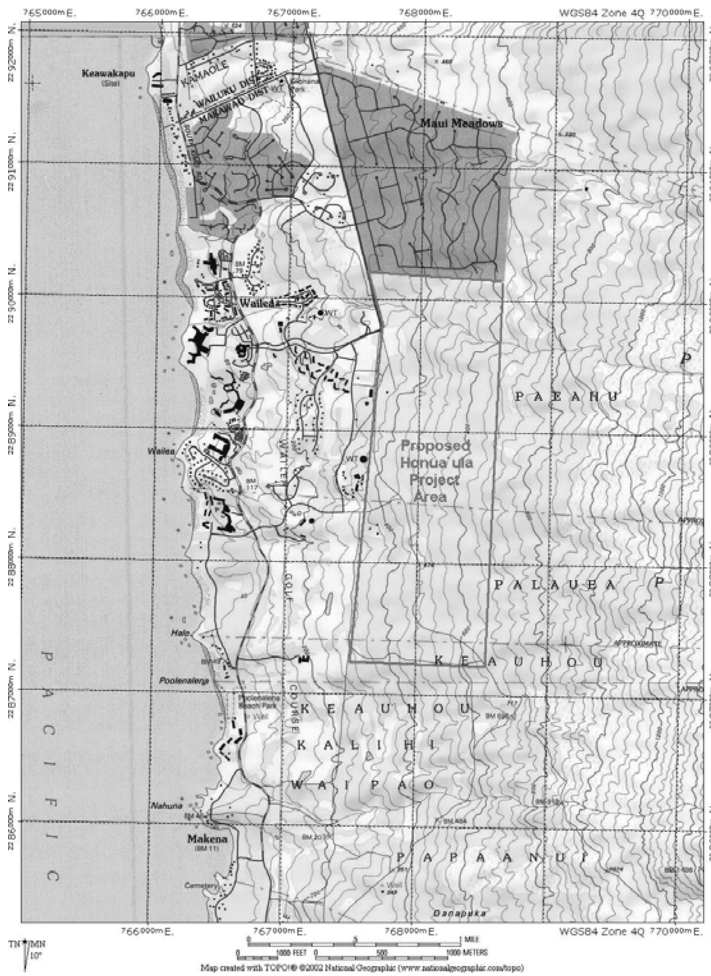

Figure 1. Location of Proposed Honua`ula Project Area on USGS Makena Quadrangle

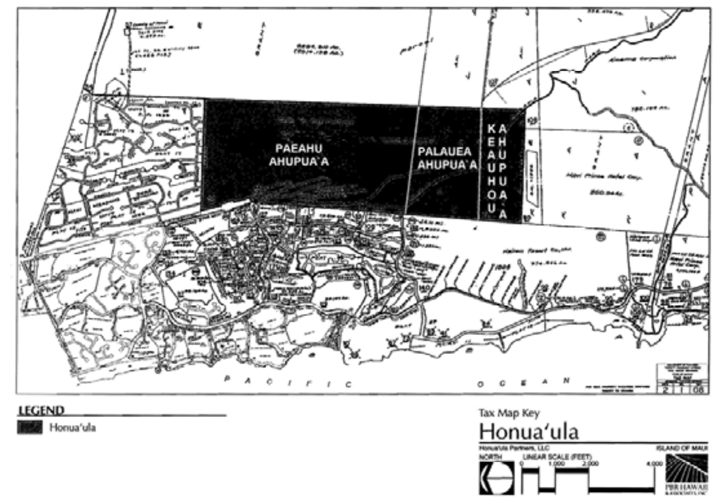

Figure 2. Tax Map of Project Area Showing Portions of the Three *ahupua`a*

roads, cuts, and clearings occur throughout the northern area. With the exception of the dry gulch and a few rocky outcrop ridge areas, extensive previous clearing is evident over most of the northern two-thirds of the project area. The southern section consists of dense, tree cover on old pahoehoe ridges and aa flows with expansive, open, more recent, aa flows. Very Stony Land is characterized as areas where 50-90% of the surface is covered with stones and boulders. On Maui, this land type consists of young aa lava and occurs as large areas on the slopes of Haleakala (Foote el al. 1972:124). Soils in the southern portion include the Oanapuka Series, a well-drained and very stony silt loam that occurs on low uplands and derived from volcanic ash and cinders on slopes between 7-25%. These soils are characterized with slow runoff, moderately rapid permeability, and represents slight to moderate erosion hazard (Foote et al. 1972:101). The southern portion, too, exhibits signs of previous disturbances in the form of bulldozed cuts, clearings, and secondary growth vegetation. A wide corridor was cleared by bulldozer in conjunction with the proposed Pi`ilani Highway extension which to date has not been implemented. The western or *makai* half of the southern portion below the jeep road shows expansive areas of previous disturbance, only some of which can directly be attributed to development activities in the adjoining areas or for utility infrastructure within the project property. Some of the clearing is probably associated with historic and modern ranching and also some pre-WWII period, military activities. The project area elevations range between 300 to 720 feet above mean sea level. Annual rainfall averages 10 to 15 inches, with most of it occurring during the winter months between November and February (Armstrong et al. 1983:62).

In the northern portion, the dominant vegetation is various dry grasses and shrubs with limited stands of *kiawe* (*Prosopis pallida*) and *koa haole* (*Leucaena leucocephala*) as high cover in the gulch areas. Some *pili* or Tanglehead grass (*Heteropogon contortus*) also occurs in the northern portion. In the southern portion, the dominant high cover vegetation is *kiawe* and the dominant ground cover in certain localities is dry grasses. Other notable flora consists of *wiliwili* (*Erythrina sandwichensis*), *koa haole*, *ilima* (*Sida fallax*), lantana (*Lantana camara*), wild basil (*Ocimum basilicum*), beggar's tick (*Bidens pilosa*), and golden crown-beard (*Verbesina encelioides*). Two species of cacti, *Panini* or prickly pear (*Opuntia ficus-indica*) and hedge cactus (*Cereus uruguayanas*) are also present. Fauna includes cattle, axis deer, feral cats, wild pigs, mice, and various common exotic avian species.

HISTORICAL BACKGROUND

Detailed historical summaries for the Wailea/Makena region have been presented in various reports including Clark and Kelly (1985), Cordy and Athens (1988), Schilt (1988), Gosser et al. (1997), McIntosh et al. (1997), and most recently Donham (2006). The reader is referred to a few notable studies completed for neighboring areas, in particular *Na Lawai`a o `Ao`ao o ka Moku: Excavations at the Southern Acreage and Lot 15, Wailea Maui* (Gosser et al 1993); *Data Recovery Procedures for Parcels III and IV, Makena Resort Corporation* (Gosser et al. 1997); *Addendum Survey and Supplementary Tasks for: Archaeological Inventory Survey of Portions of Palauea ahupua`a Makawao District, Maui, Hawaiian Islands (*Rotunno-Hazuka, Pantaleo, and Sinoto 2000); and *He Mo`olelo `Aina No Ka`eo Me Kahi `Aina E A`e Ma Honua`ula O Maui: A Cultural-Historical Study of Ka`eo and Other Lands in Honua`ula, Island of Maui* (Maly and Maly 2005). In addition, *Wailea: Waters of Pleasure for the Children of Kama* (Barrere 1975) and *Sites of Maui* (Sterling 1998) contain important historical information and ethnographic accounts regarding the region. Thus, a brief summary of key points is presented here.

The earliest prehistoric settlement on Maui Island is postulated to have occurred between A.D. 300-600 along the windward regions where abundant rainfall and fertile soil supported crop

cultivation and human populations (Kirch 1985, Cordy and Athens 1988, Gosser et al. 1997). Population expansion into the drier, leeward areas of Kihei, Wailea, and Makena, likely took place by A.D. 1000-1200 (Cordy 1974, Kirch 1985) although localized area of earlier permanent occupation appear to have been present (Gosser et al. 1997). The traditionally held view that population pressures forced expansion into the more "marginal" regions has been questioned by more recent research. The general pattern of occupation suggested by archaeological research to date consists of seasonal settlements occurring along the coastal areas to exploit marine resources, while permanent settlements occupied the upland areas to utilize forest products and cultivate agricultural resources. Between these settlement loci was an arid area used for cultivating sweet potatoes and during transit on *mauka-makai* trails. Upland populations exchanged taro, bananas, and sweet potatoes with the coastal populations for ocean resources (Handy 1940). Although a number of scenarios regarding the prehistoric chronology of the coastal Honuaula region have previously been postulated (Cordy and Athens 1988, Gosser et al. 1996, and Donham 2006), the number of dated sites is still too limited to permit the establishment of cogent intra-regional chronological benchmarks.

The inhabitants of Honua'ula subsisted mainly on fish and sweet potatoes, a common diet of those who lived in the leeward area of Maui (Barrere 1975:41). The early French navigator La Perouse noted, while anchored at Keoneoio Bay that "this part of the coast was altogether destitute of running water. The inhabitants had no drinking water but a brackish water obtained from shallow wells." (1798:350)

Due to the lack of running water, agricultural production in leeward Maui Island was limited to dryland taro in the upland areas in pockets of moist soil where rainfall was greater, while sweet potatoes were grown at the lower elevations (Handy 1940:113-114). Irish potatoes became an important cash crop in East Maui, for provisioning whaling ships and supplying the west coast of North America during the Gold Rush of 1848. By 1846, the cultivation of Irish potatoes had spread from Kula to Honua'ula. Sweet potatoes were also grown for export, and sugarcane was being cultivated commercially by 1841. M.J. Nowlein and S.D. Burrows leased lands from Kamehameha III at Ulupalakua to grow sugarcane and Irish potatoes. In 1845, Nowlein and Burrows transferred their lease and interests to Linton L. Torbert, who extended sugarcane cultivation to adjoining lands and started cattle ranching. In 1856, Captain James Makee bought the Torbert Plantation and it was later referred to as the "Rose Ranch." By 1862, sugarcane was being extensively cultivated, and a steam mill was built for processing sugar. A severe drought in 1878 forced the end of sugarcane production, and cattle ranching became the dominant commercial enterprise of Honua'ula. By the 1880s, `Ulupalakua Plantation was basically a cattle ranch utilizing the road and landing at Makena in Papa`anui. From the late1800s into the 1970s, even through several land purchases and name changes including, Dowsett in 1886, Raymond in 1900 (Raymond Ranch), Baldwin in 1923 (Ulupalakua Ranch), and Erdman in 1963, ranching continued to dominate the economic activity in the region. However, although ranching still continues today in a more limited capacity, the dominant economic and land-use theme since then has focused on tourism-related and residential development. The past three decades have seen the intensification of golf course, resort, and luxury residence developments in the Wailea and Makena areas.

Land Tenure During the Historic Period

During the Mahele in 1848, lands of Hawaii were divided among the Royalty, Government, and commoners. Applications for land titles were considered by the Board of Commissioners to Quiet Land Titles. When a claim was validated, a Land Claim Award (L.C.A.) was awarded. Following payment of this claim, a Royal Patent (R.P.) was issued.

The *ahupua`a* of Paeahu was part of the lands assigned to Moses Kekaiwa, the eldest son of Kekuanao`a, a powerful governor of O`ahu. However, in 1842, it was included with other Honua`ula lands that were reclaimed by the government (Barrere 1975:32). The commutation of lands to the government, in lieu of cash tax payments, was a common practice among the chiefs. Thus, much of the land of Honua`ula became government lands (Cordy and Athens 1988:15). At the time of the Great Mahele, nine (9) *kuleana* Land Commission Awards (L.C.A.) in Paeahu ranged in size from 0.22 to 11.68 acres and consisted of shoreline parcels, houselots, and agricultural lands. Banana, dryland taro, and sweet potato were listed as the cultivated crops (Stocker et al. 1992:14). One of the *kuleana* awards, LCA 10665 to Piopio, appears to have been located close to, but beyond the northern boundary of the current project area, probably within the existing Maui Meadows subdivision. The locations of the other LCAs, with the exception of 5220 to Koukaina, located at the coast, were undocumented and are currently unknown. Based on the pattern seen in this region, the other parcels were most likely located *mauka* of the current project area in the inland agricultural zone. Following 1850, portions of Paeahu *ahupua`a* were sold to *haole* businessmen, and large acreages changed owners often, until in 1864; 4,445 acres wre sold to James McKee, the famous founder of Rose Ranch in Ulupalakua. Much of the lands passed through McKee to Ulupalakua Ranch and Alexander and Baldwin, Ltd. (Kleiger et al.1992:25). For a detailed narrative of the history of land tenure in Paeahu *ahupua`a*, the reader is referred to Stocker et al. 1992 and Kleiger et al. 1992.

The *ahupua`a* of Palauea, comprising about 2,130 acres (LCA 11216:21) was awarded to Chiefess Miriam Kekauonohi during the Mahele of 1848. The current project area includes a portion of this Land Commission Award. Upon her death in 1851, the land passed to her husband Levi Haalelea. In 1862, most of the *ahupua`a* was sold to James McKee through public auction. A total of fourteen (14) Land Commission Awards and eleven Royal Patent Grants are listed for Palauea *ahupua`a.* Four (4) are described as Irish potato plots and three (3) others as houselots. The remaining awards are not described as to land use. Map locations of *kuleana* are unavailable. However, the narrative descriptions of two of the houselots place them at the coast. The others likely consisted of agricultural lots located in the wetter uplands.

In 1852, L.C.A. 6715 (R.P.8213) was awarded to Ho`omanawanui, which included the entire *ahupua`a* of Keauhou 1. The award covered an area of 853 acres. In 1856, Ho`omanawanui and her husband Hikiau sold Keauhou 1 to James McKee for $1,000.00. Eleven commoner awards are listed for all of Keauhou (1 and 2) *ahupua`a*. Although their locations are unknown, based on the descriptions given in the award documents, most appear to be Irish and sweet potato lands or houselots. The potato lands probably occured further inland (above the 1200' elevation) of the current project area, while the houselots were most likely located closer to the coast. In addition, five (5) Royal Patents Grants are also listed. None of the *kuleana* awards and grants appeared to have been within the boundaries of the current project area.

PREVIOUS ARCHAEOLOGY

Due to the advent of resort and residential development in the region in the past four decades, a large number of development-related archaeological studies have taken place in Wailea and Makena. Several have dealt with large land holdings ranging from 40 to more than 1,800 acres.

Island-wide Studies

For Maui Island, there are three references that can be considered to form the basis for the archaeological investigations that followed. The seminal work is the 1931 survey by Winslow Walker that focused on prominent sites throughout Maui. In Honua`ula *moku* his survey documented 10 coastal *heiau*, four upland *heiau*, a number of fishing shrines (*ko`a*), a coastal village, and two fishponds. Sterling continued where Walker left off and undertook extensive surface surveys in various regions of Maui and collected valuable first-hand information from native Hawaiian *kupuna* that lived in the regions. Although Sterling's data was not published until 1998, the represented body of her work spans a decade of research between 1960 and 1970. The third was the Maui Island component of the Statewide Inventory of Historic Places that took place during 1972-1973 under the auspices of the State of Hawaii, to complete an inventory of known sites on the island. The conditions and dispositions primarily of sites previously recorded by Walker and Sterling were evaluated in the field by a team of archaeologists from the Bishop Museum accompanied by Maui *kupuna* Charles Keau. Recommendations for nominations and eligibility to the Hawaii and National Registers of Historic Places were made and established the foundation for modern historic preservation initiatives on Maui and in the State of Hawaii. Although implementation did not take place until the mid-1980s, this undertaking also paved the way for establishing and maintaining a Statewide database of archaeological and historic records.

Regional Studies

A large number of studies have been completed in the coastal areas of Wailea and Makena. The reports for studies undertaken in conjunction with expansions of the Wailea (Gosser et al. 1993) and Makena (Gosser et al. 2002) golf courses, developments in coastal Palauea *ahupua`a* (Rotunno-Hazuka, Pantaleo, and Sinoto 2000), development parcels in Wailea (Stocker et al. 1992 and Kleiger et al. 1992), and coastal Makena (Donham 2006) contain comprehensive summaries of previous work in the general region (Fig. 3). The reader is referred to those reports for an archaeological overview of traditional occupation in the vicinity of the current project area.

The majority of previously completed projects in Paeahu *ahupua`a* have taken place along the coastal areas or immediately *makai* of Pi`ilani Highway and Kalai Wa`a Street adjacent to the western boundary of the current project area. Brief summaries of selected studies in Paeahu *ahupua`a* are presented below.

In 1985, PHRI conducted archaeological data recovery for the Wailea Point Condominium site (Walker et al. 1985), located on the shoreline at Wailea Point. Three multiple feature sites were investigated. A total of 13 features; including 4 C-shapes, 4 U-shapes, a terrace, 2 walled enclosures, and two enclosed terraces; were investigated. The smaller, simple features yielded sparse midden and limited artifacts while the larger, more complex structural features yielded a profusion of prehistoric and early historic period artifacts. Of the more than 6,500 artifacts, 49% were prehistoric in type, 39% were historic, and 12% were modern. A span of occupation ranging from AD 1350 through 1900 was indicated through radiocarbon, stratigraphic, and artifactual analyses. Relocation and reconstruction of several of the features were recommended for public interpretation and were subsequently implemented.

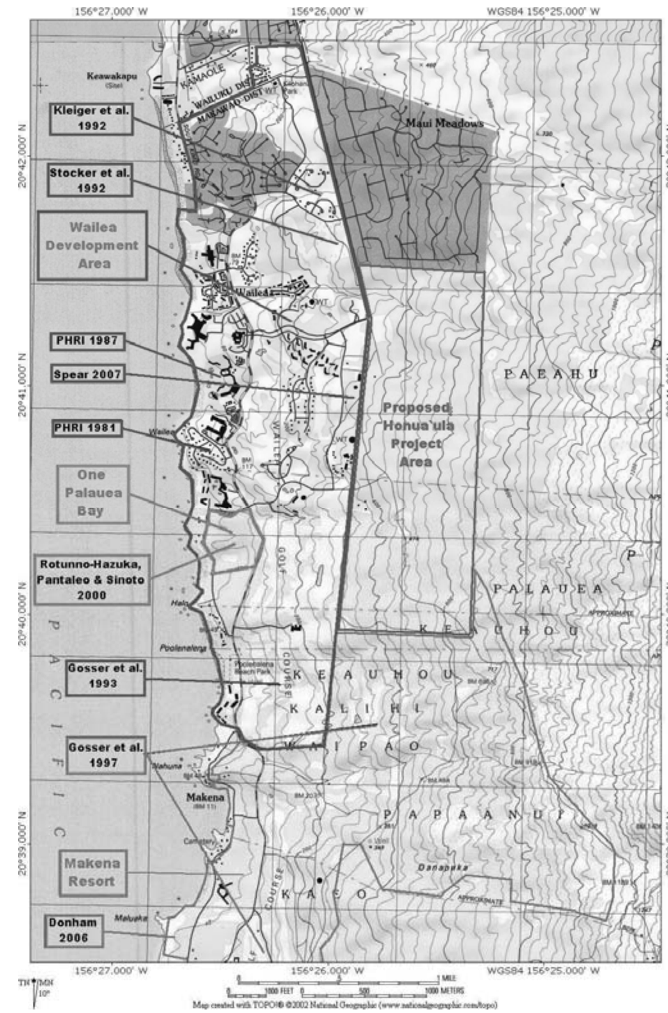

Figure 3. Locations of Previous Archaeology and Major Development Areas

In 1987, PHRI conducted archaeological data recovery for the proposed Grand Wailea Hotel (Rosendahl and Haun 1987), located on the shoreline of Paeahu *ahupua`a*. Site 2012, a single enclosure feature, and Site 2013, with 6 features (A-F) were excavated. Utilization of Site 2012 during three periods, late prehistoric (AD 1640-1890), early historic (AD 1650-1950), and recent (WWII) was determined. Two human burials were recovered from Site 2013 along with an extensive collection of portable artifacts. The prehistoric occupation of site was dated between the mid-1300s to the mid-1600s. Glass bead burial goods indicated that the burials originated during the historic period. No further work was recommended. These sites were destroyed during hotel construction and the burials were disinterred and later re-interred within the project area. A large number of burials, mostly prehistoric, were encountered during the subsequent monitoring procedures during hotel construction.

The Applied Research Group (ARG) of the Bishop Museum conducted archaeological data recovery in Parcel SF-7 of the Wailea Resort company holdings in 1992 (Klieger et al. 1992). Two sites were investigated including 3 C-shapes and two modified outcrop features. The only artifacts recovered from excavations were basalt and volcanic glass flakes and polishing stones. The radiocarbon analyses were unsuccessful, yielding modern or no dates. The C-shapes were all relegated to be of WWII origin while the modified outcrops were interpreted as traditional Hawaiian. No further work, for any of the features associated with the two sites, was recommended.

In the same year, ARG undertook an archaeological inventory survey in a portion of Wailea Resort Company Parcel MF-12 (Stocker et al. 1992). Four structural features of one site; two circular alignments, one oval enclosure, and one wall; were investigated within a portion of this parcel slated for a rock crusher site. No subsurface deposits or features were encountered. No further work was recommended for three of the features, and future data recovery was recommended for the wall feature.

Scientific Consultant Services conducted an archaeological inventory survey of a 17.89 acre parcel located between the 160-300 ft. elevation of Paeahu *ahupua`a* (Spear 2000), immediately *makai* of the current Wailea 670 project area. The area was found to be extensively altered previously and no surface cultural remains were encountered during the walk-through survey. Due to the negative results of the surface survey, no testing was performed and no further work was recommended.

Gosser's characterization of the nature of dry-land agriculture in the lower reaches of Paeahu to Papa`anui *ahupua`a* in the Wailea development area adjoining the subject project area to the west states in part that:

> Agriculture in the Wailea region was restricted to small plots that were probably under sweet potato cultivation. Not much can be said about the agricultural sites in the Wailea area because very little excavated material was recovered from them and no attempt to calculate crop yields was made, primarily because crop production is potentially very variable. In terms of chronology, it is statistically significant that only one radiocarbon sample derived from an agricultural context dated to earlier than A.D. 1600. Agriculture, within the immediate region (perhaps in contrast to the wetter Makena region to the south) was not a primary pursuit although sweet potato was cultivated (based on the evidence of small mound clusters at Sites 2549, 2534, and 2535), probably at the *kauhale* or *kulanakauhale* level; it should also be stated that only one agricultural site (Site 2549) extended outside the project area, suggesting that the contiguous agricultural site was relatively small and would not constitute a "field system." (Gosser 1993:261)

The nature of the early occupation of the more arid localities in the *moku* of Honua`ula is still unclear. However; that a number of other factors influenced the settlement of these areas, besides just population growth and expansion from other districts and political hegemony, are becoming progressively understood. The transition from seasonal recurrent occupation for the exploitation of marine resources to the development of small permanent hamlets in localized areas with favorable micro-climates and brackish water sources, such as in Ka`eo in Makena, would not have been too difficult to imagine or to effect.

Previous Studies within the Project Area

Four surveys were previously conducted within the current project area; two for the previous proposed development of the Wailea 670 property, one for the proposed Piilani Highway extension, and the most recent, for a cinder haul road at the southern boundary. The earliest was completed in 1972 and covered the segment of the right-of-way corridor for the proposed highway extension within portions of Paeahu, Paluaea, and Keauhou *ahupua`a* (Walton 1972). Seven sites were recorded within the current project area. Site 200 is the long wall that forms the northern boundary of the project area. Site 201 is a complex of fairly prominent structural features. Site 202 is a complex of deteriorated walls near the Site 200. Site 203 is a deteriorated C-shaped enclosure. Site 204 is a small platform built against a bedrock ledge with an associated paved area. Site 205 is an enclosed overhang shelter. Site 211 is a single aa boulder alignment constructed along the base of a rocky ridge. All of the sites were recommended for avoidance with no further work. Site 201 was recommended for data recovery if avoidance was not possible and Sites 204 and 205 were recommended for public interpretation. Sites 202, 203, and 211 could not be relocated during any of the subsequent surveys.

The first survey for the whole Wailea 670 property was completed seven years after Walton's report. This reconnaissance survey, completed in one day, did not locate any remains and failed to relocate Walton's sites, all of which were assumed to have been destroyed during the bulldozing of jeep roads (Hammatt 1979). Based on the supposed "total absence of sites", archaeological "clearance" of the whole area was recommended without any further work including monitoring during construction. This researcher apparently mistook the wall (Walton's Site 200) at the northern boundary of the southernmost 190 acres to be the southern boundary of Wailea 670, so the southern third of the project area was not included in the survey.

The second survey of the 670 property was completed 9 years after Hammett's. This seven-day surface survey which also supposedly covered the whole area, both on foot and in a 4WD vehicle, failed to relocate any of Walton's sites or record any new sites (Kennedy 1988). One remnant of a historic water tank base was mentioned on the northern section. Although Kennedy's survey included the whole property, no sites, including Walton's, were located. Based on the informal testimony of a former *paniolo* for Ulupalakua Ranch, the walls were assumed to be associated with "modern" ranching activities and considered not to warrant documentation, all of Walton's sites were assumed destroyed, and no further work was recommended.

The cinder haul road survey (Sinoto and Pantaleo 1993) was conducted along the southern boundary of the current project area. Three sites, a C-shaped enclosure (3156) and two walls (3156 and 3157) were recorded. Testing of the interior floor of the C-shape produced negative results. No further work and avoidance of these sites were recommended with limited breaching of the walls, with archaeological monitoring, for the cinder haul road. No inadvertent findings were made during monitoring.

No subsurface testing was previously undertaken in any of the known sites in the project area. Thus, the age of the sites are not known and at the same time, a paucity exists of dates obtained from sites in neighboring areas at around the same elevation. The closest dated sites occurred in the north course of the Maui Prince Golf Course and produced a date range of A.D.1327-1889 (Gosser et al. 1997). Corresponding date ranges occur in the coastal areas as well and indicate that a similar chronology could be predicted for the occupation of the current project area.

Current Phases of Archaeological Work in the Honua`ula Development Area

Commencing in April 2000, archaeological inventory procedures were undertaken within the ca 190-acre southern portion of the Honua`ula project area. The results of this study were reported in May 2000 and the final revision was completed in October 2000 (Sinoto and Pantaleo). Following this initial report, after re-evaluating the previous work by Hammatt and Kennedy, the State Historic Preservation Division (SHPD) concluded that the negative findings may have resulted from inadequate fieldwork and an inventory survey of the northern two-thirds of the Honua`ula project area was recommended (Fig. 4). At the same time SHPD requested additional walk-through transects to be completed within the 190-acre inventory survey area. The addendum survey addressing these concerns was completed during March through May 2001 and reported in June 2001 (Sinoto and Pantaleo). Only one site, an unmodified, natural overhang shelter (SIHP Site 50-50-14-5109) was found in a gulch within the northern two-thirds of the Honua`ula project area. The northern area was found to have undergone compounded extensive disturbances through historic and recent ranching activities and possibly some military activities during WWII. Within the southern third however, a total of 27 archaeological sites comprised of 43 component features were recorded during the course of the two surveys. In October of 2003, a GPS point survey was conducted in which all, but one of the sites recommended for *in situ* preservation was located. More transects sweeps were conducted during dry periods when ground cover vegetation was minimal. A total of 40 archaeological sites comprised of 60 component features, the subject of the following sections of this report, have been recorded in the proposed Honua`ula development area. Only one site comprised of one feature is represented in the northern section of the project area, the remaining sites and features all occur within the southern section.

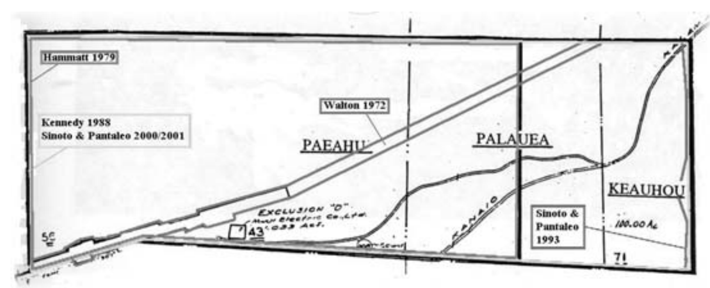

Figure 4. Map Showing Areas Covered by Previous Investigations within the Project Area

SETTLEMENT PATTERN INFERENCES BY PREVIOUS RESEARCHERS

Researchers such as Kirch (1974) have asserted that later prehistoric expansion on Maui led to the occupation of harsher or more ecologically marginal regions. Chapman and Kirch (1979) proposed that a pattern of transience existed between coastal and inland areas. Inhabitants of the upland agricultural region may have utilized the coastal shelters as temporary or seasonal bases for expanding the range of resource exploitation. Trails linked these permanent upland habitation areas to coastal areas. Cleghorn (1975) suggested dual permanent settlement in both coastal and inland areas of Keauhou. Temporary habitation sites, located along trails linking upland and coastal settlements were used by travelers from upland residences to the coast in order to exploit the seasonal marine resources.

Sinoto (1978) and Gosser er al. (1997) argued that the presence of localized, environmentally favorable zones, such as areas with more rainfall, influenced permanent occupation and the types of activities that took place. In fact, for Wailea, the area immediately west of the Honua`ula Development area, only 20% of the sites recorded within a 187-acre project area was considered to have some agricultural function. These primarily consisted of mounds for sweet potato cultivation, but the low frequency led Gosser to conclude that agriculture in Wailea, "was not a primary pursuit" (Gosser et al.1993:248).

Following a review of previous reports completed to the year 2000, Haun compiled a listing of minimally 77 permanent habitation features, 192 temporary habitation features, 282 agricultural features, 8 human burials, 23 ritual features, and 11 trail segments in coastal Honua`ula from Keauhou to Onau *ahupua`a*.

Based on work undertaken in Wailea, Gosser et al. (1993) noted a strong *ahupua`a* constrained site distribution along the coastal areas between Paeahu and Papa`anui. Additionally, the coastal settlement of Palauea and Keauhou *ahupua`a* appeared to indicate that the earliest sites were permanent residential units and other structural features that may have had religious or ceremonial functions. In both Keauhou and Palauea, these site types occur near the central portions of the *ahupua`a.* In Keauhou, a site complex that extends from the coast to approximately 300 m inland (40-80ft. elevation) consists of four to six *kauhale* (residential compound), a *mua* (or men's house), a *heiau*, and a *ko`a* (fishing shrine).

Late prehistoric/early historic settlement in Palauea and Keauhou was characterized by permanent habitation along the coast and limited agricultural expansion into harsher, more ecologically

marginal regions (Kirch 1977). Sites over a quarter-mile inland continued to be temporary habitation and agriculture, although scattered permanent habitation extended as far as a half-mile inland in certain localities (Schilt 1988). The presence of earlier permanent settlements on the coast has been recently discovered as well (Donham 1986 and Fredericksen 1999).

According to Cordy (1978), where the 30-inch rainfall zone exceeded distances of 6 to 7 miles inland, dual permanent settlement occurred. If it was less than 6 miles inland, permanent settlement would primarily be coastal. In the current study area, 30-inch rainfall occurs beyond 6 miles inland, thus suggesting permanent settlement both on the coast and further inland. Situated between the 300-700-foot elevations, the project area occurs wholly within the intermediate zone. This zone was traditionally considered by researchers primarily as a zone of transit between the coastal and inland areas during the prehistoric period and increasing agriculture-related permanent occupation during the early to middle historic period.

In Paeahu, the regional pattern of habitation on the coast below the 150-200-foot elevations and at higher elevations above 3000 feet in areas with more rainfall appears applicable. The intermediate zone that lies between these two permanent settlement areas exhibits a much lower density of sites and a decrease in site type variation. Only marginal structural features such as modified outcrops, rock shelters, and stone mounds are common to this intermediate zone.

The foregoing pattern of occupation, in the general region of the project area, is applicable to the prehistoric and early historic patterns of traditional occupation. By the 1800s, with the advent of cattle and commercial agricultural enterprises; the introduction of the western concept of private ownership of land; together with the development of cart paths, roadways, and harbors; the traditional occupation pattern underwent major changes throughout this region as well as island-wide.

SITE EXPECTABILITY

According to the settlement pattern model inferred by previous researchers as discussed in the preceding section; the subject area, located approximately three-quarters of a mile to one and a quarter miles inland, is situated in a harsher, more ecologically marginal area. Sites expected in this zone would include features related to temporary habitation, possibly limited dry-land agricultural features, and transportation during the prehistoric period. Features represented may include modified outcrops, isolated C-shape and U-shape structures, overhang shelters, and trails. Most likely, the historic period sites would primarily be related to ranching activities. These may include; walls, mounds, pits, modified outcrops, enclosures, clearings, and roadways. Site density is expected to be sparse with occurrences being scattered and dispersed over a wide area. Especially within the northern portion, with evidence for extensive previous disturbance over much of the area, only those remnant areas near and within the gulches and rocky outcrops have potential for extant remains.

METHODS

The fieldwork for the initial inventory survey, limited only to the southern section, took place discontinuously over a three week period, commencing on April 18 and concluding on May 9, 2000. The project personnel consisted of Jeffrey Pantaleo, M.A. principal investigator and Aki Sinoto, project coordinator; assisted by Lisa Rotunno-Hazuka and Paul Titchenal, M.A.. The survey entailed walking systematic north-south and east-west transects. The density of vegetation and the type of terrain directly influenced the transect intervals, which generally ranged between 5-25 m apart. Areas disturbed through extensive mechanical clearing were spot checked. To facilitate the walk-through survey and locating the recorded sites on a map, the bulldozed roadways were used to subdivide the survey area into increments of more manageable size. The project area was divided into east and west sectors using the main unpaved access road that traverses across the area from the Ulupalakua Ranch gate at the southeast corner through the central section of the Site 200 wall on to the two entry gates into the Wailea 670 property. When a site was identified, it was cleared of vegetation, assigned a temporary site number, plan mapped using tape and compass, and located on a topographic map provided by the client. The site was tagged with a piece of flagging tape, labeled with the site number, for subsequent relocation and identification. B&W and color photographs in 35mm format were taken of project area overviews and selected sites. The subsequent work employed digital photographs.

Subsurface testing was conducted at selected sites/features to determine the presence/absence and extent of cultural remains, deposits, and to retrieve any datable samples. Controlled manual excavations, using a trowel, were conducted by natural layers, subdivided into 5 cm levels, and soil was sifted through a 1/8" mesh screen. Any collected material was placed in labeled bags.

The fieldwork for the amendment survey took place discontinuously over a two month period during March-May 2001, with an accumulated total of twenty person days being expended for preparation and surface survey. The personnel consisted of Lisa Rotunno-Hazuka, Ian Bassford, Aki Sinoto, and Jeffrey Pantaleo, M.A. In the southern section, the amendment procedures entailed traversing areas with denser vegetation with closer interval transects. Each pass was

oriented in the direct opposite direction of the previous pass in order to maximize visual coverage of outcrop and ledge areas. In the northern, grass-covered section where immediate ground visibility was poor, an enlargement of a 1996 aerial color photograph taken by the R.M. Towill Corporation was utilized to determine specific localities of potential sensitivity. These areas, concentrated along the vegetated dry gulches and remnant outcrop ridges, were thoroughly inspected by walking systematic transects. Subsurface testing was undertaken at the solitary overhang shelter located in the northern portion. Following the completion of the amendment procedures, SHPD concurred with the findings and conclusions that the northern section exhibited ample evidence of compounded, extensive previous impacts and absent of significant archaeological remains. Thus, subsequently, attention was focused on the southern section.

During August 2003, June 2008, and February 2012 various field procedures; including additional walk-through inspections during the die-back of cover vegetation in the dry season and GPS point survey of sites recommended for preservation were conducted. Some monitoring was also undertaken in conjunction with the clearing of firebreaks along the northern boundary with Maui Meadows, marking sites for surveyors, assessing the impact of deer on archaeological surface remains, and the construction of a water tank and access road for Wailea Resort within a portion of the subject project area. These tasks were undertaken by Kimokeo Kapahulehua; Eugene Dashiell, M.A.; Paul Titchenal, M.A.; and Aki Sinoto.

During July to October of 2006, A & B Wailea LLC, constructed a 1 million gallon water tank and access road in the Paeahu portion of the project area. Although, archaeological monitoring was not required by SHPD based on the negative results of the aforementioned amendment survey (Sinoto and Pantaleo 2001), informal monitoring during clearing and grading of the access road, water tank construction, and trenching within Kaukahi Road was conducted by Aki Sinoto Consulting at the request of A & B Wailea LLC. The monitoring procedure was completed with negative results.

Accepted standard archaeological procedures, techniques, and practices were followed throughout the inventory survey procedures described in this report. Permanent State Site (SIHP) numbers were obtained from the State Historic Preservation Division for all sites. Handheld Garmin GPSmap 76Cx and Trimble Pro XRS GPS units were used for GPS point survey. The collected data was later processed in the office using Garmin and ArcView GIS software to produce various maps of the project area.

RESULTS OF SURVEY

A total of 40 sites comprised of 60 component features have been recorded within the 700-acre, project area during multiple field sessions that took place between April 2000 and June 2008. One site was located in the northern section (Fig. 5) and the remaining thirty-nine sites are in the southern section (Fig. 6 and large folded map in back cover). Seven of the sites in the southern section were previously recorded prior to the start of the current procedures. Thus, a total of thirty-three sites were previously unknown. Remnant segments of the historic roadway referred to as the Kanaio-Kalama roadway were apparently obliterated at the time when the current access road was bulldozed atop the same alignment. Waterworn cobbles and boulders, representing manuports foreign to the environment, presumably used in the original construction of the Kanaio-Kalama roadway, can be seen strewn on either side of the existing jeep road in certain locations. Portions of the roadway may also have been modified for use by the military.

Twenty-eight sites (Sites 200-205, 3156-3158, 4945-4961, and 5109-5112) recorded in 2000 and 2001 were previously assigned permanent State Site numbers. Twelve additional sites (Sites 6794-6805) were added later. Descriptions of all recorded sites are presented below:

SITE 200 *(all permanent SIHP numbers are prefixed by 50-50-14-)*
This well-constructed wall, running *mauka-makai* (east/west) and previously recorded by Walton (1972), defines the northern boundary between the north and south sections of the project area. This free-standing, double-faced wall built of 4-10 courses of stacked basalt cobbles and boulders, ranges 0.80-2.0 meters in height and 0.50-0.80 meters in width, and continues beyond the east and west boundaries of the project area (Fig. 7). According to Walton (1972:10), this wall was constructed by Ulupalakua Ranch in the 1880s. The wall was breached in several locations by bulldozing for access roads. Other walls also intersect and conjoin with this wall. The east-west segment measures ca 1000 meters in length.

SITE 200 (southern divergence)

The second longest wall in the project area is the southern divergence of Site 200 which starts around 170 m from the western boundary of the project parcel and follows the curving edge of a drop in elevation toward the south for 500 meters. This wall, upon reaching an area of bare aa, sharply turns towards the west and continues beyond the west boundary (Fig. 8). This wall is similar in construction and dimensions to Site 200 over most of its length although in places the construction does not appear contemporaneous. This segment was not recorded by Walton, but designated as part of Site 200 because these two prominent walls are joined.

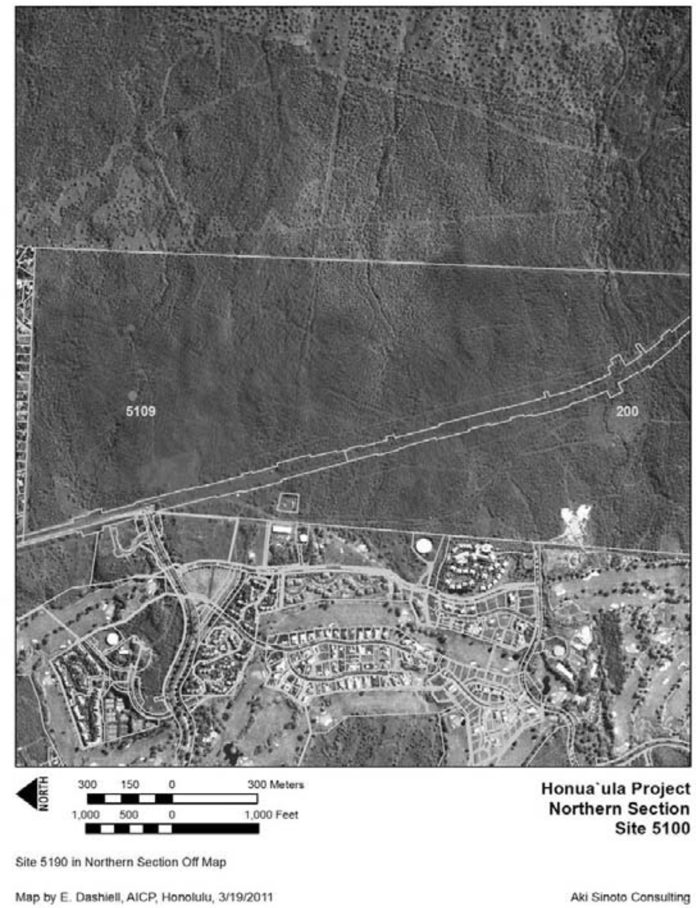

Figure 5. Location of Site 5109 in the Northern Section of the Project Area
(Note Site 200 Wall to the South)

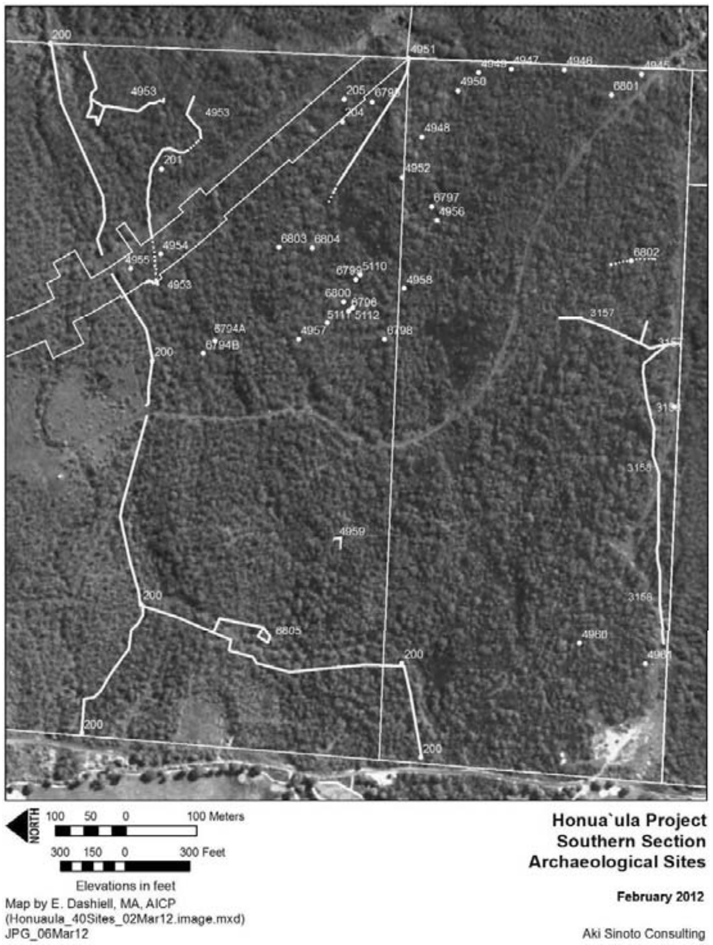

Figure 6. Locations of 39 Sites in the Southern Section
(See large folded map insert at back of this report)

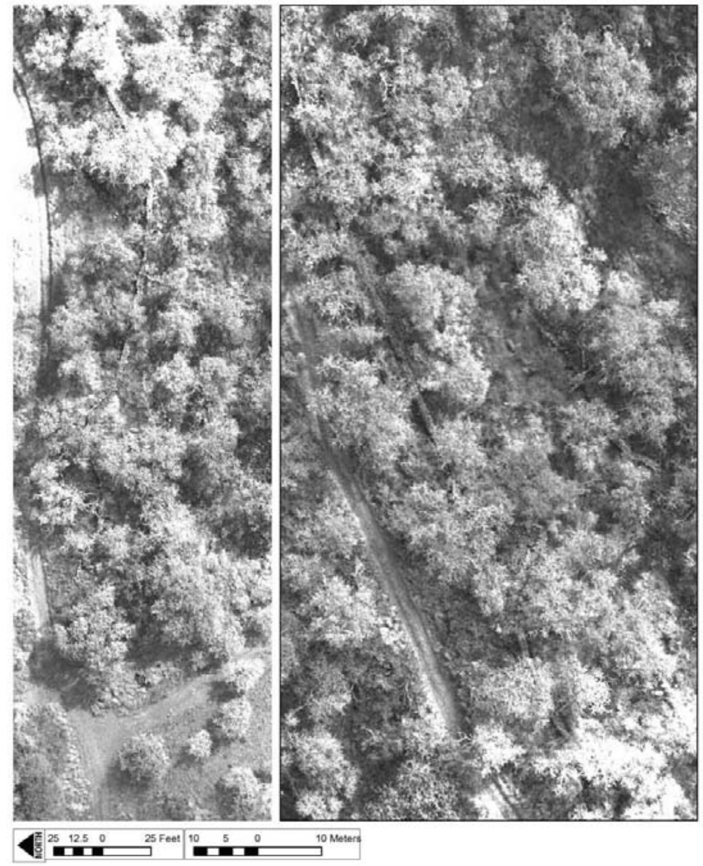

Figure 7. Partial Aerial Overviews of Intact Sections of Site 200 Wall
Left Panel: Lower Segment Showing Breach at Jeep Road Entry
Right Panel: Upper Segment Connected to Lower Segment
(Aerial Courtesy PBR Hawaii, Inc.)

Figure 8. View of the Site 1/200A Wall Near Its Western Breach at Boundary, View to East

SITE 201

This site, previously recorded by Walton (1972:17), is a complex consisting of a meandering wall, a platform, overhang shelter, parallel walls, and a low, amorphous clinker platform located near the northeast corner of the south section (Fig. 9). The site occupies ca 4100 square meters.

Feature A is a terrace platform built against the southern edge of an outcrop ledge (Fig. 10 top). The platform measures 10.2 by 3.5 m and ranges between 0.7 to 1.8 m high. It is solidly constructed of stacked basalt cobbles and boulders, 3-10 courses high, and filled with boulder/cobble clinkers. A depression was observed on the surface in the southeastern corner of the platform and a portion of the long southern face is tumbled.

Feature B is an overhang shelter located 10 m west of Feature A. The shelter measures 2.8 by 1.2 m and the ceiling at the entrance is 0.8 m high. Fronting the shelter is a level soil terrace enclosed by a piled basalt cobble/boulder wall. The terrace measures 2.6 by 2.8 m. The wall enclosing the soil area is circular, 3-4 courses high, and measures between 0.4 to 0.7 m wide and interior height 0.55 m and exterior height 0.65 m. A cowrie shell octopus lure was found on the surface of the south wall.

Feature C consists of parallel walls located in a swale 8 m north of Feature B (Fig. 10 bottom). These free-standing parallel walls are 3 m apart and constructed of stacked basalt cobbles and boulders. They measure 10.6 by 0.8 m and 1.0 to 1.6 m high.

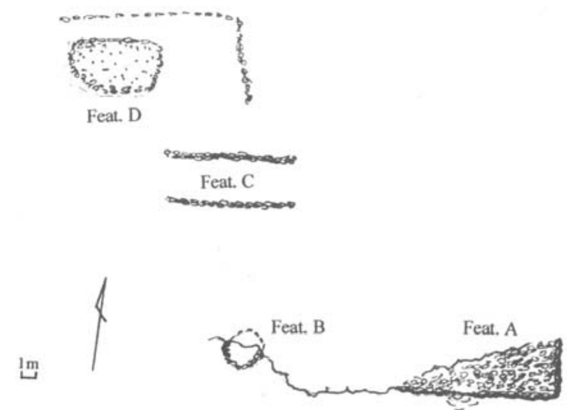

Figure 9. Plan View of Site 201 Complex

Feature D is a crude platform located on a ridge approximately 4 m north of Feature C. It is constructed of stacked cobbles and small boulders, filled with cobbles and clinkers, and its sides are not faced. It is roughly rectangular, measuring 6.0 by 4.0 m, and orients east-west along its long axis. The brass washer was located on the east side of this platform. The meandering Site 4953 wall is located to the east, west, and north of this feature and complex. The western end of the wall extends to the Pi`ilani Highway extention right-of-way cut where it is truncated. A short remnant segment continues west of the cut (see Fig. 6).

Figure 10. (top) Site 201 Feature A Platform to West
(bottom) Site 201 Feature C Parallel Walls to East

SITE 204

This site, also previously recorded by Walton (1972:12) is a platform and a small paved area located approximately 30 m west of Site 205 along the base of a sloping outcrop ridge (Fig. 11). The platform measures 5.5m long by 3.9 m wide and 1.2 m high. It is constructed of stacked basalt cobbles and boulders, 3-4 courses high. A coral manuport is located on a level soil area immediately north of the platform. The eastern portion of the platform has been disturbed by a large, fallen *wiliwili* tree. The paved area, one stone high and measuring 2.0 m by 1.0 m, is located roughly 6 meters north of the large platform. The brass washer with site number was located in a boulder on the north face, near the northwest corner of the large platform.

SITE 205

This site, previously recorded by Walton (1972:14), consists of an overhang shelter open to the west with an enclosed walled area fronting the opening (Fig. 12). The shelter measures 3.7 m long by 1.5 m deep and 0.85 m high at the entrance. Fronting the shelter is a level soil area measuring 3.0 by 4.0 m enclosed by a three-sided wall. The north wall measures 2.2 m long, 0.9 m wide, and 0.6 m high; the south wall measures 2.5 m long, 0.8 m wide and 0.2 m high; and the west wall measures 3.7 m long, 0.6 m wide, and 0.8 m high. The western side of this wall is tumbled. No artifacts or midden were seen on the surface or the interior floor. The brass washer with site number left by Walton was located above the opening of the shelter, wedged into a crack in the outcrop.

SITE 3156

This C-shaped structure constructed of stacked aa cobbles and boulders, measures 3.8 by 2.3 m with wall heights of 0.65-0.80m. This site, located roughly 5 m north of the southern boundary fence-line, was previously recorded by Sinoto and Pantaleo (1993:7). Subsurface testing of two units on the interior floor and at the opening produced negative results. Based on the absence of cultural materials, its age and function are not clear. This site was previously destroyed.

SITE 3157

This site is a ranch wall located near the central portion of the southern boundary of the project area. It is oriented north-south and continues beyond the southern boundary of the project area. This wall, constructed of stacked aa cobbles and boulders, was also previously recorded by Sinoto and Pantaleo (1993:10). Its length was estimated to exceed 180 m, with widths ranging 0.60-1.0 m and heights ranging 1.0-1.5 m. Its northern end has been impacted by bulldozing. A short 25 m spur to the east is truncated by previous bulldozing. An outcrop boulder sits at the junction.

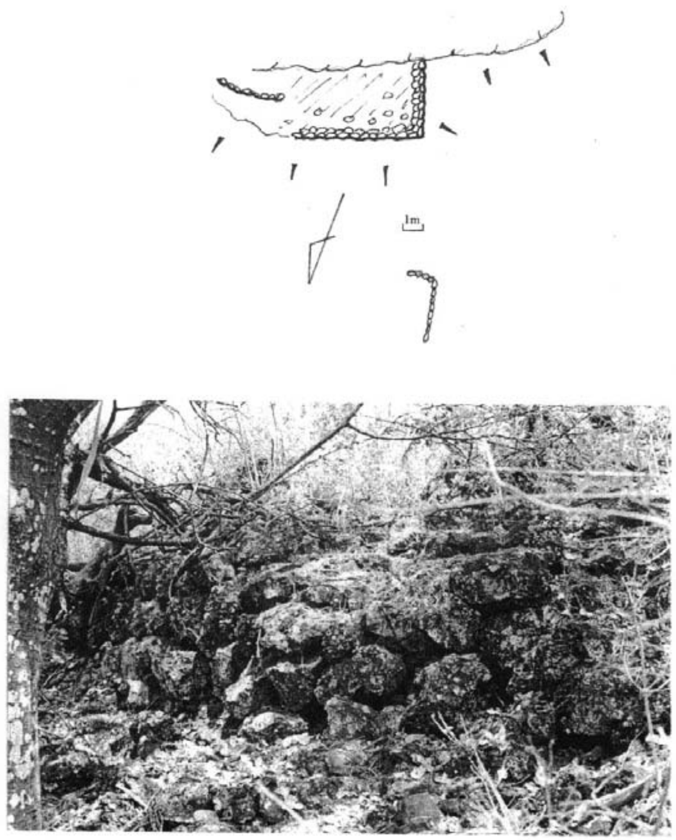

Figure 11. Plan View and Photo of Site 204 Platform to East

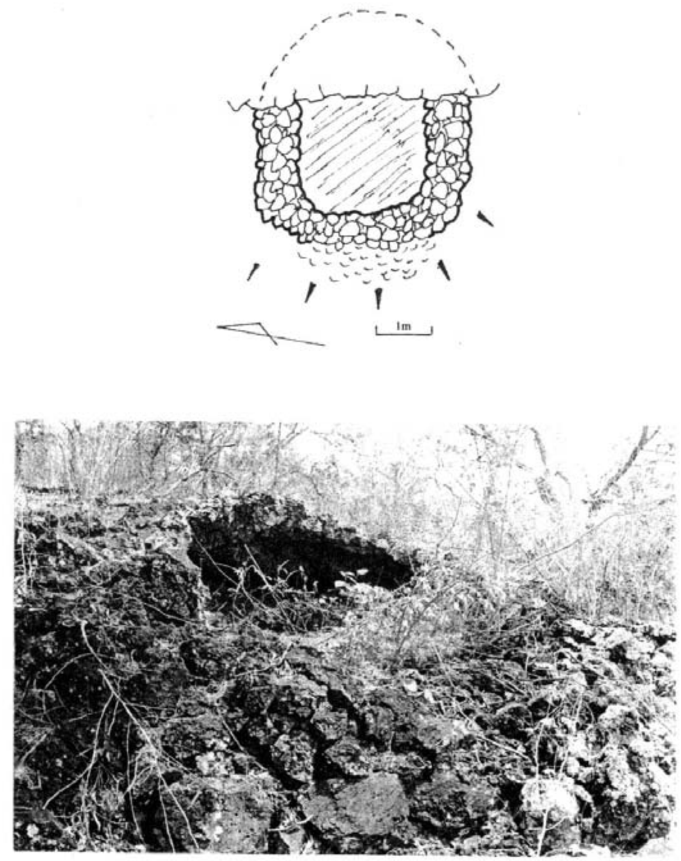

Figure 12. Plan View and Photo of Site 205 Modified Overhang Shelter to East

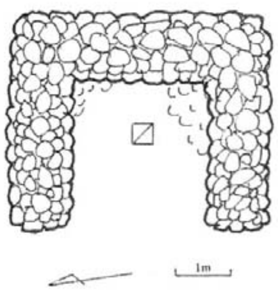

Figure 13. Plan and Photo of Site 4945, U-shaped Enclosure, View East

SITE 3158

This free-standing, double-faced wall measures 1.2 to 2.5 m high and 1.0 to 1.5 m wide. It is constructed of stacked aa cobbles and boulders and oriented east-west. This site was also previously recorded by Sinoto and Pantaleo (1993:10). At the time of the previous survey, this wall was reported to continue in both directions beyond the project area. Currently, large segments of the wall appear to have been bulldozed by the construction of the gravel haul road. Discontiguous segments are still extant along a 450m long alignment. The eastern end of this wall adjoins the Site 3157 wall (see Fig. 6).

SITE 4945

This site is a U-shaped enclosure located at the southeastern corner of the project area (Fig. 13). It is constructed of stacked basalt cobbles and boulders with clinker fill and open to the west. The enclosure measures 4.6 by 4.0 m, with walls between 0.3 to 0.65 m high and 1.0 to 1.2 m wide. The south wall is tumbled and the northeast corner incorporates an outcrop. The interior floor is soil and no midden or artifacts were observed on the surface.

Testing

A 0.25 X 0.25m test unit revealed no cultural deposit within the soil floor of this structure. A thin overburden, 2-3cm, covered a sterile clinker and loam substratum. Excavation was terminated at 20 cmbs due to the absence of cultural remains and abundant clinkers (Fig. 14).

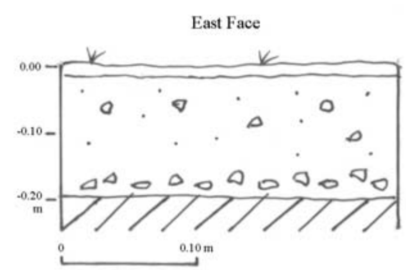

Figure 14. Stratigraphic Profile of Test Unit at Site 4945

SITE 4946

This site is a C-shaped enclosure located 7.5 m west of the eastern boundary fence near the southeast corner of the project area. It is constructed of stacked basalt cobbles and boulders with clinker fill and open to the south. The enclosure measures 4.2 by 2.2 m and the collapsed wall heights range between 0.2 to 0.4 m (Fig. 15). This C-shape is in poor condition due to extensive bulldozing in the area. No midden or artifacts were observed on the surface.

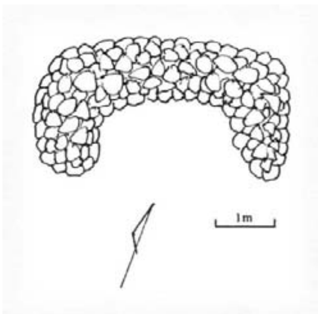

Figure 15. Plan of Site 4946, Collapsed C-shaped Enclosure

SITE 4947

This site is an overhang shelter fronted by two levels of modified outcrop terracing (Fig. 16). It is located on the south edge of a gulch, along the northern slope of an outcrop ridge near Site 4946 along the eastern boundary of the project area. The overhang shelter measures 2.2 m wide by 2.0 m deep and the ceiling at the entrance is 0.6 m high. Fronting the shelter are two levels of terracing. The upper terrace is constructed of an alignment of basalt cobbles and boulders creating a level area measuring approximately 4.5 m long and 0.8 m wide. The terrace face is 0.5 to 0.6 m high. The lower terrace near the base of the slope measures approximately 4.0 m long and 1.8 m wide. This terrace is disturbed and in poor condition due to tumbled wall face. No midden or artifacts were observed on the surface in or near this site.

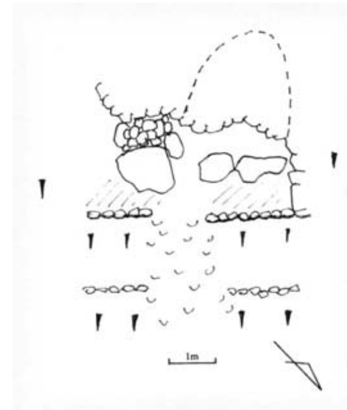

Figure 16. Photo and Plan of Site 4947, Overhang Shelter with Terraces, View to Southwest

SITE 4948

This site is a large, open, earthen clearing measuring, 30 m east to west and 15m north to south. A series of 10+ amorphous rock, probable clearing, mounds, roughly 1.0 to 1.5 m in diameter and ranging 0.10 to 0.30 m in height, are located near the southwestern edge of the clearing.

SITE 4949

This site consists of 3 overhang shelters fronted by 4 modified outcrop terraces (Fig. 17). It is located 14 m west of the eastern boundary of the project area along the southern edge of an outcrop ridge. The eastern shelter measures 5.0 by 3.5 m and 0.8 m high at the entrance, and the interior measures 1.8 m deep and 3.0 m wide. The middle shelter measures 4.5 by 3.5 m and 0.6 m high, and the interior measures 1.0 m deep and 2.0 m wide. A clinker paved area measuring 4.0 by 3.0 m separates the eastern and middle shelters. The western shelter measures 2.5 by 2.0 m and 0.5 m high, and the interior measures 1.5 m deep and 0.8 m wide. Fronting the series of overhang shelters are 4 modified outcrop terraces constructed of basalt cobble and boulder alignments creating level areas. This site occupies a 60 square meter area which measures 15m (e/w) by 4m (n/s).

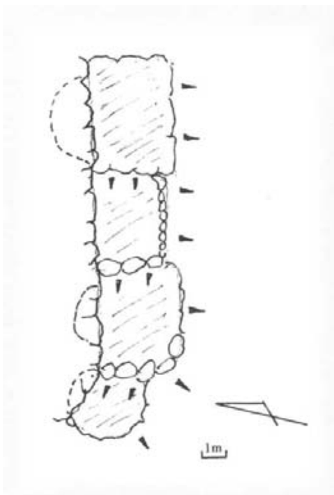

Figure 17. Plan of Site 4949, Overhang Shelters and Terraces

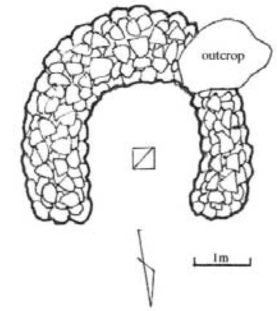

Figure 18. Plan and Photo of Site 4950, C-shaped Enclosure, View to Southeast

SITE 4950

This site is a C-shaped enclosure located 30 m north of Site 4949 along the eastern boundary of the project area (Fig. 18). It measures 4.0 by 3.5 m and is constructed of stacked basalt cobbles and boulders incorporating a large outcrop on the southwest portion. The C-shape is open to the north with a clinker filled interior floor. The opening measures 1.7 m wide. The walls measure 1.0 m wide and the exterior heights range between 0.25 to 0.8 m and interior between 0.2 to 0.3 m. No midden or artifacts were observed on the surface in or around this site.

Testing

A 0.25 by 0.25 m test unit was excavated in the central interior floor of the enclosure. No subsurface cultural remains or deposits were encountered during testing. The culturally sterile soil matrix consisted of a brown silty loam with abundant rocks. Excavation was terminated at 15 cm below surface due to reaching bedrock (Fig. 19).

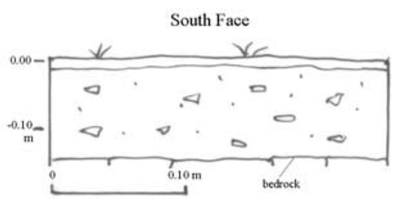

Figure 19. Stratigraphic Profile of Test Unit at Site 4950

SITE 4951

This site is a stepping-stone trail located on an open aa flow in the central area of the eastern half of the southern section (Fig. 20). The trail is constructed of flat basalt slabs placed at 0.5 to 1.0 m intervals. It is oriented east-west and continues beyond the eastern boundary of the project area. The segment measures approximately 30 m long. Another segment of this trail was identified further west within the same aa flow (4959). Recent fence-line replacement activities by the neighboring ranch have impacted the eastern segment of this trail *mauka* of the eastern boundary of the project.

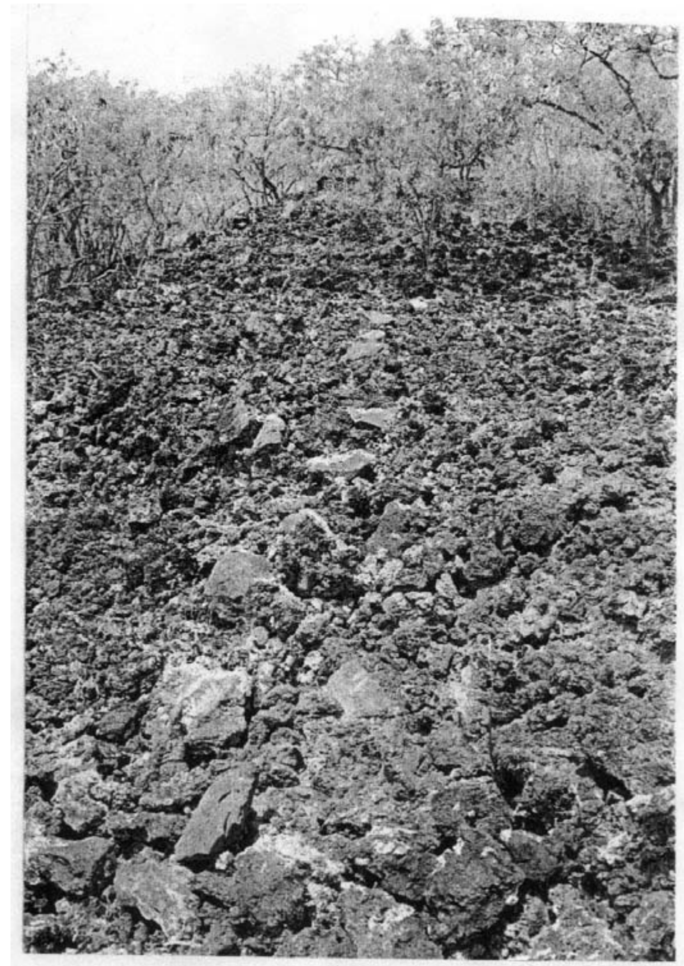

Figure 20. Photo of Site 4951, Steppingstone Trail in Aa Flow, View to West

SITE 4952

This site is a platform built against an outcrop on a gentle slope to the west of the Site 4951 steppingstone trail (Fig. 21). It measures 2.3 by 1.5 m and ranges between 0.7 to 1.3 m high along the faced sides. The platform is constructed of stacked basalt cobbles and boulders, 3-4 courses high, on the northeast and northwest sides. The southern side abuts a large outcrop bench creating a level area. No midden or artifacts were observed.

SITE 4953

This site consists of a series of intersecting and conjoined walls totaling ca 480 meters long in the northeastern corner of the southern section (see Fig. 6). The wall segments are located along the southern edge of a gulch, in low-lying areas between outcrop ridges, and along the tops of ridges. The walls range 0.6-0.8 m in width and 0.7-1.5 m in height. It is double-faced and constructed of stacked basalt cobbles and boulders and generally trends east to west. A discontiguous wall, incorporating an outcrop ledge, extends east-west along the top of a ledge, and is constructed of stacked and aligned basalt cobbles and boulders and terminating at a large outcrop boulder at its eastern end (Fig. 22). A free-standing segment extends roughly 100m northward, from the northern base of the ledge towards the Site 200 wall along the northern boundary of project area. It is constructed of stacked basalt cobbles and boulders and measures 0.8 m high along the western side and 0.7 high along the eastern side. The wall is 0.8 m wide, and is breached in several areas. A segment also occurs along the north side of the Site 201 complex. This wall continues down-slope, across the Piilani Highway extension right-of-way for a short distance. A bulldozed cut destroyed most of the remaining down-slope segment of the wall.

SITE 4954

This site is a deteriorated C-shaped enclosure located, immediately north of a road cut near the northern boundary and west of the Pi`ilani Highway extension corridor (Fig. 23). It measures 3.2 by 2.5 m with walls 0.8 m wide and 0.4 to 0.5 m high. A large outcrop boulder is incorporated into the northeast wall measures 1.3 m long, 1.0 m wide, and 0.50m high.

Testing

A 0.25 by 0.25 m test unit was excavated in the central interior floor of the C-shape. A culturally sterile cobbly, silt loam was encountered immediately underlying the humic overburden. No cultural remains were observed during testing. Excavation encountered bedrock at 10 cmbs (Fig. 24).

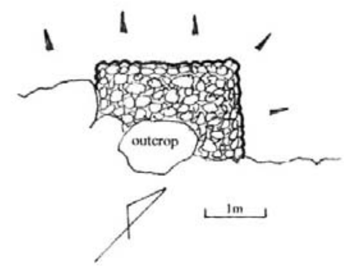

Figure 21. Plan and Photo of Site 4952, Modified Outcrop Platform, View to Northwest

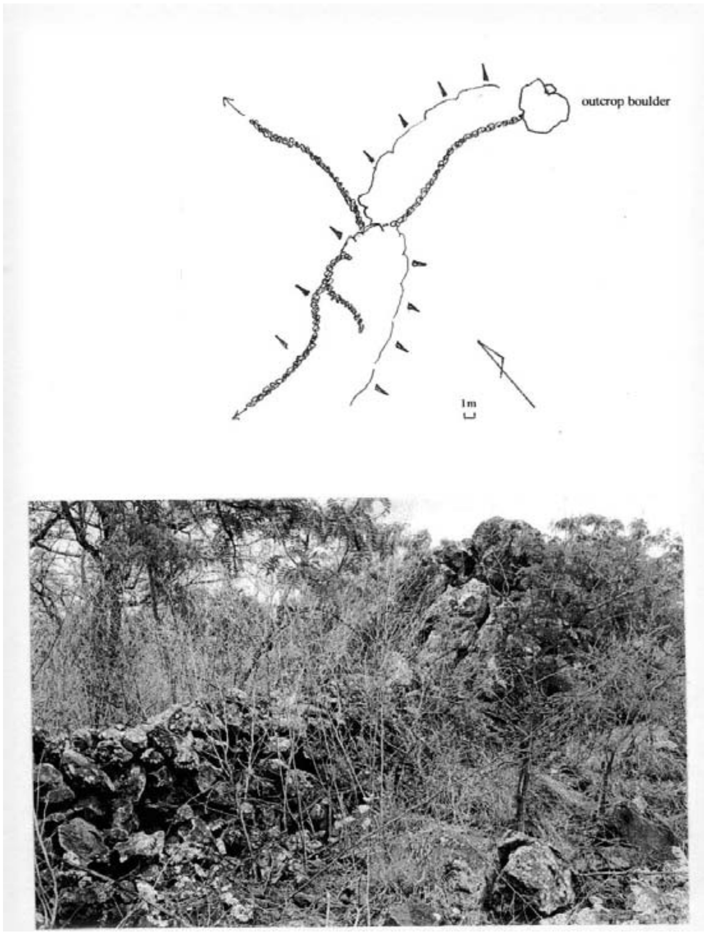

Figure 22. Plan and Photo of Site 4953, Interconnected Walls, View to East

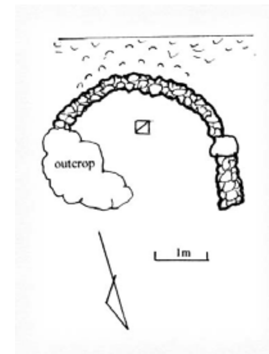

Figure 23. Plan of Site 4954, C-shaped Enclosure

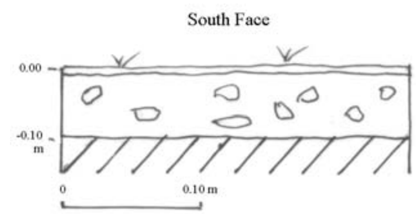

Figure 24. Stratigraphic Profile of Test Unit at Site 4954

SITE 4955

This site is an overhang shelter with a flat, soil terrace fronting the opening with two walls partially enclosing the soil area (Fig. 25). It is located on the south slope of a ridge south of a bulldozer cut paralleling the northern boundary wall (Site 200) within the proposed highway corridor. The overhang in the outcrop ledge measures 2.0 m wide, 1.2 m deep, and 0.70 m high at the opening. The soil terrace measures 5.0 m by 2.0 m. The western wall segment measures 2.0 m long, 0.80 m wide, and 0.60 m high. The longer eastern wall segment measures 2.8 m long, 1.2 m wide, and 0.80 m high. A sea urchin shell fragment and a medium bird bone were observed on the surface of the shelter floor.

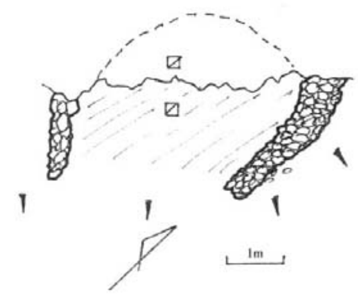

Figure 25. Plan and Photo of Site 4955, Modified Overhang, View to Northwest

Testing

Two 0.25 by 0.25 m test units were excavated; one in the interior floor of the overhang and another in the central area of the soil terrace fronting the shelter. The interior unit was taken to 15cm below surface and the other to a depth of 22 cm. Both units revealed a sterile, cobbly silt loam deposit with no cultural materials (Fig. 26).

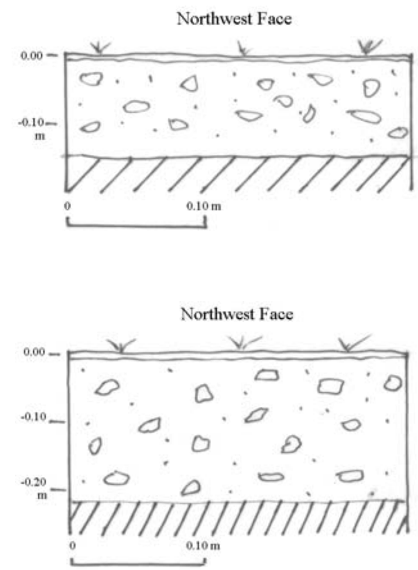

Figure 26. Stratigraphic Profile of Test Units at Site 4955
(top) interior unit (bottom) exterior unit

SITE 4956

This site consists of a 7.0 m long outcrop ledge, oriented northeast-southwest, with two small overhangs (Fig. 27). It is located in the southern central portion of the east half of the southern section. The smaller western overhang measures, 0.80 wide, 1.0 m deep, and 0.30 m high at the opening. It is fronted by a rectangular alignment, 1.6 by 2.3 m, of single boulders and one large slab forming the eastern side. A flat soil area 4.5 m by 2.0 m fronts the ledge. At the eastern end is another small overhang, 0.80 m wide, 2.0 m deep, and 0.70 m high at the opening. A cranium of a cat was found on the interior floor surface.

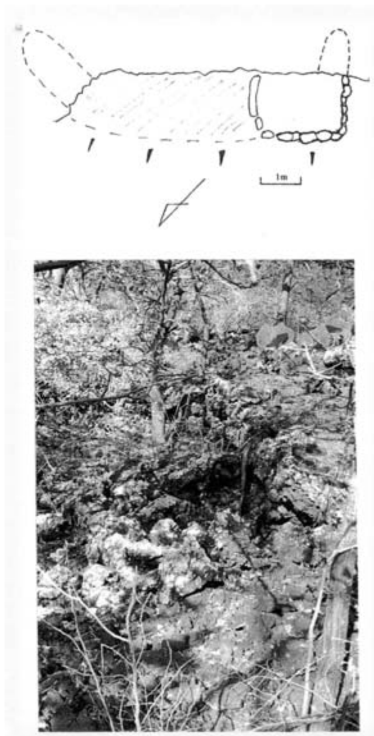

Figure 27. Plan and Photo of Site 4956, Modified Overhangs, View to Northeast

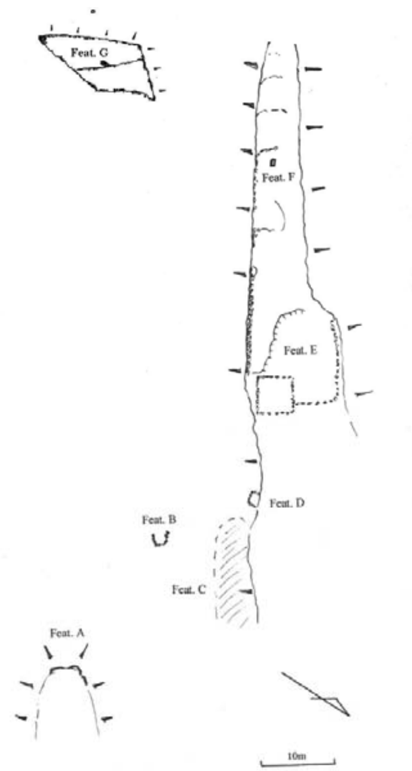

Figure 28. Plan View of Site 4957, Ridge-top Complex

SITE 4957

This complex of 6 features is located along a ridge crest on the southern edge of a gulch east of the jeep road in the eastern half of the southern section near the Site 200 wall (Fig. 28). It encompasses ca 3000 square meters and measures 100m (ne/sw) by 20-50m (nw/se). Portions of this complex are visible from the main access road.

Feature A is a cluster of 10+ modified outcrops along the base of an outcrop ridge located to the east of the main complex. These features consist of filled areas, single stone alignments, and crude mounds.

Feature B is a C-shaped enclosure measuring 5.0 m by 2.8 m with dilapidated walls ranging in height from 0.20 to 0.45 m. The enclosure opens to the west and the interior floor is soil. The southern portion of this structure incorporates a large outcrop into the wall.

Testing

One test unit, 0.25 by 0.25 m, was excavated in the center of the soil floor. Underlying the superficial humic overburden was a culturally sterile, cobbly, silt deposit. The excavation was stopped at 15 cm (Fig. 29). No cultural materials were encountered.

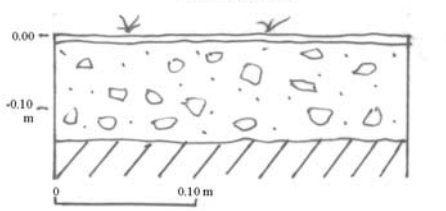

Figure 29. Stratigraphic Profile of Test Unit at Site 4957 Feature B

Feature C is an open, earthen clearing, adjacent to the outcrop ridge. It measures about 15 m east-west and 6 m north-south. Several clearing mounds of rocks and cobbles occur in the area between this feature and Feature B.

Feature D is a small plaform built up against the southern base of the ridge just 4 m southwest of Feature C. It measures 2.4 m square and 1.0 m high at its southern facing. Its northern side is incorporated onto a bedrock ledge.

Feature E consists of a rectangular enclosure with two adjoining walled areas and several small activity areas that are leveled and descend down the top of a narrow outcrop ridge towards the southwest (Fig. 30 top). The enclosure measures roughly 5.5 m square, with walls ranging in width from 0.80-1.0 m and 0.70-1.4 m high. A straight wall adjoins the southern corner of the enclosure and follows the edge of the ridge down-slope for 14.5 m. An L-shaped wall adjoins the enclosure on the northwest side to create a three-sided enclosed area. This wall follows the northern edge of the ridge for about 8.0 m. The interior floor areas are fairly clear of rocks and flat. A branch coral manuport was located outside the southwest wall of the enclosure. Below these structures along the ridge are at least three, stepped, modified terrace areas that measure 5.0 by 3.0 m. Each terrace is about 0.35-0.40 m lower. Modification of rock and rubble fill areas and some boulder alignments define these terrace areas.

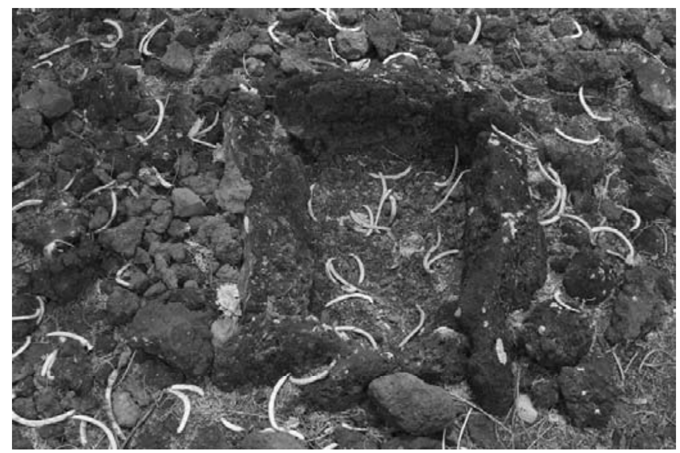

Figure 30. (top) Site 4957 Feature E, Rectangular Enclosure and Attached Wall, View to NW (bottom) Feature F, Slab-lined Firepit, Long Axis Orients Northeast/Southwest

Feature F is a rectangular firepit located on the last well-defined terrace area of Feature E (Fig. 30 bottom). It is located nearly centrally within a level floor area measuring 6.1 by 2.6 m. It is composed of four elongate, thin slabs of basalt set on edge to form a rectangular enclosure measuring 0.73 by 0.56 m. and standing about 0.16 m above ground surface. Each of the slabs was buried about 12-14cm into the ground.

Testing

The western end of the firepit was excavated in an effort to collect charcoal for dating. A 0.35 by 0.30 m unit was excavated and produced a small amount of charcoal. Three small fragments of cowrie shell and seven small fragments of sea urchin carapace were recovered. The excavation was terminated at 10 cm below surface when bedrock was encountered. Unfortunately, upon transmittal and processing, the consultant found the quantity of charcoal collected to be inadequate to permit chronometric analyses.

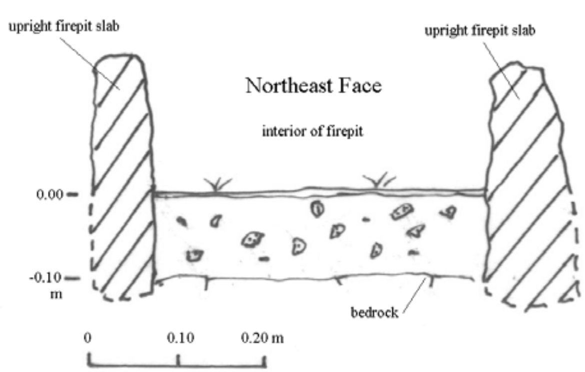

Figure 31. Stratigraphic Profile of Testing at Site 4957, Feature F, Firepit

Feature G is a four-sided area roughly encompassing about 120 sq m consisting of modified outcrop terraces and low enclosures located on a small plateau across a low-lying area south of the ridge where Feature F occurs. Linear outcrop benches are modified with rock fill.

SITE 4958

This site consists of a circular enclosure and an adjacent low rectangular enclosure constructed 2m apart, on an aa flow in the central portion of the southern section (Fig. 32).

Feature A, the circular enclosure, measures 4.0 by 3.5 m with an interior height of 1.1 m and an exterior height of 0.9 m. The walls are core-filled and constructed of stacked basalt cobbles and boulders. The southern and northern ends are tumbled. The interior floor of the structure is rock filled.

Feature B, the low rectangular enclosure, is located 2.0 m west of Feature A. It measures 3.0 by 2.7 m and ranges between 0.3 to 0.5 m high. A possible entranceway is located along its western wall. The walls are core-filled and constructed of stacked basalt cobbles and boulders. The interior floor consists of soil and rocks.

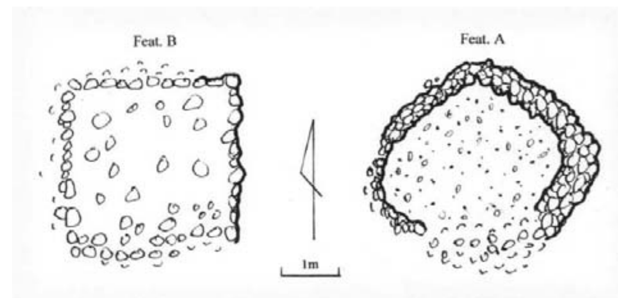

Figure 32. Plan of Site 4958, Two Adjoining Enclosures

SITE 4959

This site consists of two intersecting segments of steppingstone trails and pits located in an aa flow in the central portion of the western half of the southern section (Fig. 33). The steppingstone trail is constructed of flat basalt slabs placed at 0.5 to 1.0 m intervals. One segment of the trail extends north-south and measures approximately 15 m long. The east-west segment intersects with the north-south segment and measures 20 m long. This longer segment is probably a continuation of the Site 4951 trail segments located on the same aa flow to the east.

At the western end of the longer trail segment are 3-4 pit features in the aa flow. These pits are the result of removing aa rocks and clinkers to create a shallow depression. The pits range from 1.0-1.5 m in diameter and between 0.5 to 0.7 m in depth. These pits are artificial and exhibit diagnostic attributes when compared with depressions formed naturally when trees are uprooted.

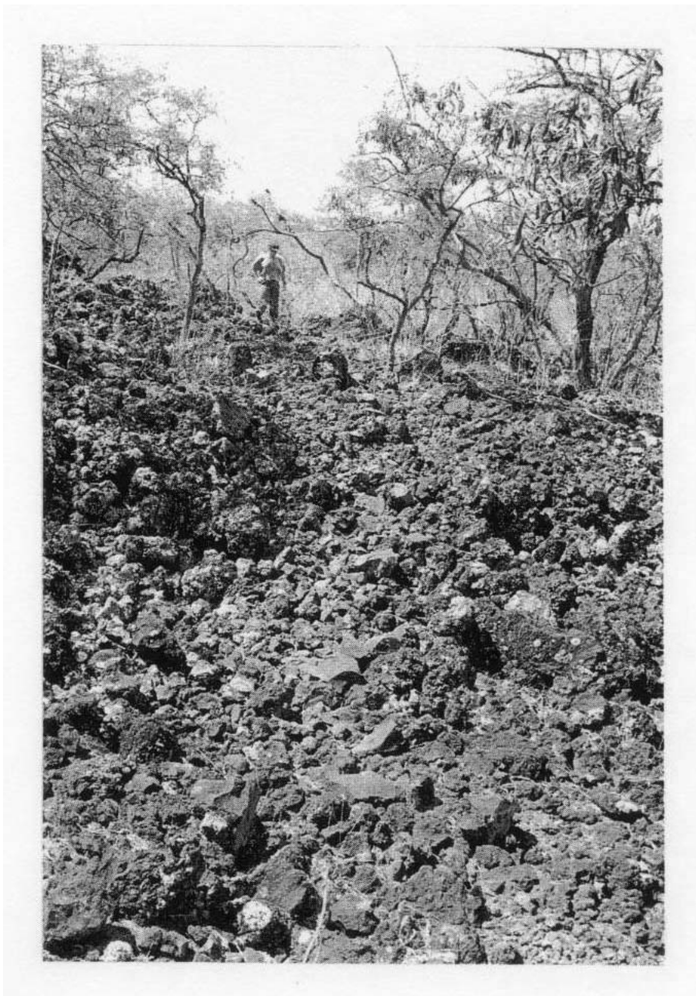

Figure 33. Site 4959, Steppingstone Trail on Aa, View to East

SITE 4960

This site consists of two adjoining platforms constructed against the base of a ridge located in the central portion of the southern half of the western half of the southern section (Fig. 34). The feature measures 6.7 m in total length, with the lower paved platform, to the north, measuring 3.5 m and the filled platform 3.2 m. The filled platform is 1.3 m in height and the interior is rock and soil filled, while the paved platform is .90 m high and its surface is paved with cobbles and clinkers. A 1.2 m long common wall separates the two features with the paved platform situated 0.30 m lower than the filled platform. Constructed stone facings define the north, west, and south sides of this structure but the eastern side is built up against the ridge base.

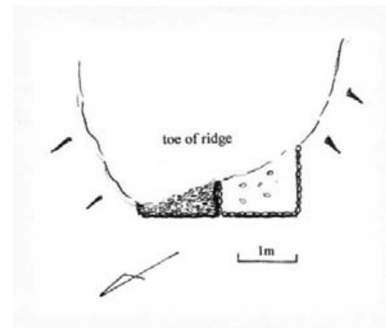

Figure 34. Plan of Site 4960, Two Adjoining Platforms

SITE 4961

This site is a remnant bend of a wall located along the base of a ridge near the southern boundary in the middle of the western half of the southern section (Fig. 35). The wall is core-filled and constructed of stacked basalt cobbles and boulders. The long segment of the wall along the base of the ridge is oriented east-west and measures 7.9 m long, 1.0 m wide, and 0.7 m high. The eastern end of the wall is breached and the western end is tumbled. The north-south segment measures 4.0 m long, 0.6 m wide, and 0.85 to 0.4 m high. This wall segment extends from the top to the base of the ridge.

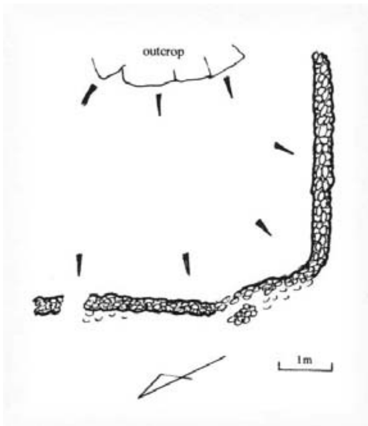

Figure 35. Plan of Site 4961, Remnant Wall

SITE 5109

This site consists of a small overhang shelter situated near the 500 ft. elevation on the north edge of the second gulch southward from the northern boundary in the northern section of project area. The overhang is located on a ledge 4 meters above the gulch bed and measures 6.0 m wide and ranges in depth from 0.50 to 1.5 m from the drip-line. The ceiling heights vary from 0.50 to 0.70 m at the drip-line and decreases towards the back wall of the shelter, where the ceiling eventually meets the floor. A small, natural, earthen terrace area, measuring 1.5 m wide and 4.0 m long, fronts the shelter opening to the south (Fig. 36). Two fragments of sea urchin carapace were observed on the surface of the interior floor in the central portion of the shelter (Fig. 37). No other cultural remains were present.

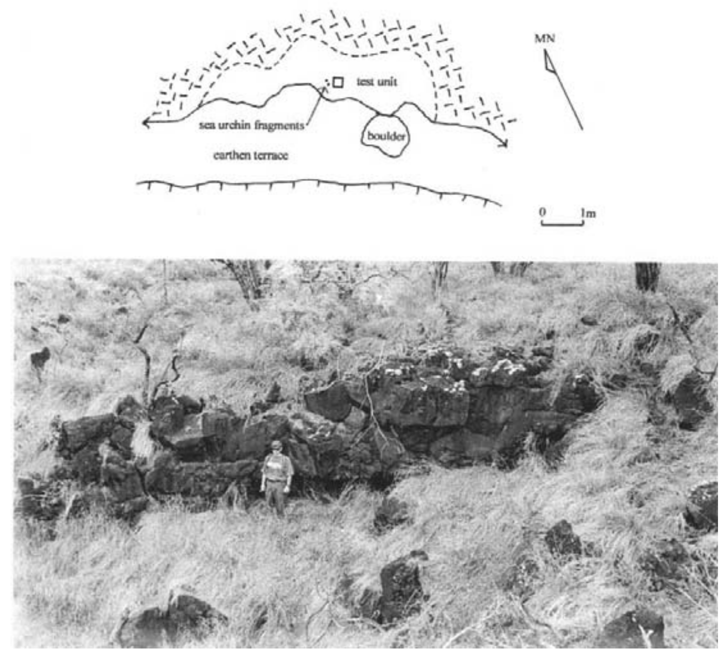

Figure 36. Plan and Photo of Site 5109, Overhang Shelter, View to North

Testing

A small test unit, 0.25 by 0.25 m, was excavated in the central interior floor near the sea urchin shell fragments (Fig 37). The unit revealed a culturally sterile deposit of silty loam and saprolytic rock overlying a solid bedrock substratum. The deposit was 0.20m deep with reddish brown (5YR 4/4) silty loam occupying the upper half (0 to 10 cm) and saprolytic rock within the same silty loam matrix in the bottom half (10 to 20 cm). No cultural material was encountered.

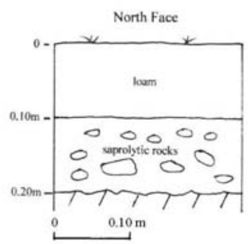

Figure 37. Sea Urchin Fragments on Surface of Shelter Floor and North Face Profile of Test Unit

SITE 5110

This site is a small, collapsed lava-blister shelter measuring 2.7 m wide, 1.6 m deep, and 0.75m high at the dripline (Fig. 38). It is located on the northwest facing edge of an outcrop ledge near the 560 ft. elevation. A few small fragments of marine shell were observed on the interior floor surface. However, a series of trowel probes revealed a shallow deposit (0.15 m) of culturally sterile silty loam with cobbles overlying bedrock on the interior floor.

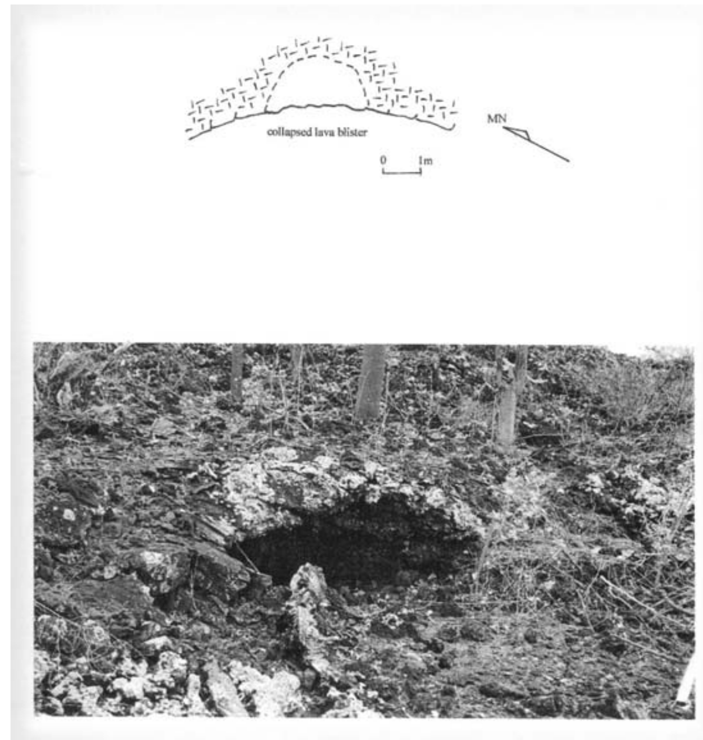

Figure 38. Plan and Photo of Site 5110, Lava Blister Shelter, View to Northeast

SITE 5111

This site is a small terrace platform constructed against an outcrop ridge around the 680 ft. elevation within the southern half of the eastern half of the southern section, roughly 182m (600 feet) west of the eastern boundary fenceline. It is also located immediately west of an old bulldozed road. The site measures 5.0 m long, 2.0 m wide, and varies in height from 0.30 m on the south side to 1.2 m on the west side (Fig. 39). An outcrop ridge occupies the eastern side, and the northern side is tumbled. Five to six courses of aa boulders form a facing around the exterior of this roughly rectangular structure. The upper surface and interior are clinker-filled and leveled. No cultural material was observed on the surface of the structure or in areas surrounding this site.

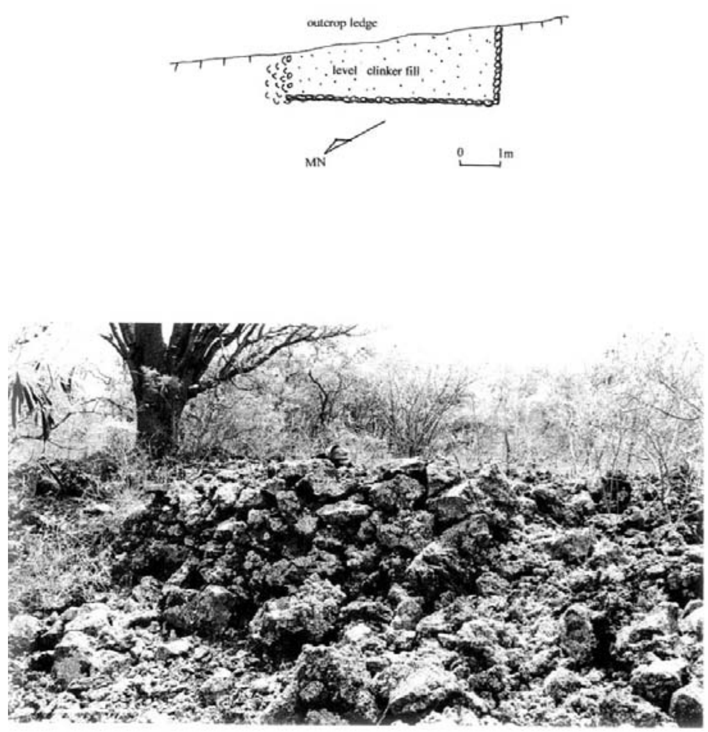

Figure 39. Plan View and Photo of Site 5111, Platform, View to Northeast

SITE 5112

This site, similar in construction and form to Site 5111, is another terrace platform incorporating an outcrop ridge. It is located about 40 m northwest of the Site 5110 shelter. This platform is constructed against the northwest side of an outcrop ridge and measures 12.0 m in length, 2.5 m in width, and averages 1.3 m in height (Fig. 40). The structure is roughly rectangular with three sides faced with 3-4 courses of aa cobbles and boulders with the interior and upper surface clinker-filled. Its long axis orients roughly east to west. No cultural material was observed on the platform surface or in the surrounding areas.

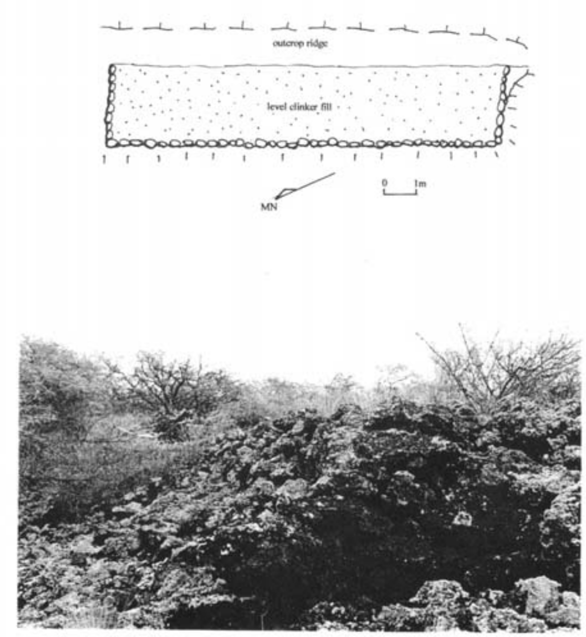

Figure 40. Plan View and Photo of Site 5112, Platform, View to Northeast

SITE 6794

A small cluster consisting of two small structural features occurs along the northern slope of a ridge located ca 260 meters south of the north boundary wall (Site 1/200) of the southern section (Fig. 41). The site is located 90-100 meters east of the main jeep road that separates the eastern and western halves of the southern section of the project area.

Feature A is a small platform terrace built along the toe of the west-facing slope of a rocky ridge roughly 100 meters east of the main jeep road. The structure measures 2.5 m in length, 1.5 m in width and 0.80m in height with 4-5 courses of stone facing on three sides; north, west, and south. The eastern side is built into the slope of the ridge. The long-axis of the platform trends north/south.

Feature B, located 20m northeast of Feature A on a small level plateau below the ridge, is a U-shaped enclosure. This structure measures 4.0m in length, 2.0m in width, and its walls built of 2-3 courses of stacked boulders is 0.60m in height. The west side is open and the interior earthen floor has been cleared of rocks.

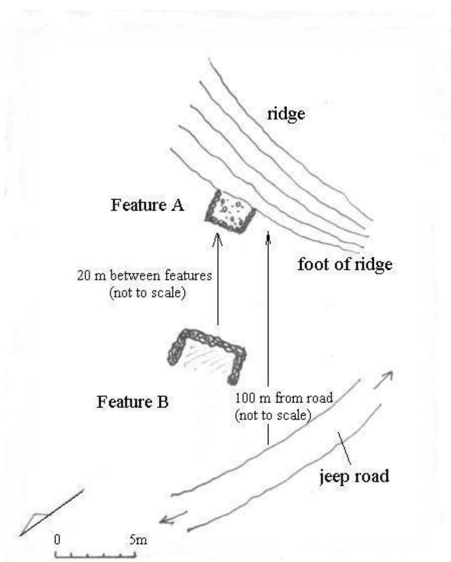

Figure 41. Plan of Site 6794, Two-feature Cluster
(Note distances are not to scale)

SITE 6795

This C-shape is located about 40 meters south of the Site 205 modified overhang shelter on a low bedrock bluff on the eastern edge of a bulldozer cut. The enclosure measures 3.0 by 3.0 meters with wall width 0.40 m and 0.40 m in height (Fig. 42). The interior floor is bedrock with some loose cobbles and boulders. The feature opens to the east. No surface remains were observed in or around this site.

Figure 42. View of Site 6795, C-shaped Enclosure, to North

SITE 6796

This site is a modified outcrop platform located roughly 60 meters northeast of the Site 6798 cluster of two C-shaped enclosures. This feature is built up against an outcrop ledge and measures 5.0 m long by 1.8 m wide and averages 0.80 m in height (Fig. 43). The outcrop is incorporated on the south side and the long axis of the feature is east to west. The top is clinker and cobble filled. No surface remains were observed.

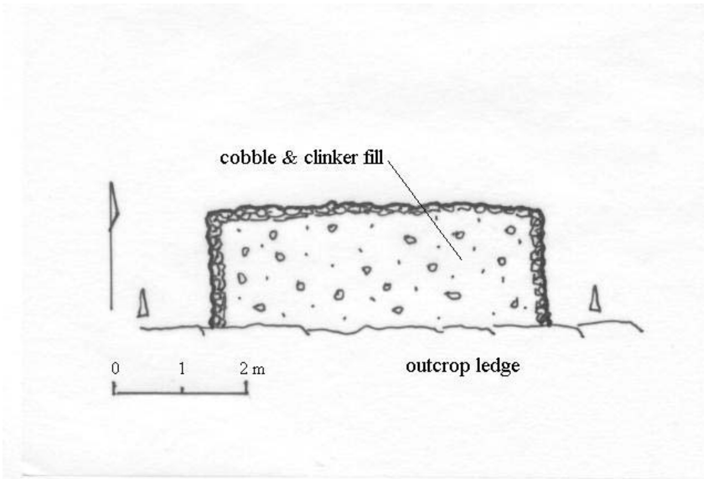

Figure 43. Plan and Photo of Site 6796, Modified Outcrop Platform, View to Northeast

SITE 6797

This site is a short segment of a steppingstone trail located about 20 m east of the Site 4956 modified overhang shelter. This short segment, measuring 5.0 m in length in a north/south orientation with only 4 visible steppingstones, is in a low-lying open aa flow. This trail remnant, located more than 140 meters southwest of the Site 4951 steppingstone segment, probably did not connect to that segment.

SITE 6798

This site is a feature cluster comprised of two C-shaped enclosures situated 2 meters apart in a low-lying area, roughly 100 meters due south of the Site 4957 complex. The larger structure, Feature A, measures 3.5 m by 4.5m with 0.80 m thick walls that range in height from 1.0 to 1.2 meters (Figs. 44 & 45). The opening is oriented 151^{o} of magnetic north. Feature B, the smaller structure, located roughly 2.0 meters to the south-southwest, measures 3.6 m in diameter with 0.60 m wide walls that range in height from 0.20 to 0.40 m. The opening of the smaller C-shape is oriented 126^{o} of magnetic north. The interior floor of both features is dirt. No cultural remains were observed on the surface in or near both features.

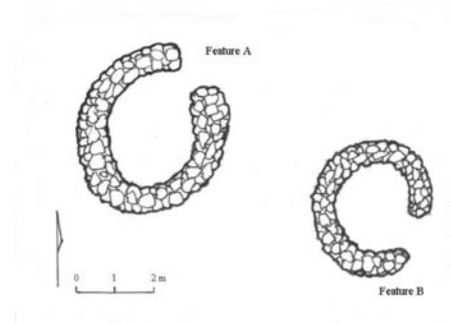

Figure 44. Plan of Site 6798, Two C-shaped Enclosures

SITE 6799

This overhang shelter is at the base of an outcrop ledge and opens to the north. The opening measures 2.5 m wide, 1.5 m deep, and 0.90 m high at the dripline (Fig. 46). The interior floor consists of silt with some cobbles. No surface remains were observed.

Figure 45. Photos of Site 6798, Two C-shaped Enclosures, (top) View of Feature A to East (bottom) Overview to North with Feature A to Left and Feature B to Right

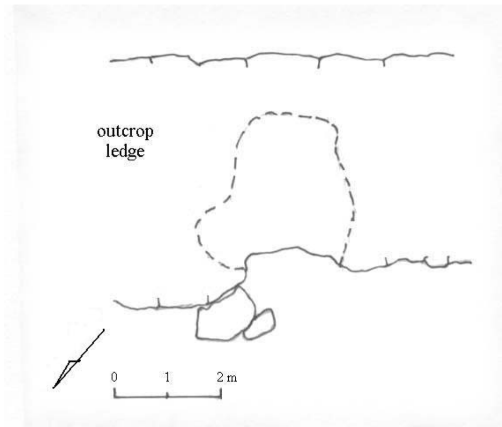

Figure 46. Plan and Photo of Site 6799, Overhang Shelter, View to South

SITE 6800

This modified outcrop, rectangular platform, measuring 9.0 m long, 2.5 m wide, and 1.2 m in height, is built along the edge of an outcrop ridge with its long axis oriented at 210° of magnetic north (Fig. 47). This site is located about 50 meters south of the eastern terminus of the Site 20/4957 complex and northeast of Site 27/5112.

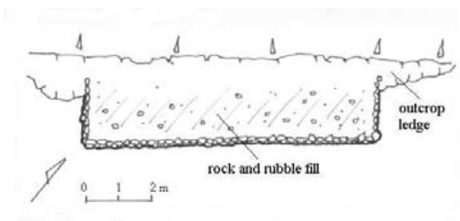

Figure 47. Plan and Photo of Site 6800, Terrace Platform on Edge of Outcrop Ridge

SITE 6801

This site is a lava tube with the opening facing east and measuring 1.2 m east/west, 0.80 m north/south, and 0.80 m in height (Fig. 48). The interior opens up to a chamber measuring 3.0 m wide and 3.5 m deep with ceiling heights ranging from 0.8 to 1.3 m. The opening is situated at the eastern edge of a bedrock ledge approximately 1.0 m high. This site is located near the southeast corner of the southern section roughly 50 meters northwest of Site 4945 and 30 meters east of the main jeep road.

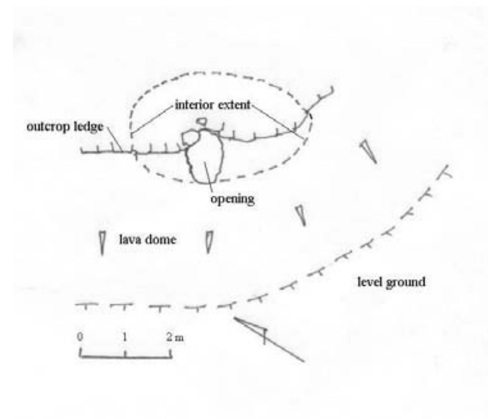

Figure 48. Plan and Photo of Site 6801 Lava Tube, View to Northeast

SITE 6802

This site is a segment of a stone wall, crudely constructed of stacked single slabs of basalt, located near the southern boundary of the project area, roughly a third of the way west from the southeast corner of the project area. The segment measures 50 m long, 0.30 m wide, and ranges in height from 0.30 to 0.70 m. A bulldozed road cut parallels the wall on the east along a north/south orientation.

SITE 6803

This modified outcrop ridge is located roughly 100 northeast of the Site 20/4957 complex and consists of a 40 m long ridge top roughly 5.0 m wide. Associated with this natural feature are a number of artificial modifications including a worn trail, a roughly 6.0 X 2.0 meter filled and paved area, and a stacked rock facing 7.0 m long and 1.2 m in height with 6 courses of stones along the north edge of the paved area (Fig. 49). The long axis of the ridge is oriented east/west.

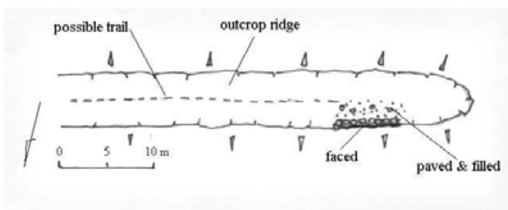

Figure 49. Plan of Site 6803, Modified Outcrop Ridge

SITE 6804

This site is a small overhang shelter at the east end of a 7.0 m long outcrop ledge oriented east/west. It is located about 30 m south of Site 38. The opening faces south and measures 0.60 m wide and 0.30 m high with a walled modification built along the western edge of the shelter, creating a level area 1.5 m square fronting the feature to the southwest (Fig. 50). No surface remains were observed.

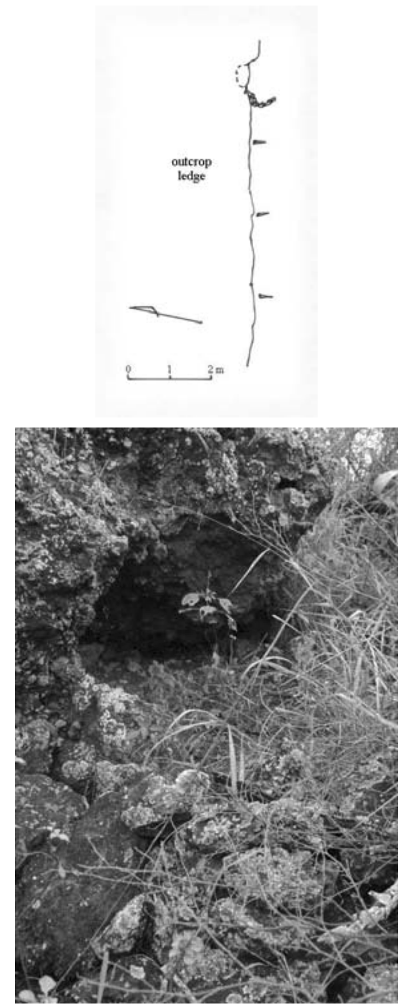

Figure 50. Plan and Photo of Site 6804, Modified Outcrop Shelter, View to Northeast

SITE 6805

This site consists of a wall which is connected to the Site 200 wall southern diversion near its central section between the northern bend to the east and the southern bend to the west. The feature consists of a wall segment roughly 100 m long which parallels the 200 wall to the east and incorporating a segment of the Site 200 wall creates a large, roughly rectangular enclosure, encompassing almost 4000 square meters, with an opening on the south. Built on to the southern end of the Site 40 wall is a triangular enclosure (see Fig. 5). The wall is well constructed and consists of up to 5-8 courses of stones. The wall ranges in width from 0.60 to 0.80 m and in height from 0.70 to 1.2 m. Three shorter remnant wall segments occur near the southern end of this feature. A bulldozed road parallels the Site 200 wall in this area.

SUMMARY

The subsurface testing procedures, comprising 10 test units at seven sites, produced negative results, with the exception of the Feature F firepit at Site 4957. The remaining units exhibited total absence of subsurface cultural components and associated midden, other sample material, or artifacts. No post-field laboratory procedures were warranted. There was also a pronounced paucity of surface remains, especially historic period artifacts, such as glass bottles, and cans that are usually found in association with occupation areas. A summary of all findings by site is presented on Table 1 below and data summaries for all sites is presented on Table 2 on the following page.

Table 1. All Surface and Subsurface Portable Cultural Remains

Site	Feat.	Type	Surface	Test Unit/Subsurface
201	B	OH*	cowrie shell octopus lure	
204		platform	coral manuport	
4955		OH	sea urchin shell frag., med. bird bone	
4956		OH	cat cranium	
4957	E	rect encl.	branch coral manuport	
"	F	firepit		cowrie and sea urchin shell frags. and charcoal pieces
5109		OH	sea urchin shell fragments	

*OH – overhang shelter

Table 2. Archaeological Sites in the Honua`ula Development Area

No.	SIHP *	Type	Feats.	*ahupua`a*	Period	Recorded	Signif.	Pres.	Data Rec.	NFW
1	200	wall	1	Palauea	historic?	1971	C,D	X		
2	201	complex	5	"	traditional?	"	A,D	X		
3	204	platform	2	"	"	"	D	X		
4	205	mod OH	1	"	"	"	"	X		
5	3156	C-shape	1	Keauhou	"	1993	nls			X
6	3157	wall	1	"	historic?	"	nls			X
7	3158	"	1	"	"	"	nls			X
8	4945	U-shape	1	"	traditional?	2000	D		X	
9	4946	C-shape	1	"	"	"	"		X	
10	4947	mod OH	1	"	"	"	"		X	
11	4948	open area	1	"	historic?	"	"		X	
12	4949	mod OH	2	"	traditional?	"	"		X	
13	4950	C-shape	1	"	"	"	"		X	
14	4951	SS trail	1	Palauea	"	"	C,D,E	X		
15	4952	platform	1	"	"	"	D	X		
16	4953	walls	3	"	historic?	"	D	X		
17	4954	C-shape	1	"	traditional?	"	D		X	
18	4955	mod OH	1	"	"	"	"		X	
19	4956	"	2	Keauhou	"	"	"		X	
20	4957	complex	6	Palauea	"	"	A,D	X		
21	4958	enclosures	2	"	"	"	D		X	
22	4959	SS trail/pits	3	"	"	"	C,D,E	X		
23	4960	platform	1	Keauhou	"	"	D		X	
24	4961	wall seg.	1	"	historic?	"	nls			X
**25	5109	OH	1	Paeahu	traditional	2001	D	X		
26	5110	lava blister	1	Palauea	"	"	"		X	
27	5111	platform	1	Keauhou	"	"	"	X		
28	5112	platform	1	Palauea	"	"	"	X		
29	6794	cluster	2	"	"	2003	"		X	
30	6795	C-shape	1	Palauea	"	2008	"		X	
31	6796	platform	1	"	"	"	"		X	
32	6797	trail	1	Keauhou	"	"	C,D,E	X		
33	6798	cluster	2	Palauea	"	"	D	X		
34	6799	OH	1	"	"	"	"		X	
35	6800	platform	1	"	"	"	"	X		
36	6801	lava tube	1	Keauhou	"	"	"	X		
37	6802	wall	1	"	historic?	"	Nls			X
38	6803	mod outcrop	1	Palauea	traditional?	"	D		X	
39	6804	OH	1	"	"	"	"		X	
40	6805	walls	2	"	historic?	"	Nls			X
Totals			**60**					**16**	**18**	**6**

* State Inventory of Historic Places Site Number (prefixed by 50-50-14-)
** Site located in northern two-thirds of project area

DISCUSSION

The project area includes portions of three *ahupua`a*; Paeahu, Palauea, and Keauhou, from north to south. The majority of the northern two-thirds occupies a section of Paeahu *ahupua`a* and roughly half of the width of a section of Palauea *ahupua`a*. Only one site was recorded in all of the northern two-thirds of the project area and although there is ample evidence that the area had previously undergone compounded extensive disturbances, the paucity of archaeological remains is remarkable especially when compared to the southern third. The southern one-third consists of the remaining half of the width of the section of Palauea *ahupua`a* and a partial section of Keauhou *ahupua`a*. This portion of the project area consists of large areas of later aa flows with intermittent earlier pahoehoe flow ridges and there is much more vegetation cover in comparison to the northern portion. Due to the rough terrain, it appears that the earlier historic ranching activities attempted to keep the cattle out of this southern area and did not encroach south of the large wall (Site 200) until a later phase of the ranching activities. Ninety-seven and a half percent (97.5 %) of the recorded sites occur within the southern one-third of the project area. Also, the presence of two sites representing feature complexes with some prominent structural features and the presence of 7 platform sites are relatively uncommon for the elevation. These sites and the overall density of sites were unexpected, especially in view of the climate and topography.

The distribution of the 40 sites within the three *ahupua`a* consists of; Paeahu – 1, Palauea- 23, and Keauhou-16. The two complexes and the majority of the platform sites are located in Palauea *ahupua`a*. The fact that the full width of only Palauea *ahupua`a* is represented in the project area may be an important consideration when comparing the number and assemblage of sites among the three *ahupua`a.* The distribution of sites in the eastern portion of the southern section, *mauka* of the main jeep road may not be just the result of extensive disturbance in the western half. Three clusters of sites are apparent with the central one around the Site 4957 complex by far the most prominent. Whether this clustering indicates a functional association among the sites or attributable to other factors is currently unclear.

Figure 51 presents a graphic representation of the four most frequently occurring feature types within the Southern Section of the project area. These are platforms with nine (9), followed by C-shapes and walls both with eight (8), and overhang shelters (7). With the exception of the wall features, the other features all appear to be clustered within the eastern half of the southern section.

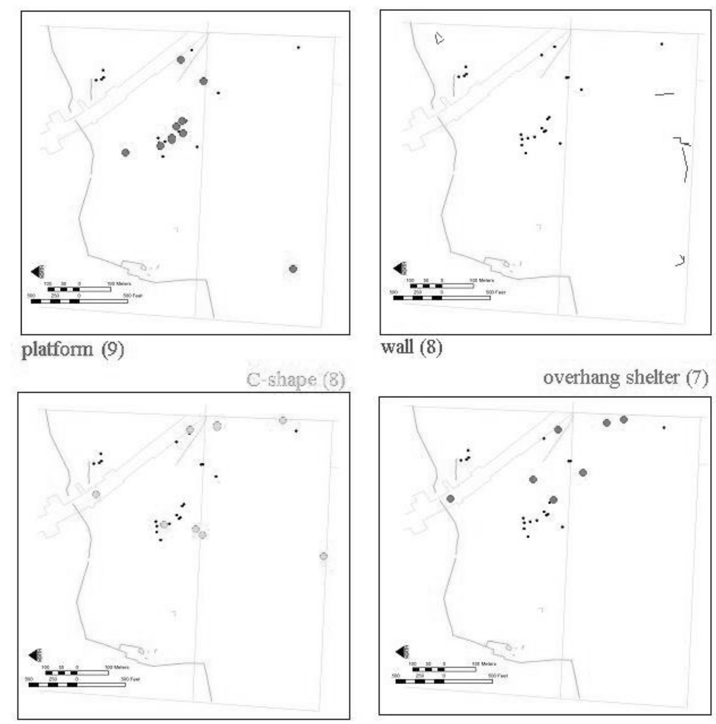

Figure 51. Distribution of Most Frequently Occurring Feature Types in the Southern Section

During the current inventory procedure, eight subsurface test units were excavated at six sites. These were; Site 4945, U-shaped enclosure; Sites 4950, 4954, Site 4955, overhang shelters; Site 4957 Feature B, C-shaped enclosure; Feature F, firepit; and Site 5109 overhang shelter. Only the firepit (Site 4957 Feature F) yielded any cultural material, sparse quantity of marine midden consisting of 3 small cowrie shell fragments and seven small fragments of sea urchin. Only one other site has been tested during the course of the previously completed surveys. Site 3156, the C-shaped enclosure located near the middle of the southern boundary of the project area was tested with negative results from the two units (Sinoto and Pantaleo 1993:7).

Thus, with the available data, interpreting the function and age of the two prominent complexes at Sites 201 and 4957, remains problematic. However, some general observations can be presented regarding the settlement pattern postulated in earlier sections of this report. The presence of the steppingstone trail in the aa flows and the small, isolated feature types that are best represented, support the argument that these mid-elevations zones were primarily used for temporary transit stops during travel between the coast and inland areas. Based on the results of previous research in the region, the dispersed, isolated occurrence of these small, crudely constructed, structural features; such as C-shapes, modified outcrops and overhang shelters; can be indicative of temporary habitation. These feature types are well-represented in the neighboring areas and have been interpreted as temporary habitation sites, most with intermediate to late prehistoric period origins. The paucity of subsurface remains is also a common trait of these types of features. One possibility is the agricultural function of such sites and the presence of marine shell attributed to fertilizing the soil rather than being the remains of human consumption as previously postulated by Handy (1940).

The two multiple feature complexes (Sites 201 and 4957); composed of more substantial structural features in terms of variety, size, numbers, and construction; suggest more intensive, if not permanent, occupation in the area. How these two complexes relate chronologically and functionally to the other temporary sites are important questions that still need to be answered. Perhaps, these complexes originated later and are associated with historic period ranching activities. Also, how the various sites fit into the broader settlement patterns of the rest of Paeahu. Palauea, and Keauhou *ahupua`a* is another interesting question. Perhaps the most intriguing question is why this particular area, with such rough terrain and unfavorable topography was utilized at all while much less harsher areas were available in the immediate neighboring areas, even within the same *ahupua`a*. Further investigations of the vicinity are needed to clearly understand the nature of occupation for these sites.

CURRENT INSIGHTS ON THE REGIONAL SETTLEMENT PATTERN

As amply demonstrated by the various hypotheses put forth by previous researchers regarding the nature of *mauka/makai* settlement, the prevailing conventional archaeological interpretation regarding the prehistoric settlement of this region has, until recently, held to two generalized patterns of occupation. One, consisting of seasonal satellite settlements occurring along the coastal areas to exploit the marine resources, while permanent settlements occupied the upland areas to utilize forest products and cultivate agricultural resources in a more favorable climatic zone. The second, consisting of permanent settlements in both the coastal and inland areas given

certain environmental conditions. In both patterns, the area between the two activity loci, termed the "intermediate zone" was considered an area of transience represented by trails and occupied by only a low number of marginal, temporary site types.

The progressive broadening of the archaeological knowledge base over the past two decades has shown that this conventional settlement pattern is applicable to some areas (*ahupua`a)*, but not to the whole Honua`ula region. The traditionally held generalization that the "intermediate zone" was barren, used only during transit between the inland and coastal areas, and lacked any consequential occupation until the late prehistoric or historic periods, has been refuted by the results of investigations in the Wailea and Makena areas. Recent studies of the intermediate zone (Gosser et al. 1993 & 1997, Sinoto & Pantaleo 2000/2001) highlight the importance of the intermediate zone in specific areas of the region and describe the wide range of site types representing various activities engaged in by the inhabitants of this zone.

The foregoing discussion indicates that the interpretation of the human occupation of an extensive region such as Honua`ula cannot be generalized to any single pattern. Each traditional land unit, the *ahupua`a*, needs to be first analyzed on the basis of its discrete characteristics. Only then can the nature of human occupation for the whole region be meaningfully interpreted and this can only be accurately undertaken with the availability of a broad knowledge base. The current availability of the necessary information permits such interpretations to be made only within the northern half of the vast Honua`ula region, where the majority of development-related investigations to date have taken place.

The northern two-thirds of the Property, including portions of Paeahu and Paluea *ahupua`a*, exhibits an "intermediate zone" largely devoid of sites with seemingly more arid environmental conditions relative to the areas to the south. Thus, in the northern section of the Property, the major human activities appear to have been taking place in the inland and coastal settlements, with the "intermediate zone" primarily an area of transit between the two loci.

The southern third of the Property consisting of portions of Palauea and Keauhou *ahupua`a* with aa flows, a more undulating terrain, and cover vegetation indicative of less arid conditions; exhibit remains of a more diverse and intensive human occupation. In contrast with the northern section, the majority of the recorded sites occur within the southern section. Although further work, such as age determinations for specific sites are needed to make conclusive temporal interpretations (prehistoric or historic) of the occupation of the southern section, the frequencies of more prominent site types reflect permanent or seasonal recurrent occupation in this "intermediate zone."

During the historic period transition, permanent settlements in both the inland and coastal areas concentrated along the cart paths and roadways and the strong intra-*ahupua'a* based relationships declined as the movement of people and goods shifted to one that laterally cut across traditional land (*ahupua'a* and *moku*) boundaries. This shift in the settlement pattern reflected the cultural transition from a traditional subsistence economy to an introduced market economy that induced the inhabitants to become progressively dependent on imported goods and affected by global economic trends.

SITE CHRONOLOGY

No subsurface testing was previously undertaken in all, but one (Site 3156), of the previously recorded sites in the project area. Due to the lack of chronometric data from the project area and a marked scarcity of dates from previously investigated sites occupying similar elevations in neighboring areas, the age of the extant sites in the project area remains unclear. A date range of A.D. 1327-1889 obtained from three sites in the North Course of the neighboring Maui Prince Golf Course (Gosser et al. 2002:349) to the south and a date range of A.D. 1280 to 1650 from three lower elevation sites in the Wailea Golf Course (Gosser et al. 1993:258-259) to the west represent the closest dated sites to the subject area. Since similar age ranges occur from sites in the coastal areas, corresponding chronological ranges of A.D. 1300-1500 as early and A.D. 1600-1800 as late, may be tentatively postulated for the occupation of the subject area. The later prehistoric and proto-historic date ranges also suggest that the occupation may have continued into the historic period at certain sites. However, early historic period artifacts, (ie. diagnostic glass bottles, square nails, etc.), are markedly lacking from the project area.

Due to the absence of dated sites from the project area, the chronology of the sites are still unclear. However, based on the site type or the presence/absence of diagnostic artifacts, the relative periods of origin for the sites can be inferred. For instance, most of the long walls can be attributed to historic ranching period, while the other features such as platforms and overhang shelters can be associated with the prehistoric period. Of the 40 total sites recorded, 32 can be categorized as traditional-type sites and 8 as historic sites. Table 3 on the following page presents this breakdown by site type.

Table 3. Site Type Frequencies

Site Types Traditional Type	Number
Cluster	2
Complex	2
C-shape	5
Enclosure	1
lava blister	1
lava tube	1
mod OH	5
mod outcrop	1
OH	3
Pits	0.5*
Platform	7
SS trail	2.5*
U-shape	1
Total	**32**
Historic Type	**Number**
open area	1
Wall	7
Total	**8**
Total	**40**

**the pits and one of the trail segments occur together and are thus counted as 1 site*

INITIAL SIGNIFICANCE ASSESSMENT

Initial significance has been assessed for all 40 recorded sites in the current project area. These assessments are based on the five Hawaii Register of Historic Places significance evaluation criteria which are stated as follows:

> **Criterion A** specifies association with events or broad patterns important to the prehistory or history of a region, island, or Hawaii in general;
>
> **Criterion B** reflects association with persons important to the prehistory or history of a region, island, or Hawaii in general;
>
> **Criterion C** applies to sites that reflect architectural achievements or are excellent examples of a specific type of site;
>
> **Criterion D** specifies that the site has yielded or has the potential to yield information significant to the understanding of traditional culture, prehistory, history, and/or foreign influences on traditional culture and history of a region, island, or Hawaii in general; and
>
> **Criterion E** applies to sites or places perceived by the contemporary community as having traditional cultural value.

Six sites (Sites 3156, 3157, 3158, 4961, 6802, and 6805) are considered no longer significant. Six sites (Sites 200, 201, 4951, 4957, 4959, and 6797) are evaluated to be significant under multiple criteria. The remaining 28 sites are all considered significant under criterion D.

A summary of initial significance assessments is presented in Table 2.

RECOMMENDATIONS

The extant sites are recommended for placement into three categories; no further work, data recovery, or *in situ* preservation. No further work is recommended for a total of six sites which correspond to those sites which were evaluated to be no longer significant. Data recovery is recommended for 18 sites. Permanent preservation is recommended for 16 sites (Fig. 52). Table 2 also presents the recommended categories for each site. Following SHPD concurrence to the recommendations in this report, preservation and data recovery plans shall be formulated, produced, and transmitted for review in conjunction with appropriate development planning phases in the near future.

Figure 52. Locations of 15 of the 16 Sites Recommended for Preservation in the Southern Section (Site 5109 is in the Northern Section, please refer to Fig. 5 for location)

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Archaeological Inventory Survey – Wastewaterline

ASC111510

DRAFT

Archaeological Assessment Survey: Offsite Wastewater Transmission Corridor for the Proposed Honua`ula Development Keauhou, Kalihi, Waipao, Papa`anui *ahupua`a* Makawao District, Maui Island (TMK: (2) 2-1-08:71, 90, por 108)

November 2010

Aki Sinoto Consulting
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ASC111510

Archaeological Assessment Survey:
Offsite Wastewater Transmission Corridor
for the Proposed Honua`ula Development
Keauhou, Kalihi, Waipao, Papa`anui *ahupua`a*
Makawao District, Maui Island
(TMK: (2) 2-1-08:71, 90, por 108)

for:

Honua`ula Partners, LLC
c/o Pacific Rim Land, Inc.
1300 N. Holopono Street, Suite 201
P.O. Box 220
Kihei, Hawaii 96753

by:

Aki Sinoto

and

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November 2010

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ABSTRACT

During discontinuous periods between November 2009 and April 2010, Aki Sinoto Consulting of Honolulu at the request Honua`ula Partners LLC of Kihei, undertook archaeological inventory survey procedures in conjunction with the proposed off-site, waste-water transmission and treatment plan for the proposed Honua`ula Development. This waste-water plan is an alternative to an on-site waste-water treatment facility and calls for the waste-water generated by the proposed development to be conveyed by a pipeline for treatment at the neighboring Makena Waste Water Treatment Facility (MWWTF). A technical memorandum submitted by R M Towill (April 2008) determined the preferred alignment to be a force main connecting a proposed pumping station directly to the MWWTF.

The project area, consisting of a roughly 1.5 mile long north/south corridor in inland Wailea and Makena, Maui Island, includes portions of Keauhou, Kalihi, Waipao, and Papaanui *ahupua`a* in the Makawao District and traverses across the Makena Resort property which adjoins the proposed Honua`ula development area immediately to the south. The transmission corridor traverses across portions two separate tax map parcels; TMK: (2) 2-1-08:90 and (2) 2-1-08:108, also constituting portions of 6 discrete development parcels of the Makena Resort. Portions of the project corridor have previously been included in seven previous archaeological investigations. The current walk-through surface survey of the proposed project area together with the review of previous reports resulted in no previously recorded or newly discovered archaeological or historic remains within the project corridor. No surface structural remains or any other features indicative of prehistoric period or traditional Hawaiian cultural activities nor significant historic period activities were encountered within the project boundaries during the course of the fieldwork. Subsurface data recovery procedures previously undertaken at a few sites in adjoining areas yielded negative results. The absence of findings resulting from the current fieldwork warranted the preparation of this archaeological assessment survey report in accordance to HAR 13-284-5(A).

In view of the negative results of the current assessment, no further pre-construction archaeological procedures are warranted. However, archaeological monitoring of construction–related ground disturbing activities is recommended. When the transmission system plans are finalized, an archaeological monitoring plan shall be prepared and submitted to SHPD for review. Approval of this plan is required prior to commencement of any construction activities.

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INTRODUCTION

At the request Honua`ula Partners LLC of Kihei, Aki Sinoto Consulting of Honolulu undertook archaeological inventory survey procedures in conjunction with the proposed off-site, waste-water transmission and treatment plan for the proposed Honua`ula Development. This plan is an alternative to an on-site waste water treatment facility and calls for the wastewater generated by the proposed development to be conveyed by a pipeline for treatment at the neighboring Makena Waste Water Treatment Facility (MWWTF). A technical memorandum submitted by R M Towill (April 2008) determined the preferred alignment to be a force main connecting a proposed pumping station directly to the MWWTF. The project corridor traverses across the Makena Resort property which adjoins the proposed Honua`ula development area immediately to the south. Based on the negative results of the fieldwork, this archaeological assessment survey report was prepared in accordance to HAR 13-284-5(A).

PROJECT AREA

The project area, consisting of a roughly 1.5 mile long north/south corridor in inland Wailea and Makena, Maui Island, includes portions of Keauhou, Kalihi, Waipao, and Papaanui *ahupua`a* in the Makawao District (Fig. 1). The project area, comprising a proposed corridor for a 12-inch diameter, waste-water transmission line, measures approximately 6,400 linear feet in length and thirty feet in width. The corridor traverses elevations ranging between 260 to 360 ft. amsl. This force main transmission line (Fig. 2) is slated to connect a proposed pump station located at the southwestern corner of the proposed Honua`ula Development area (TMK: (2)2-1-08:71) with the existing Makena Waste Water Treatment Facility (TMK: (2)2-1-08:por 108). The transmission corridor traverses across portions two separate tax map parcels; TMK: (2) 2-1-08:90 and (2) 2-1-08:108 which also constitute portions of 6 discrete development parcels of the Makena Resort; S-1 through S-4 (designated for single family development), M-2 (multi-family), and Fairways 6 and 14 of G-1 (the North Golf Course).

ENVIRONMENTAL SETTING

The environment of the Wailea/Makena region is similar to arid leeward regions of the other Hawaiian Islands. There exist, however, localized micro-climatic variations. The project area receives approximately 20 inches of annual rainfall with January being the wettest month and July the driest (Armstrong 1973). Although rainfall data averaged for the year shows only slight differences, analyses of monthly rainfall data indicate that Makena receives more overall precipitation than Kihei or Coastal Wailea, especially during June through September. The

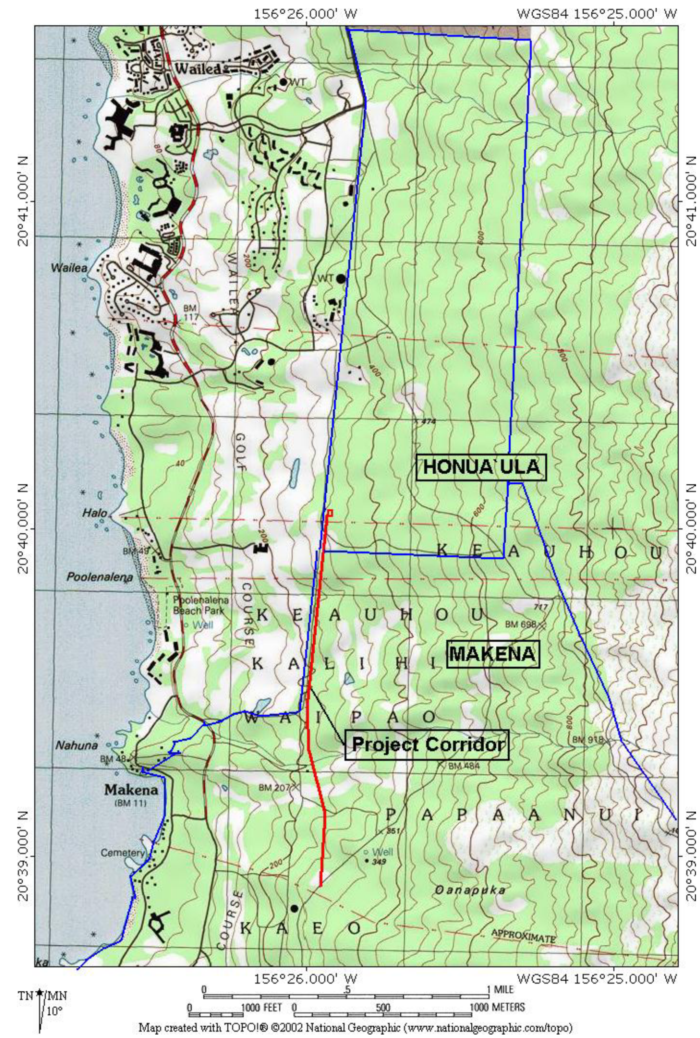

Figure 1. Location of Project Area (in red) on USGS Makena Quadrangle

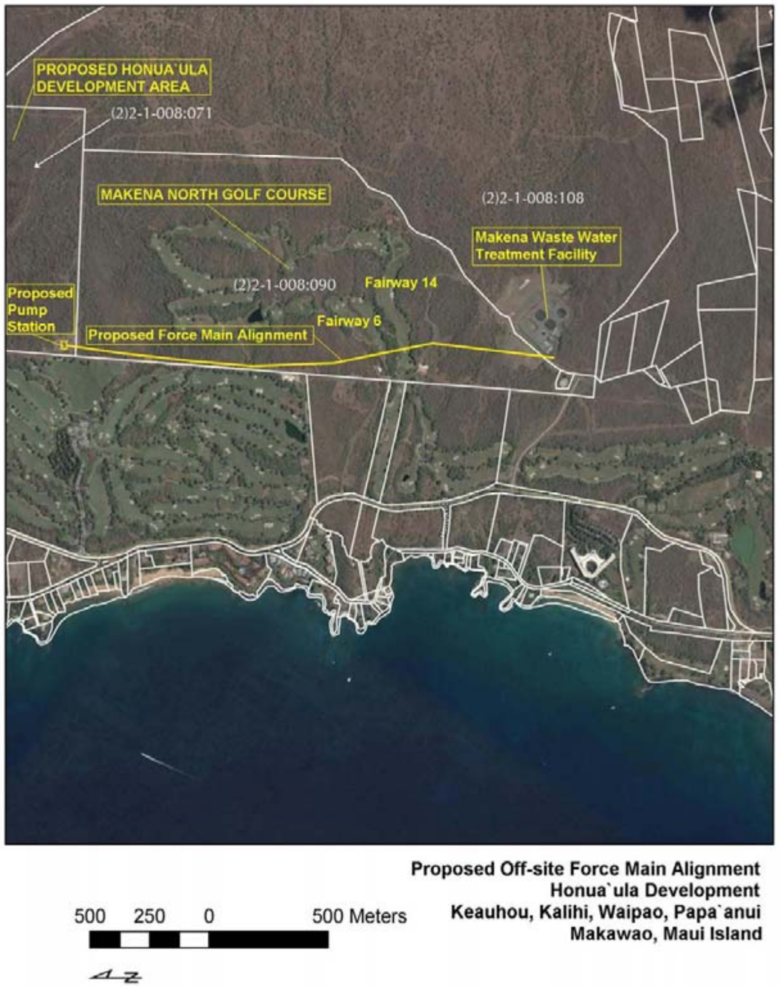

Figure 2. Aerial Showing TMK Boundaries (in white) and Project Alignment (in yellow) (aerial base map courtesy PBR Hawaii, Inc.)

project area elevations range from about 260 to about 360 feet above mean-sea-level with the topography generally consisting of gently-sloping areas with a few ridge and gulch areas with exposed bedrock outcroppings interspersed with scatter patches of soil. Vegetation in the project area can largely be characterized as lowland dry scrub (Pratt 1998:22-29). The majority of the vegetation is xerophytic; consisting of common exotics such as *kiawe* (*Prosopis pallida*) and *koa haole* (*Leucaena leucocephala*) as the dominant high cover with intermittent, isolated stands of endemic *wiliwili* (*Erythrina sandwichensis*) trees. Common ground cover includes endemic *`ilima* (*Sida fallax),* exotics such as basil (*Ocimum basilicum*), lantana (*Lantana camara*), beggar's tick (*Bidens pilosa*), castor bean (*Ricinus communis*), and various dry grasses. Golden crown-beard (*Verbesina enceliodes*) with its yellow, daisy-like flowers predominates as secondary ground cover in areas that have been cleared of primary growth. The central segment of the corridor traverses the existing North Golf Course along the western portions of Fairways 6 and 14. At the time of the current survey, the region was drought stricken and the natural ground cover was exceptionally sparse and permitted unhampered visibility.

The soils in the project area consist of two major classifications; Makena loam, stony complex and very stony land. The Makena series are well-drained soils developed in volcanic ash with moderately rapid permeability, slow to medium runoff, and slight to moderate erosion hazard. Stony land, occurring on low ridges, makes up 30-60% of this complex and Makena loam in gently sloping areas, occurs between the low ridges of stony land (Foote et al. 1972:91). Very stony land consists of areas where 50-90% of the ground surface is covered with stones and boulders on slopes ranging from 7-30% and is composed of young aa lava with a thin covering of volcanic ash. The project area is dominated by basalt outcrops, interspersed with shallow, natural terraces of coarse rocky alluvium. There are no well-established gulches or seasonal water sources. Infrequent heavy rains cause sheet flooding, which normally courses along existing roadways, and through small, localized drainages.

The survey revealed evidence of historic and modern landscape alterations for activities associated with ranching which preceded the more recent development of access roads, water wells, maintenance facilities, golf courses, and other activities associated with the existing resort developments in Wailea and Makena. The disturbances associated with modern development occur sporadically in localized settings. However, more widespread through the project area are signs of extensive previous disturbances associated with both historic and modern ranching activities. The majority of the flat areas bore signs of having been chain-dragged, characterized by localized accumulations of loose stones, remains of displaced vegetation, and boulders around larger natural outcroppings and knolls, together with the presence of secondary vegetation regimes of fairly uniform growths, and the marked absence of large trees.

METHODS

The current archaeological walk-through survey was conducted during three occasions amounting to a total of 20 person/hours, between November 2009 and April of 2010. The subject transmission line corridor was systematically inspected by two persons walking the whole alignment. In addition, reports documenting the results of pertinent previous archaeological investigations within the parcels traversed by the transmission corridor were reviewed to evaluate sensitivity of the specified areas.

Based on the absence of any significant surface remains or other indications of significant prehistoric or historic period cultural activities within the project area, no subsurface testing was conducted.

The project personnel consisted of Kimokeo Kapahulehua and Aki Sinoto with Eugene Dashiell, M.A., as Principal Investigator.

RESULTS OF FIELDWORK

The current walk-through surface survey of the proposed project area together with the review of previous reports resulted in no previously recorded or newly discovered archaeological or historic remains within the project corridor. No surface structural remains or any other features indicative of prehistoric period or traditional Hawaiian cultural activities nor significant historic period activities were encountered within the project boundaries during the course of the fieldwork. Data recovery procedures previously undertaken at a few sites in adjoining areas also yielded negative results, lending support to the postulation that the intermediate zone in the northern portions of the region was traditionally sparsely occupied and/or utilized for sedentary activities.

SUMMARY OF PREVIOUS ARCHAEOLOGY

Portions of the project corridor have previously been included in seven previous archaeological investigations. A summary of these projects are provided in this section and the respective areas covered are depicted on Figure 3. The report references are also cited in the Bibliography section of this report.

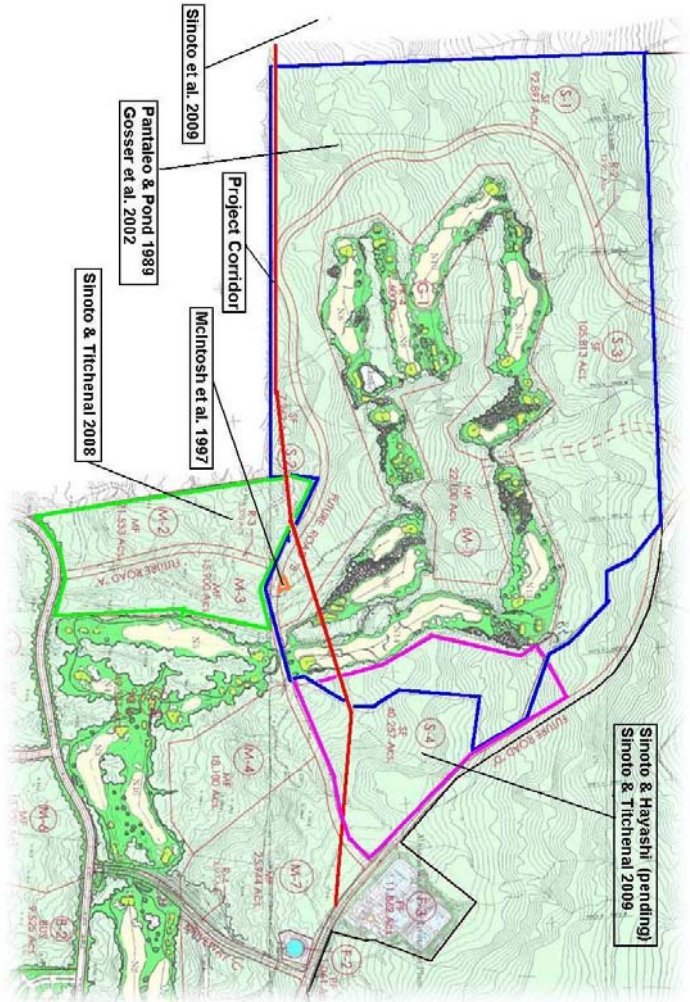

Figure 3. Map Showing Project Corridor, Makena Development Parcels, and Previous Work (base map courtesy Makena Resort Corp.)

The northern terminus of the project corridor was the southeastern corner of the proposed Honua`ula development area included in the inventory survey undertaken by Aki Sinoto Consulting (Sinoto et al. 2009). The segment of the subject corridor from the property boundary near the northern terminus to where it crosses the unpaved road south of Fairways 6 and 14 was included in the inventory survey and data recovery procedures undertaken by Bishop Museum in 1989 (Pantaleo and Pond 1989 & Gosser et al. 2002). Three previously recorded sites, 50-50-14-2614, 2588, and 2591 occur in relative proximity (ca 50m) to the proposed transmission alignment, however none of the sites or component features occur within the boundaries of the subject corridor. One of these three, Site 50-50-14-2591, a large boulder overhang shelter, was tested during the course of a subsequent project and resulted in negative findings (McIntosh 1997). The central portion of the project corridor was also included in the survey of development parcels M-2 and M-3 (Sinoto and Titchenal 2008) which also produced negative results. The corridor traverses the eastern end of parcel M-2. The southern third of the transmission corridor traverses across parcel S-4 which was surveyed in conjunction with the offsite water tank and waterline routing plan for Parcels M-2 and M-3 (Sinoto and Titchenal 2009). A surface survey was also conducted for Parcel S-4 which also resulted in negative findings (Sinoto and Hayashi pending).

RECOMMENDATIONS

In view of the negative results of the current assessment, no further pre-construction archaeological procedures are warranted. However, archaeological monitoring of construction–related ground disturbing activities is recommended. When the transmission system plans are finalized, an archaeological monitoring plan shall be prepared and submitted to SHPD for review and approval prior to commencement of any construction activities.

The 12-inch pipeline, as well as the limited width of the 30-foot wide transmission corridor, is anticipated to facilitate avoidance of any inadvertent discoveries that warrant preservation. Coincident to this point, the R. M. Towill report states that, "The alignment has some flexibility and can be adjusted as necessary to local development needs. The route attempted to follow open pathways to minimize its impact on the vegetation." (R.M. Towill 2008:4).

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Sinoto, Aki; Jeffrey Pantaleo; and Paul Titchenal
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Archaeological Inventory Survey – Waterline

ASC111610

DRAFT

Archaeological Assessment Survey: Existing Offsite Wells, Proposed Well-Field, Reservoir, and Water Transmission Corridor Keokea, Kamaole, and Paeahu *ahupua`a* Makawao District, Maui Island (TMK: (2) 2-2-02:001, 050, & 054) (TMK: (2) 2-1-08:001 & 054)

November 2010

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ASC111610

Archaeological Assessment Survey:
Existing Offsite Wells, Proposed Well-Field,
Reservoir, and Water Transmission Corridor
Keokea, Kamaole, and Paeahu *ahupua`a*
Makawao District, Maui Island
(TMK: (2) 2-2-02:001, 050, & 054)
(TMK: (2) 2-1-08:001 & 054)

for:

Honua`ula Partners, LLC
c/o Pacific Rim Land, Inc.
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November 2010

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ABSTRACT

During discontinuous periods in April and September of 2010, Aki Sinoto Consulting of Honolulu at the request Honua`ula Partners LLC of Kihei, undertook archaeological inventory survey procedures for the proposed well field and the water transmission corridor linking two existing off-site wells and proposed off-site reservoir to the northern section of the proposed Honua`ula Development (TMK: (2) 2-1-008:056). The project area, consisting of a roughly 3 mile long north/south corridor in inland Kihei and Wailea, Maui Island, includes portions of Keokea, Kamaole, and Paeahu *ahupua`a* in the Makawao District (Fig. 1). The project area traverses portions of property owned by Haleakala Ranch (TMK: (2) 2-2-002:001, 050, and 054) in the northern section and Ulupalakua Ranch (TMK: (2) 2-1-008:001 and 054) in the southern section (Fig. 2).

The current surface survey resulted in negative findings. No new or previously unrecorded surface structural remains or any other features indicative of prehistoric period or traditional Hawaiian cultural activities were encountered within the project boundaries during the course of the fieldwork. Due to the absence of any significant surface remains or other indications of significant prehistoric or historic period cultural activities within the project area, no subsurface testing was conducted. One free-standing ranching wall, incorporating a fence-line along the northern side of a ranch road, is located *mauka* of the northern third of the Maui Meadows subdivision. The evidence of extensive and compounded previous disturbances was observed in the project area. However, the marked absence of archaeological remains most likely is not attributable solely to the impact of ranching and the other development-related disturbances. The intermediate zone, within which the project area occurs, has been characterized by researchers primarily as a zone of transit between the coastal and inland areas beyond the 1000 to 1200 foot elevations during the prehistoric period. The intermediate zone in the more arid northern part of the traditional Honua`ula District generally manifests the lowest density of extant sites when compared to the neighboring areas to the south.

Based on the negative results of the fieldwork, this archaeological assessment survey report was prepared in accordance to HAR 13-284-5(A) and no further pre-construction archaeological procedures are warranted. However, archaeological monitoring of construction–related ground disturbing activities is recommended. When the water system plans are finalized, an archaeological monitoring plan shall be prepared and submitted to SHPD for review. Approval of this plan is required prior to commencement of any construction activities.

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INTRODUCTION

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PROJECT AREA

The project area includes the existing well sites and a proposed well field, water transmission corridor, and water storage-tank area. The well field, wells, and main transmission corridor occupy elevations of 520 to 640 ft. amsl. The proposed storage-tank area is located at the 810-foot elevation. The primary corridor for the 12-inch water-line is approximately 12,000 linear feet in length and 30 feet in width with its north/south alignment traversing above and roughly paralleling the upper boundary of the existing Maui Meadows subdivision to reach the Honua`ula Development area (Figs. 3 & 4). The proposed reservoir consists of a 0.20 million-gallon tank for potable water and an adjoining 0.50 million gallon tank for non-potable water within a 0.61-acre area. The proposed reservoir and the ca 2000 linear-foot, secondary transmission corridor for the 12" line, occupy Ulupalakua Ranch property within Paeahu *ahupua`a* (Figs. 5& 6). The well field, occupying portions of Keokea and Kamaole *ahupua`a*, is roughly 10,000 feet in length and 750 feet wide.

ENVIRONMENTAL SETTING

The environment of the Wailea region is similar to arid leeward regions of the other Hawaiian Islands. The project area receives approximately 20 inches of annual rainfall with January being the wettest month and July the driest (Armstrong 1973). The project area elevations range from 520 to 810 feet above mean-sea-level, manifesting topography that varies from gently-sloping soil areas to ridge and gulch areas with exposed bedrock outcroppings. Vegetation in the project area can largely be characterized as weedy fields and old pasture (Pratt 1998:22-29). The majority of the vegetation is xerophytic; consisting of common exotics such as *kiawe*

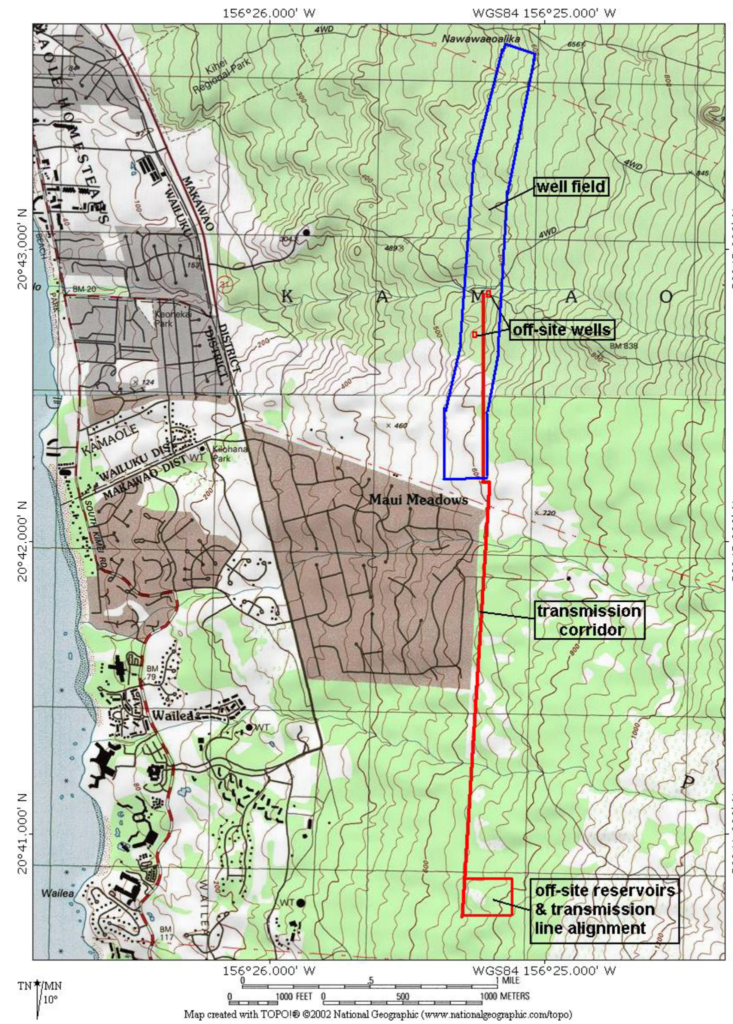


Figure 1. Project Location on USGS Puu O Kali and Makena Quadrangles

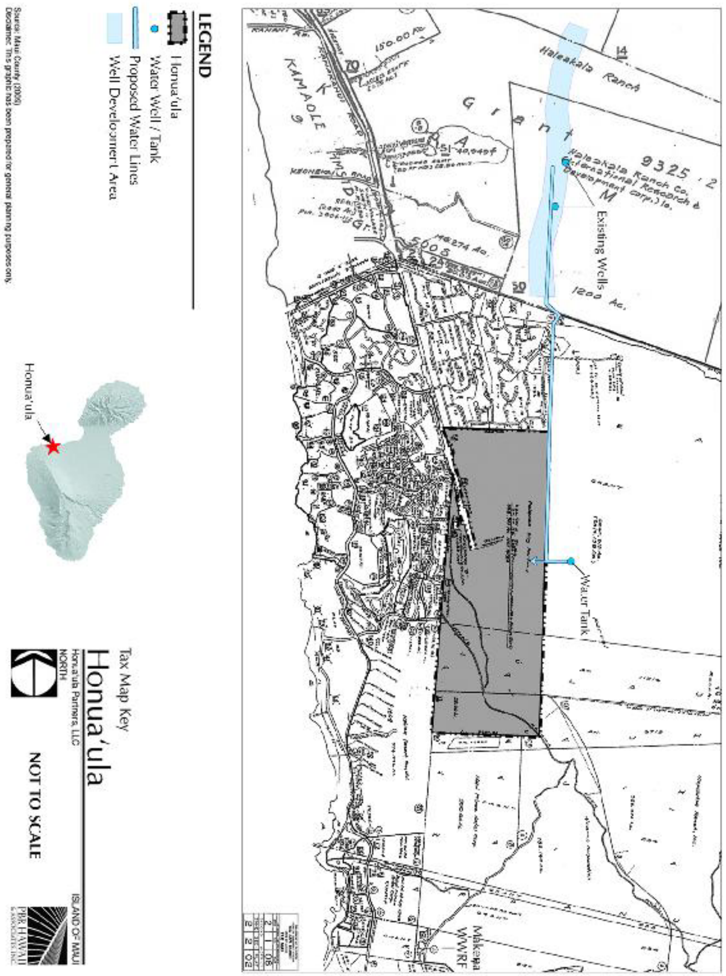
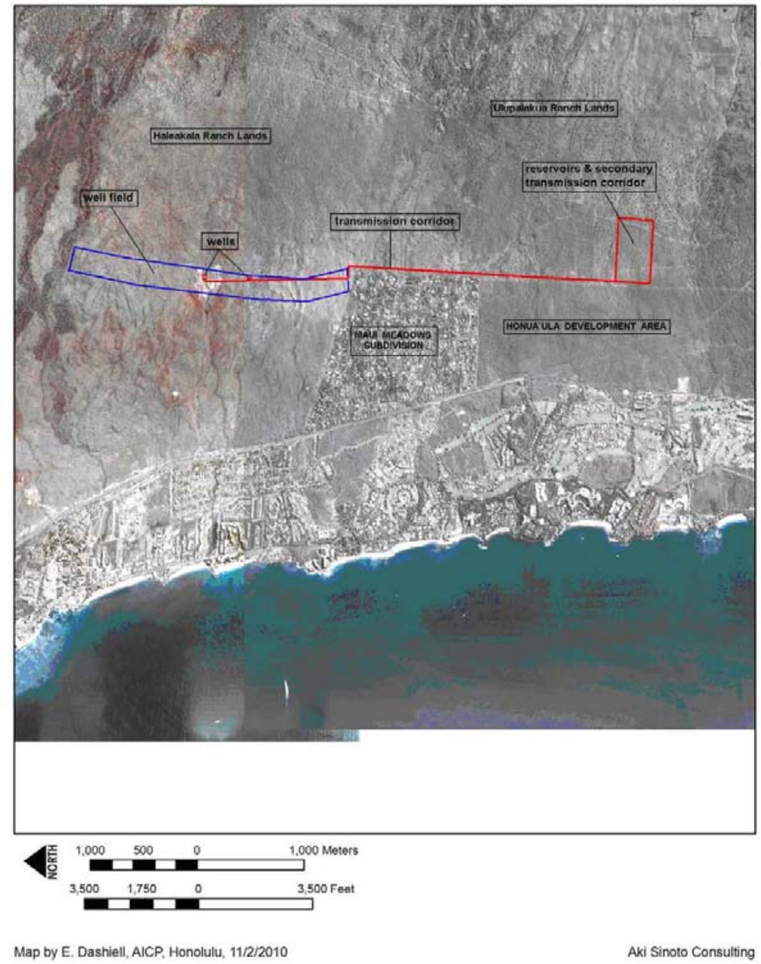


Figure 2. Map Showing Tax Map Key and Proposed Well Field (in Light Blue)
(map courtesy PBR Hawaii)



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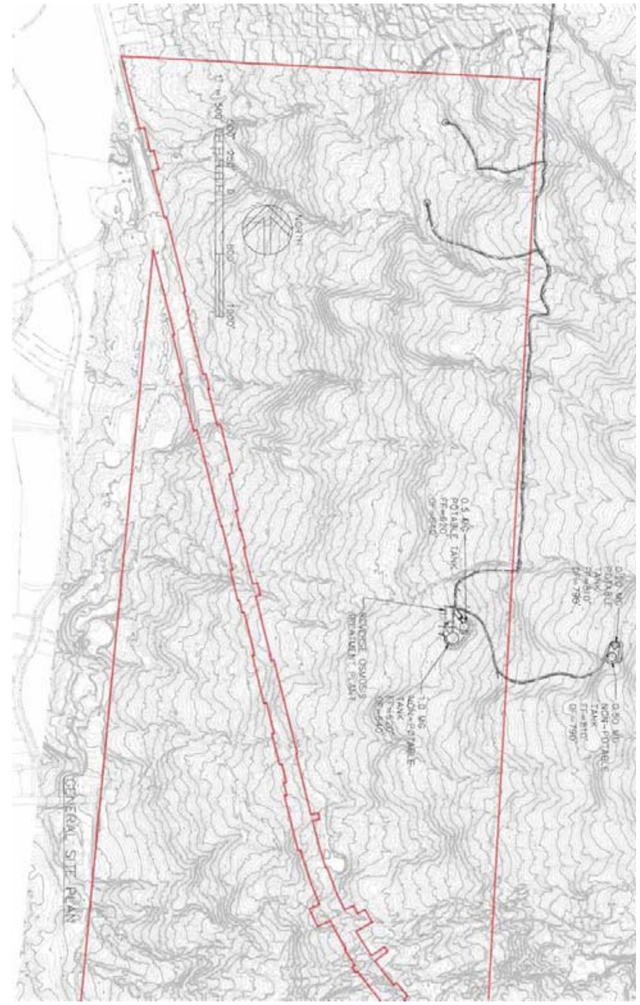

Figure 5. Preliminary Layout of the Storage Reservoirs
(figure courtesy of PBR Hawaii, Inc.)

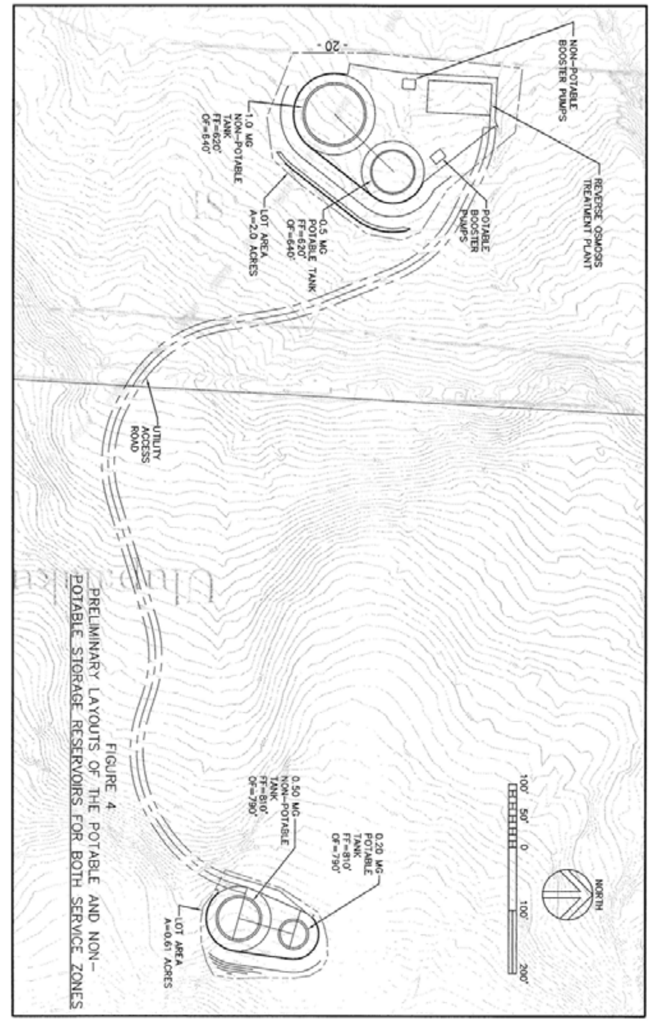

Figure 6. Preliminary Layout Detail of the Storage Reservoirs, Upper Facility is Off-site (figure courtesy Tom Nance Water Resource Engineering, Inc.)

(*Prosopis pallida*) as the dominant high cover with intermittent, isolated stands of endemic *wiliwili* (*Erythrina sandwichensis*) trees. Common ground cover includes endemic *`ilima* (*Sida fallax),* exotics such as basil (*Ocimum basilicum*), lantana (*Lantana camara*), beggar's tick (*Bidens pilosa*), castor bean (*Ricinus communis*), and various dry grasses. Golden crown-beard (*Verbesina enceliodes*) with its yellow, daisy-like flowers predominates as secondary ground cover in areas that have been previously cleared of primary growth. At the time of the current survey, the area was drought stricken and the ground cover was exceptionally sparse. Surface visibility was unhampered.

The soils in the project area consist exclusively of Makena loam, stony complex. The Makena series are well-drained soils developed in volcanic ash with moderately rapid permeability, slow to medium runoff, and slight to moderate erosion hazard. Stony land, occurring on low ridges, makes up 30-60% of this complex and Makena loam in gently sloping areas, occurs between the low ridges of stony land (Foote et al. 1972:91). The project area is dominated by basalt outcrops, interspersed with shallow, natural terraces of coarse rocky alluvium. There are no well-established gulches or seasonal water sources. Infrequent heavy rains cause sheet flooding, which normally courses along existing roadways, and through small, localized drainages.

The survey revealed evidence of modern landscape alterations such as access roads, water tank development, firebreaks, storm water diversion, and other activities associated with the existing Maui Meadows residential subdivision. These more recent disturbances occurred in only about a third of the total surface length of the project area in areas immediately adjoining the subdivision. Extensive landscape alteration in the form of clearing activities for well-drilling, associated access roads, and a borrow site were encountered in the area near the well heads. However, throughout the project area, were signs of extensive previous disturbances associated with both historic and modern ranching activities. The majority of the flat areas bore signs of having been chain-dragged, characterized by localized accumulations of loose stones, vegetation, and boulders around larger natural outcroppings and knolls, together with the presence of secondary vegetation regimes of fairly uniform growths, and the marked absence of large trees. With the exception of paved utility roadways, dirt ranch roads, and existing bulldozed firebreaks, the remaining project area comprises undeveloped portions of previously cleared (chain-dragged) ranch lands. Although some WWII-period military activities occurred in the general area, no specific evidence of such use, usually represented by shell casings, ammunition cans, or C-ration remnants, was encountered during the course of the current survey. Evidence of previous brush fires was observed in the form of charred stumps, fallen trunks, and secondary vegetation.

METHODS

The current archaeological walk-through survey was conducted during three periods amounting to a total of 40 person/hours, between April and September of 2010. The water transmission line corridor, from the off-site wells to the eastern boundary of the proposed Honua`ula Development area, was systematically inspected by two persons walking the whole alignment. At the southern end of the main transmission corridor, the secondary transmission corridor to the proposed reservoir and the reservoir site were also systematically inspected by a two-person team. The survey coverage exceeded the proposed boundaries, thus achieving 100% coverage of the Area of Potential Effect (APE) of the proposed project. The boundaries of the proposed project were established in the field through the use of topographic maps and plans provided by the owner. The existing well-heads facilitated orienting the walk-though transects along the proposed transmission alignment. Proper orientation was maintained employing a hand held compass and a Garmin 76 Cx mapping GPS.

Based on the absence of any significant surface remains or other indications of significant prehistoric or historic period cultural activities within the project area, no subsurface testing was conducted.

The project personnel consisted of Kimokeo Kapahulehua and Aki Sinoto with Eugene Dashiell, M.A., as Principal Investigator.

RESULTS OF FIELDWORK

The current surface survey resulted in negative findings. No surface structural remains or any other features indicative of prehistoric period or traditional Hawaiian cultural activities were encountered within the project boundaries during the course of the fieldwork. One free-standing ranching wall incorporating a fence-line is located *mauka* of the northern third of the Maui Meadows subdivision (see Fig. 3). A ranch road parallels this wall on the southern side. Although evidence of extensive and compounded previous disturbance were observed in the area, the absence of archaeological remains most likely is not attributable solely to the impact of ranching and the other development-related disturbances. The intermediate zone within which the project area occurs, has been characterized by researchers primarily as a zone of transit between the coastal and inland areas beyond the 1000 to 1200 foot elevations during the prehistoric period.

The intermediate zone in the more arid northern part of the traditional Honua`ula District generally manifests the lowest density of extant sites when compared to the neighboring areas to the south.

Previous surveys in neighboring areas within similar elevation ranges have also resulted in largely negative findings, including the results of test excavations conducted at extant surface features in the Honua`ula Development Area (Sinoto et al. 2009) as well as the adjoining Makena Resort development area (McIntosh et al. 1997).

RECOMMENDATIONS

Due to the negative results of the current assessment, no further pre-construction archaeological procedures are warranted. However, archaeological monitoring of construction–related ground disturbing activities is recommended. When the water system plans are finalized, an archaeological monitoring plan shall be prepared and submitted to SHPD for review and approval prior to commencement of any construction activities. The 12-inch pipeline, as well as the limited width of the 30-foot wide transmission corridor, is anticipated to facilitate avoidance of any inadvertent discoveries that warrant preservation.

In addition, no new well development is currently being considered within the well field area included in the current assessment. An appropriate monitoring plan shall be prepared and submitted for approval when planning commences for the development of new wells in the future.

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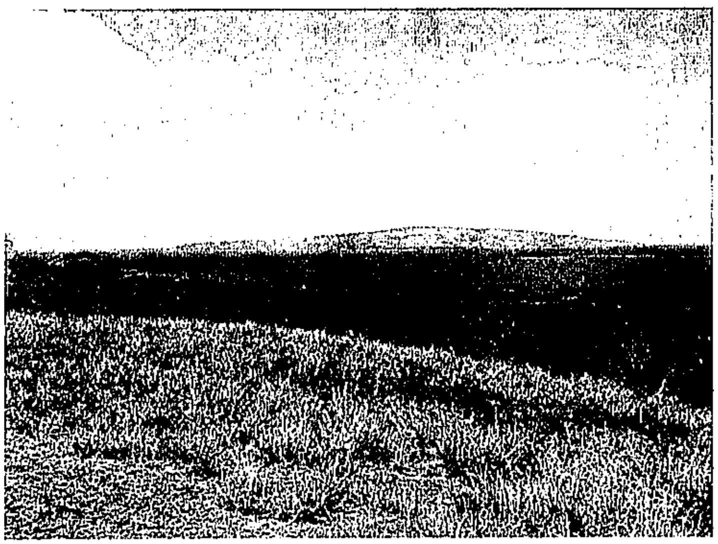
Appendix J

Cultural Resources Preservation Plan

HONUA'ULA

CULTURAL RESOURCES PRESERVATION PLAN:
Proposed Honua`ula Development
Paeahu, Palauea, & Keauhou *ahupua`a*
Makawao District, Maui Island
(TMK: (2) 2-1-08: por 56 and 71

February 2010



Aki Sinoto Consulting, LLC

Hana Pono, LLC

and

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ASC100219

CULTURAL RESOURCES PRESERVATION PLAN:
Proposed Honua`ula Development
Paeahu, Palauea, & Keauhou *ahupua`a*
Makawao District, Maui Island
(TMK: (2) 2-1-08: por 56 and 71

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FOREWORD

There are very few opportunities in our lives when something can be done to secure and honor the past while at the same time providing for our future. This Cultural Resource Preservation Plan is the first step in the process of identifying and preserving the cultural past of Honua`ula and will hopefully serve as a model for other similar efforts in the future. The Honua`ula project team, especially the cultural experts and practitioners working on this document, are owed a great debt of gratitude for keeping the faith in our project, supporting us in this effort, and working outside the box when it comes to communicating the cultural spirit of Hawai`i and as it relates to the project.

On behalf of Honua `ula Partners, LLC; to all those that will read this document, please consider this plan as the beginning of a process and a roadmap to a sound and well thought out preservation plan for the cultural resources within, not only for the proposed Honua`ula development area, but for the whole Honua`ula region.

Thank You,

Charles Jencks
Honua`ula Partners, LLC

"...When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it the esthetic harvest it is capable, under science, of contributing to culture.

That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics. That land yields a cultural harvest is a fact long known, but latterly often forgotten."

Aldo Leopold
March 4, 1948

A Sand County Almanac and Sketches Here and There

PREFACE

In the Introduction of the Winter 2009 issue of *CRM: The Journal of Heritage Stewardship* published by the National Park Service of the U.S. Department of the Interior, Barbara J. Little, its editor, states that:

> "As our cultural heritage inspires research and responsible stewardship, there is also a recognized need for professional principles to guide the thoughtful engagement of the broader public." (Vol. 6, No. 1, Winter 2009; pg.4)

To strengthen the framework upon which preservation initiatives are founded, Little affirms that the Charter for Interpretation and Presentation of Cultural Heritage Sites, ratified on October 4, 2008 by the International Council on Monuments and Sites (ICOMOS) identified seven key principles upon which legitimate public interpretation should be based as:

1. Access and Understanding
2. Information Sources
3. Attention to Setting and Context
4. Preservation of Authenticity
5. Planning for Sustainability
6. Concern for Inclusiveness
7. Importance of Research, Training, and Evaluation

The objectives based on each of the principles are set forth as follows to:

1. Facilitate understanding and appreciation of cultural heritage sites and foster public awareness of the need for their protection and conservation.
2. Communicate the meaning of cultural heritage sites through careful, documented recognition of their significance, through accepted scientific and scholarly methods as well as from living cultural traditions.
3. Safeguard the tangible and intangible values of cultural heritage site in their natural and cultural settings and social context.
4. Respect the authenticity of cultural heritage sites, by communicating the significance of their historic fabric and cultural values and protecting them from the adverse impact of intrusive interpretive infrastructure.
5. Contribute to the sustainable conservation of cultural heritage sites, through promoting public understanding of ongoing conservation efforts and ensuring long-term maintenance and updating of the interpretive infrastructure.
6. Encourage inclusiveness in the interpretation of cultural heritage sites, by facilitating the involvement of stakeholders and associated communities in the development and implementation of interpretive programs.
7. Develop technical and professional standards for heritage interpretation and presentation, including technologies, research, and training. These standards must be appropriate and sustainable in their social contexts.

This Honua'ula Cultural Resource Preservation Plan represents a sincere and concerted intent to embody these principles and objectives in its formulation and more importantly in its implementation.

E Ala Hawai'i

by Keli'i Tau'ā

This *mele* came after being in the studio for over two years. I had composed *Nā Po'o Ana o ka Lā*, the setting of the sun as a favor to my students but did not receive inspiration to write this *mele* until recently. Growing up in Kula, Maui, we always had the privilege to greet the rising of the sun on the top of Haleakalā. Now we can chant praises to the sun from any station in life.

E ala Hawai'i ke ala nei ka Lā	Awake Hawai'i, the sun rises
E ala Hawai'i ua ala 'ia ka Lā	Awake Hawai'i, the sun has risen
E ala Hawai'i mai Haleakalā	Awake Hawai'i from Haleakalā
E ala Hawai'i nā hōkū, mahina, ka lā	Awake Hawai'i stars, moon and sun
Hui:	
'Uwā ka leo	Shouting voices
E ala, e iho, e 'oni, e 'eu	Awake, come down, move, stir
Nahe ka leo	Whispering voices
E ala, e iho, e 'oni, e 'eu	Awake, come down, move, stir
'Uwā ka leo	Shouting voices
E ala, e iho, e 'oni, e 'eu	Awake, come down, move, stir
Nahe ka leo	Whispering voices
E ala, e iho, e 'oni, e 'eu	Awake, come down, move, stir
E ala Hawai'i ho'okahi Akua Mau Loa	Awake Hawai'i one Supreme God
E ala Hawai'i ka lā i mauli ola	Awake Hawai'i the sun the source of life
E ala Hawai'i e hana e ola honua	Awake Hawai'i work for life on Earth
E ala Hawai'i nā hōkū, mahina, ka lā	Awake Hawai'i stars, moon and sun
Hui:	
E ala Hawai'i e ulu o ka lā	Awake Hawai'i the rising of the sun
E ala Hawai'i ke kalo o Hāloa	Awake Hawai'i the taro of Hāloa
E ala Hawai'i ka makani, ka ino, ka ua	Awake Hawai'i in wind, storm and rain
E ala Hawai'i nā hōkū, mahina, ka lā	Awake Hawai'i stars, moon and sun
'Uwā ka leo	Shouting voices
Ua mau kēia o ka 'āina	The breath of the land
Nahe ka leo	Whispering voices
I ka pono ea	Endures in righteousness
'Uwā ka leo	Shouting voices
Ua mau kēia o ka 'āina	The breath of the land
Nahe ka leo	Whispering voices
I ka pono ea	Endures in righteousness
Ua ala ka lā	The sun awoke!

The texts; rendered in a reddish-brown, earth tone; of various *mele* and *oli*, both traditional and contemporary compositions, are interspersed in pertinent sections of this document, especially those dealing with the cultural aspects of the region. The audio tracks can be heard on the enclosed compact disc.

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A HISTORIC PRESERVATION PRIMER

The purpose of this section is to provide the reader with a brief summary of basic background information that may be useful in fully digesting material presented in this and other documents. A brief glossary of terminology commonly used in Hawaiian archaeology/cultural reports is presented first; followed by an illustrated site classification section including a descriptive listing of features; and an annotated outline of standardized development-related archaeological procedures. Many of the terms used in archaeological/cultural reports and discussions are technical and/or have a specific usage not familiar to the lay person. Thus, a brief glossary of such terms commonly used in Hawai'i and in this report is presented here. The sections that follow on Hawaiian land-use terminology, archaeological site classification, and historic preservation procedures also include some often-used terminology.

Glossary of Archaeological/Cultural Terminology

Archaic: older or more ancient.

Artifact: an object, usually portable, manufactured or modified by man.

Artificial: altered or made by man.

Avifauna: birds.

Buffer Zone: a "no impact" zone surrounding a preservation area, designed to maintain a specified distance in the transition from development area to preservation area.

Burial: human remains intentionally buried, placed, or cached in the ground, cave, sand-dune, or structure.

Burial Council: a decision-making body established for each County in the State to determine the disposition of undocumented native Hawaiian burials that are discovered in the course of archaeological studies or development activities. The council is made up of members representing each district or region and also business/development/landowner interests.

Calendrical: the date or age based on the calender, normally the Gregorian, with 365 days.

Charcoal: burnt or charred wood and other organic materials, that serve, in proper context, as an indicator of cultural activity, collected for radiocarbon dating.

Chronology: temporal placement in order of occurrence, ie. old to new.

Cluster or Complex: a small or large grouping of discrete structural features that are associated by function, other characteristics, or spatial proximity.

Context: the surrounding circumstance which specifies a meaning, ie. cultural or temporal context.

Controlled: in subsurface testing, refers to establishing a datum to accurately record provenience data.

Cross-Section: refers specifically to a vertical soil profile as in an excavation or to the representation of a vertical plane perpendicular to an axis of an object such as an artifact.

Cultural Resource Management: the process by which the significance of cultural remains are evaluated and decisions regarding mitigation measures and the future disposition of these remains are determined.

Culture: the totality of a particular society's behavior, arts, beliefs, institutions, work, and thought.

Curation: refers to the care and storage of artifacts and other research materials.

Debitage: detritus or refuse from manufacturing activities, ie. basalt debitage at an adze workshop.

Depository: a place where artifacts and other research materials remain for safekeeping.

Disturbed: a state of being adversely impacted by some action.

Ecotone: the transition between two ecological zones, ie. coastal flat and vegetation line.

Effect: the influence of an action or event, ie. agriculture on topography.

Ethnobotany: the study of the use and knowledge of plants by a specific culture.

Ethnology: the comparative, interpretive study of culture and the theory of culture.

Ethnography: a descriptive and non-interpretive study of individual cultures.

Feature: a constituent component of an archaeological site, a structural feature in a complex or cluster and also an integral internal feature such as a firepit, cupboard, or posthole, etc.

Fossil: plant or animal remains preserved in mineral form or the remains of an extinct species, ie. fossil bird bones.

GIS: acronym for Geographic Information System, which is a computerized, map-based system of data-bases with extensive application for research, planning, and resource management.

GPS: acronym for Global Positioning System, which is a computerized, satellite navigation system used for determination and mapping of terrestrial locations.

heiau: traditional Hawaiian places of worship ranging from elaborate stone structures to simple earthen terraces; several classes are known to have been employed in worship on the local to national levels of importance.

History: in Hawaii, the study of the period following western discovery (post-1778) and the advent of written documentation.

Impact: the effect or influence of one thing on another, ie. tourism on historic preservation.

In-situ: in the original location, position, or provenience.

Interpretation: an explanation, clarification, or the process of explaining the meaning of something

Inter-disciplinary: the application of different fields of science in the pursuit of archaeological knowledge, ie. botany, chemistry, geology, zoology, etc.

ko'a: shrine, a small structure built of stone, often with the inclusion of coral; for fishing or bird hunting

Layer: the natural strata or horizontal beds of subsurface soil deposition encountered in excavation.

Level: arbitrary intervals, usually 5-10cm, used to subdivide natural Layers or strata to permit finer stratigraphic control during excavation.

Lineal Descendent: individuals or families that can genealogically trace their ancestry to a specific location or personage, ie. documented direct descent from an ancestor.

Manual: non-mechanized way of excavating or clearing vegetation to minimize impact on an area.

Material Culture: elements of a culture that is tangible, ie. sites, artifacts, etc.

Midden: food remains and other detritus resulting from human activities.

Mitigation: action to lessen impact of adverse effect on a cultural resource; ie. data recovery to retrieve available information prior to development, preservation for data-banking, interpretation for public educational purposes, or monitoring during construction.

Paleontology: the study of fossils.

Palynology: the study of pollen preserved in buried sediments to gain information of past biota.

Polity: an organized, self-sustaining, social group or unit, ie. the inhabitants of an *ahupua'a*.

Prehistory: the traditional Hawaiian period before written history, pre-1778.

Primary: in the depositional context, means original, ie. primary deposit, burial, etc.

Profile: the vertical face exposed in a cross-section, such as the side wall of an excavation unit.

Provenience or Provenance: in excavation, the stratigraphic place of origin of a recovered item.

Radio-carbon Dating: a destructive method of analysis which measures the amount of radioactive carbon (C14) in archaeological samples of certain organic materials to obtain a date.

Regulatory: governmental agencies or regulations that pertain to historic preservation, ie. Advisory Council for Historic Preservation, State Historic Preservation Division, City or County Agencies.

Sample: usually non-artifactual specimen collected for analyses, archiving, or future study, ie. soil, midden, pollen, charcoal samples, etc.

Sampling: in archaeological survey or subsurface testing, the method of selecting a representative part to aid in defining the parameters or characteristics of the whole area, site, or feature.

Screen or Sieve: incremental mesh through which excavated soil is passed through to enable recovery of artifacts and sample materials of specific size intervals; ie. 1/8 and 1/4 inch wire cloths

Seasonally Recurrent Occupation: regular habitation in the same locality during a particular season, ie. for marine exploitation or for agricultural pursuits.

Secondary: in the depositional context, means not original, displaced, or moved as opposed to primary.

Settlement Pattern: the inferred or actual distribution of the various types of sites in an area or region.

Site: a specific locality defined by the material remains of past human activity, ie. habitation.

Stratigraphy: the geologic or pedologic record in the superpositioned layers of soil in an excavation which also includes the record of past cultural activities.

Subsurface: below the present ground surface.

Surface: above or on the present ground surface.

Temporal: relating to time or age of archaeological remains.

Testing: a limited excavation to assess the presence/absenc, nature, and extent of subsurface remains at a particular site, feature, or locality.

Zooarchaeology: the study of faunal remains within an archaeological context.

Glossary of Hawaiian Land and Land-Use Terminology

Land divisions from large to small-

mokupuni: island, such as O`ahu, Maui, Moloka`i, etc.

moku: district, such as Ko`olaupoko, Ko`olauloa, Kona, etc.

ahupua`a: subdivision of districts, typically described as being an elongated wedge shape stretching from the ocean to the mountaintop

lele: a discontinguous outlying portion of an *ahupua`a*

`ili:* subdivision of *ahupua`a, such as the *`ili* of Lihue in Honouliuli *ahupua`a*

`ili kupono:* abbreviated to *`ili ku, these were completely independent of the *ahupua`a* in which it is situated. Tributes were paid directly to the King

mo`o:* also *mo`o `aina*, these were the arable tracts within *`ili

pauka: subdivision of *mo`o* set aside for cultivation

ko`ele: small land unit farmed by tenant farmers for their chief

poalima: since the tenants worked in the *ko`ele* only on Fridays, later became known by that name

kihapai: the smallest land unit cultivated by the tenant-farmer for himself

Agricultural terms-

`aina mahi: agricultural lands

`aina hanai holohalana: pastoral land

`aina ulula`au: forest

`aina wai: wet land

`aina waiwai ole: waste land

kula: dry land as opposed to wet or taro land; also plain, field, open country, or pasture

lo`i: irrigated wetland agriculture; traditionally for taro and historically for rice

kuanua: banks of taro patch or stream

poalima: land farmed by tenant farmers for their chief or *konohiki*

***Mahele* terms-**

Land Commission: In 1845, the Board of Commissioners To Quiet Land Titles was established and represented the first step in the reformation of the system of land tenure in Hawai`i by allowing natives and foreigners with land claims to present their claims for evaluation and award (LCA), upon payment of commutation to the government.

The Great Mahele: In 1848, the rights of the King, chiefs, and *konohiki* on the lands was identified, thus ending the feudal system in Hawai`i. The lands were separated into three parts: one part for the King, another for the chiefs and *konohiki*, and the third part for the tenants or common people. Upon payment of commutation, a Royal Patent was awarded with the title to the land.

Kuleana: Four Resolutions adopted by the Privy Council in 1849 authorized the Land Commission to award fee simple titles to all native tenants who occupied and improved any portion of Crown, Government, or *konohiki* lands. These awards were generally free of commutations, except for houselots in Honolulu, Lahaina, and Hilo. These and subsequent acts allowed the native tenants, the commoners, to acquire their own lands. These parcels came to be known as *kuleana*.

Land and feature terms-

akau: north
alakaha: bridge
alahao: railway
alahele: right of way
alaloa: public road, highway
alanui: road or street
alodio: fee simple
apana: piece or lot
auwai: small ditch, irrigation ditch
auwai hoomalo: drain
auwai papa: flume
awa: harbor
awa awa: slope or valley
awa pae: landing
awawa: valley
eka: acre
e pili ana: adjoining
hakuone: patches cultivated for a chief
hekina: east
hema: south
holua: slope
ho`o`aina: tenant
ho`olimalima: lease
kahakai: beach
kahawai: stream
kipuka: an island of land surrounded by lava flows, usually with vegetation
komohana: west
konohiki: chiefs or landlords, agent on behalf of a chief or King
kuahiwi: mountain, grassland
kuleana: a small piece of property; also means right, title, jurisdiction, authority
loko: fishpond
mokuna: boundary
muliwai: stream
`ohana: family, relative, kinship group
pa: wall or fence
pahale: houselot
palapala hooko award certificate for native claims
palapala sila nui royal patent
palekai: sea wall
palewai: breakwater
papu: fort, as in *`aina papu* or fort land
pohopoho: swamp
punawai: spring
uku: commutation
waiwai: property

Classification of Hawaiian Archaeological Sites

The initial assessment of site function begins with locating and defining archaeological structural remains. These generally occur as the remains of single or a cluster of architectural structures (enclosures, platforms, terraces), but may also include burials, trash (midden) deposits, subfeatures such as firepits, and utilized natural features such as depressions, caves, and ponds. Due to the abundance of loose rock available throughout the islands, the Hawaiians utilized pahoehoe, a'a, other basalts, beach coral, and limestone for constructing a wide array of feature types and site complexes.

Two types of classification, formal and functional, are most commonly compiled and utilized by students of Hawaiian archaeology. Formal classification attempts to categorize only the morphological attributes of a feature; whereas, function is considered by the other classification. The two systems of classification cannot be completely separated and this is reflected in the application of classifications which are generally accepted by consensus. The figure on page xxi illustrates selected formal site types. The illustrated site types are numbered in the following narrative descriptions.

The Table below lists the kinds of features, formal and functional in order of complexity, likely to be generally encountered in the Hawaiian Islands.

Table of Archaeological Site Types

1. Depressions	10. Storage Pits	19. Walls
2. Modified Pools	11. Upright stones	20. Fishponds
3. Shelters	12. Trails	21. Platforms
4. Lava Tubes/Caves	13. Hearths	22. Open-ended Structures
5. Midden	14. Alignments	23. Enclosures
6. *papamu*	15. Mounds	24. Terraces
7. Bait Cups	16. *ahu*/Cairns	25. Burials
8. Rock Art	17. Modified Outcrops	26. Shrines
9. Quarries	18. Pavements	27. *heiau*

The 27 features listed above often include additional sub-categories, for example, the enclosure category includes rectangular and oval varieties with a range of size variations. These morphological differences generally determine the use or function of the structure. Similarly, the wall category includes low, stacked varieties; higher-standing, core-filled, bifacial structures; and retaining walls which exhibit height on only one side. These differences in feature morphology may reflect both functional and temporal distinctions. A brief narrative description of each feature type is presented below followed by a more detailed outline of site classification with selected illustrations.

Depressions

Shallow depressions are often encountered during archaeological field investigations in agricultural zones, and in barren lava flow areas on lower slopes. These features are considered to be small agricultural sites utilized for erosion control and/or cultivating sweet potatoes in arid localities with sparse water and insufficient rainfall for normal crop propagation. These depressions are common on the wide leeward coastal plains and sometimes also occur along *mauka-makai* trails.

Modified Pools

These features usually occur in coastal zones associated with fishponds. Modifications may take the form of single rocks placed as a boundary around the pool's edge, or as walls forming a small well. Springs feeding ponds are commonly walled for channeling water, and occasionally, modified pools mark the localities of legends and mythological occurrences involving water spirits.

Shelters

Shelters,.or overhangs, are small horizontal depressions along rock outcrops. Shelters are usually less than three square meters in area, and are sometimes partially shielded by a constructed, low rock wall fronting the opening. Shelters may be found in both coastal and upland areas, and frequently contain significant buried refuse from short-term occupations in the past. Primarily these types of sites are for short-term temporary occupation.

Lava Tubes and Caves

Lava tubes are differentiated from caves largely on the basis of size. Lava tubes are formed by air pockets within cooling lava flows. These pockets eventually erode or are broken, revealing subterranean chambers suitable for habitation. Not only were many lava tubes utilized for living purposes, but served as burial localities as well. Water was provided by condensation collected in gourds hung from the ceiling. Certain large caves were used as places of refuge during the centuries of conflict preceding the unification of Hawaii, ca. 1800. Lava tubes are considered significant archaeological sites due to the often diverse and numerous trash remains and artifacts. Dry cave deposit enhances the preservation of organic remains. Some lava tubes provided a natural trap for birds now extinct, and their remains form deposits of high paleontological value. The frequent discovery of one or more human burials in cave sites is a topic of concern for the native Hawaiian community and consequently often result in preservation of these areas from man-made disturbances.

Midden

Midden, or trash deposits, contain valuable data for the archaeologist. Many features are sterile containing little or no associated cultural debris. Habitation sites or the surrounding area are usually rich with the detritus of human occupation including food remains, tools, and personal objects. The density of a midden deposit indicates the intensity of occupation (permanent or temporary) and may also provide clues about the size of the household. Most importantly, trash accumulations often contain animal bone, shell, plant remains, pollen, and charcoal for dating a site, reconstructing prehistoric environments, ecology, and dietary patterns. Midden is usually found within lava tube, cave, shelters, and certain enclosure features although it also occurs as isolated surface scatters most often on lava flows.

papamu

The *papamu*, or *konane* "game boards" are encountered near trail junctions and in habitation complexes and consist of a flat pahoehoe slab with 30-40 pecked depressions in a regular pattern similar to a checkerboard. The game of *konane* was said to be played in tournaments during the *makahiki* festival celebrating the departure of the god Lono. The ceremonial aspects of the *makahiki* are closely associated with boundaries and trails, suggesting the presence of these features along *ahupua 'a* divisions and trail intersections.

Bait Cups

These are small pecked depressions, usually located at a rocky shoreline frequented for fishing. These "cups" act as small mortars where bait or *palu* can be mixed with sand and other things for making chum.

Rock Art or Petroglyphs

Rock art is characterized by geometric and/or anthropomorphic depictions on rock surfaces. These glyphs may appear as pecked, incised, or abraded and include a wide array of styles and motifs. Examples include bird-men, rainbow figures, Lono symbols, dogs, turtles, circles, dots, sails, female figures, graffiti, and footprints, and may occur in groups or as isolated examples. In general, rock art is more prominent in leeward, coastal areas around trails connecting habitation areas. Rock surfaces utilized as rock art localities include pahoehoe, smooth boulders, cliff faces, caves, and sandstone shelves along beaches (Cox and Stasack 1970:7). A variety of reasons hypothesized for the propagation of rock art range from personal accounts of trips along trails to esoteric documentaries and commemoration of legends and unusual occurrences. The majority of petroglyphs in the Hawaiian Islands consist of lines inscribed or engraved onto a relatively flat stone surface, rare examples of relief carvings, where the area surrounding the depictions or motifs have been carved away, are known from several of the Hawaiian Islands.

Quarries

The procurement of raw stone material for manufacturing adzes, sinkers, chisels, files, rubbing stones, poi pounders, abraders, and other lithic tools, was complementary to the wide range of bone, shell, coral, and perishable artifacts utilized by the Hawaiians. While many tools could be wrought from stone collected at random; the production of poi pounders, fishing sinkers, abraders. and adzes, in particular, required a supply of quality stone from quarries. Such sites are usually located in upland environments along outcrops. Some, like the Mauna Kea quarry, required travel over great distances and labor expenditure to obtain the rock and for transporting the product to a home base. Quarries can be recognized by large amounts of broken rock and waste flakes (debitage) from trimming large pieces into portable components. Trails sometimes connect quarry areas with habitations. Quarries in the Honua`ula region tend to be small and localized. One basalt quarry was recorded by Emory within Haleakala crater.

Storage Features

Storage of water, food, and material items is a universal trait among humans. Water catchments in arid zones were sometimes modified with tilted slabs to shade the pool and decrease evaporation. Tools and food were often stored in stone lined pits, stone niches, or cupboards. These features are frequently incorporated into a wall or rock outcrop. The occurrence of storage features can be expected in all areas where human activities have regularly taken place.

Upright Slabs

Solitary flat pahoehoe slabs, water-worn oblong basalt boulders, or elongate dike stones planted or erected in a vertical position may indicate either a ceremonial or marker function. A single slab may hold a religious representation or simply be trail marker and, in this respect, serves a function similar to *ahu* and caims. When occurring within the context of larger structures, upright stones are likely to hold ceremonial meaning. Walls often incorporate basal upright slabs in their construction, but frequently, the construction style may simply be dictated by the type of available raw materials rather than as an attribute of ceremonial or religious functions.

Trails

Trails were a common means of travel in Maui from prehistoric to recent times. Prehistoric trails usually follow a *mauka-makai* orientation reflecting communication and trade within the boundaries of specific *ahupua'a*. Later trails are oriented in a basic circum-island pattern for connecting settlements along the coast. Trails occur as steppingstones, or Type A varieties (Apple 1965) formed by the linear placement of smooth cobbles. These types often occur along the coast in prehistoric contexts. Modified trails utilizing a'a clinker stone for filling crevices along worn pathways crossing a lava flat constitute another form of trail (Type AB) found in zones between the coast and uplands. Parallel stone curbs and slab paved pathways are among the most elaborate trails constructed.

Hearths

Hearths are the physical remains of fireplaces built and used in the past. Most Hawaiian hearths occur within habitation sites such as enclosures, lava tubes, caves, shelters; as well as in open areas as small, often unrecognizable blackened or gray, ashy zones located below the current ground surface. Circular stone lined or rectangular slab-lined fireplaces are well-represented in the archaeological record. These features sometimes display the attributes of the Hawaiian oven (*imu*) for the slow cooking of pigs and vegetables. A typical *imu* viewed in an archaeological context would consist of a number of fire-altered rocks, ash, and soil mixed with food refuse. Hearths, like midden, offer opportunities for gathering archaeological samples that yield data relating to the prehistory of an area.

Alignments

This feature type is difficult to define in terms of function. Alignments occur as stones placed end-to-end over short distances with no apparent connections or association with other features. They may have served as direction markers leading to storage areas (Rosendahl 1992), erosion control, or some as yet unknown ideological function. At times, to distinguish and identify a true alignment from a remnant feature poses an interpretive dilemma for archaeologists.

Mounds

Mounds are characterized as free-standing, informally built, piles of rock existing in a variety of shapes ranging from circular, oval, linear, to amorphous in shape. The two, most frequent mound forms, however, are circular and elongated. Both types are often associated with agricultural areas. Mounds represent field clearing of cultivable areas and others often contain burials, although there is no way of verifying this short of excavation. Human burials have been located both within and under mounds. Mounds do not usually contain artifacts, however, large mounds with coral paving may indicate a local shrine. Mounds are among the most ubiquitous features encountered during archaeological surveys. Clearing mounds in some permanent agricultural sites are apparently constructed more carefully to avoid repeated displacement and re-mounding which gives them a very formally built appearance; posing yet another interpretive dilemma for archaeologists.

Ahu / Cairns

Ahu occur as circular piles of stacked rock, common on barren lava flows, and cairns as more substantial and formally constructed, faced circular, mound-like structures. Both *ahu* and caims frequently occur along trails, or along *ahupua'a* boundaries. Caims are sometimes located in caves, often marking burial sites or to aid in access of deeper vertical openings. *Ahu* also function as trail or bearing markers. A general rule of thumb used to distinguish cairns and *ahu* from mounds and platforms are that their height often equals or exceeds their horizontal dimensions in addition to a more formal construction style.

Modified Outcrops

This site type is one of the most ubiquitous structural features in Hawaiian archaeology and range in form from small, simple terraces, filled boulder alignments or walls, to relatively prominent platforms. The common element is that a natural bedrock outcropping is incorporated into the construction of the feature. These may occur as isolated structures or in association with other constructed features. These sites exhibit multiple functions from agricultural planting areas, habitation terraces, burial platforms, to retaining walls.

Pavements

Pavements are composed of areas on the ground surface defined by a low layer of cobbles and gravel; or water-rounded *'ili-'ili*, and a single course of flat basalt slabs. These areas are generally rectangular in shape although other shapes also occur. The function of these areas are unclear, however, they are common in lava tubes as living surfaces, or localities where activities such as eating, cooking, and tool-making occurred. Roughly paved areas are also common near agricultural fields suggesting use as small garden plots for sweet potato cultivation.

Walls

There are two basic kinds of free-standing walls related to the prehistoric and historic periods. The former category includes linear and/or meandering stacked pahoehoe or a'a cobble and boulder construction. These early walls are often low (less than one meter high) and functioned as *ahupua'a* or other boundary demarcations, and for agricultural plots. With the expansion of settlements and the introduction of livestock during the historic period, walls became more substantial resulting in double-faced, core-filled or stacked stone walls over a meter high and 0.80 m thick. These walls were primarily used for livestock control and for demarcating coastal settlements. In the Honua'ula region, walls related to exclosing and enclosing cattle are ubiquitous remains from the early historic to the late historic and modern ranching periods. The third type of wall, which is not free-standing is the retaining wall, which manifests height in only one side with the other side being build against a soil or rock embankment.

Fishponds

These features occur along the coastal areas in two or three forms. Walled ponds (*loko kuapa*) were created by building a sea wall surrounding an area or across a narrow bay. Lowland ponds (*loko pu'uone*) are modified natural ponds protected by dunes or rocky barriers. Fishponds are generally well-known through local folklore and are not as common along the Maui coast as on O'ahu and Moloka'i. Several walled, as well as *loko pu'uone*, are known in the Honua'ula region although most having been abandoned for a long time are in poor condition and almost indistinguishable from shore.

Platforms

Platforms may occur as free-standing, low cobble mounds with flat surfaces either incorporated into a hillside as part of a terrace, or as a portion of a wall or natural outcrop. Platforms served a variety of purposes, either as living surfaces, shrines, or as burial markers. Platforms range in size from low mounds to multi-tiered structures with faced sides. A variety of shapes including, rectangular, circular, oval, and irregular, are also represented.

Open-ended Structures

The C, U, and L-shape enclosures are believed to represent small shelters most commonly associated with agricultural activities. They functioned as planting, storage, and habitation areas/ These shelters are often no larger than four sq m in area and are open on one end. They sometimes contain hearths and moderate quantities of midden and artifacts. Although, considered to represent temporary usage, depending on its function, this site type often occurs in association with permanent habitation sites.

Enclosures

Enclosures are walled areas or compounds that vary in size and shape from oval structures with dirt floors to large, rectangular constructs with paved floor areas with substantial cobble and boulder walls. Enclosures may occur as single features or compound features incorporating several enclosures. Enclosures served many different purposes depending on size, shape, and period of use. Large enclosures defined garden plots, residential compounds, and animal pens. Religious structures (*heiau*) were often surrounded by a large enclosure. Historic houselots were often defined by boundary walls. During the historic ranching period, many livestock pens and cattle runs were constructed of local stones, some taken from indigenous sites that occurred nearby. Many such remnants of historic ranching activities can be seen in the Honua'ula region today.

Terraces

Terraces are artificially-leveled areas identified by retaining walls of stacked stone which are often faced, or as outcrops. Many occur as a series with the wall of one terrace providing a rear wall for a lower terrace. Terraces may be seen as a series of stepped features extending along a slope at various angles. Terraces most frequently serve an agricultural function occurring in all areas inland of the coast. Pond field complexes for taro cultivation are well-known in windward valleys with streams. In arid zones, terraces impeded water flow, encouraging silt impoundment for gardening plots. Terraces often served as foundations for habitation sites and, infrequently, as burial sites.

Human Burials

Hawaiian treatment of the dead occurred in a number of forms which include many of the feature types discussed here (eg. platform, mound, lava tube). Prehistoric burials from the earliest Hawaiian sites (AD 300-1050) were often deposited beneath habitations, however, as populations and conflict between chiefs escalated after AD 1600, burials were located away from settlements in dunes, caves, platforms, and mounds. Finally, for a while after Hawaiian unification, burial practices returned to the placement of the dead under houses. Eventually, due to Judeo-Christian influences as well as several disease epidemics in the mid-nineteenth century, cemeteries were established and generally used from that period.

Shrines

Shrines constitute alternative forms of ceremonial or religious function where a variety of ritual uses were embodied. Shrines include agricultural shrines, fishing shrines (*ko'a*), place spirit shrines (*pohaku o Kane*), and *ahupua'a* boundary shrines. Agricultural shrines are rare due to problems of identification, but are believed to be composed of water-worn beach stones located in corners of structures along with artifact offerings (Cordy et al. 1991: 537). Fishing shrines (*ko'a*) are small structures consisting of coral pavings and large upright water-worn stones. These features are located, as one would expect, in coastal locales. Place spirit shrines dedicated to Kane are usually found in caves as upright stones (Menzies 1920), as well as forested zones. *Ahupua'a*, or boundary shrines, are located along main trails bordering *ahupua'a* as rock structures (ahu). Coral offerings were commonly associated with such features.

Heiau

Most temples (*heiau*) have been known through historical accounts and legend rather than as a result of archaeological discovery. The largest and most elaborate *heiau* (*luakini*) are often described as a raised or tiered platform replete with altar and wooden house foundations, however, most archaeological remains attributed to *heiau* lack all these descriptive criteria, except size. Smaller *heiau* exist as temples of the land and people (*ipu o Lono*) and for women and children (*hale o Papa*). Locations were dependent on the temple's purpose, but could range from coastal to inland, and almost always were situated on a prominent spot providing a view of the land beyond (Stokes 1991).

Formal Site Classification

Natural Feature

Unmodified

- 1 place (battleground, birthplace, sacred grove of trees, etc..)
- 2 geological feature (pu'u, pali, rock formations, etc.)
- 3 stone/boulder with concavity (natural salt pans, water catchments, etc.)
- 4 overhang/lava tube
- 5 unmarked trail (worn from use)

Modified

- 6 modified outcrop (Fig. 1)
- 7 overhang/lava tube with wall or terrace

Man-made

Non-structural

- 8 pit
- 9 quarry (for lithic raw materials)
- 10 surface artifact/midden scatter
- 11 cleared area

Single-stone modification

- 12 upright atone (Fig. 2)
- 13 *papamu* (Fig. 3)
- 14 petroglyph (Fig. 4 motif depicting fishing from Kaupulehu, Hawaii)
- 15 bait cup (Fig. 5)
- 16 stone/boulder with modified concavity
- 17 abraded surface (grinding depressions, etc.)

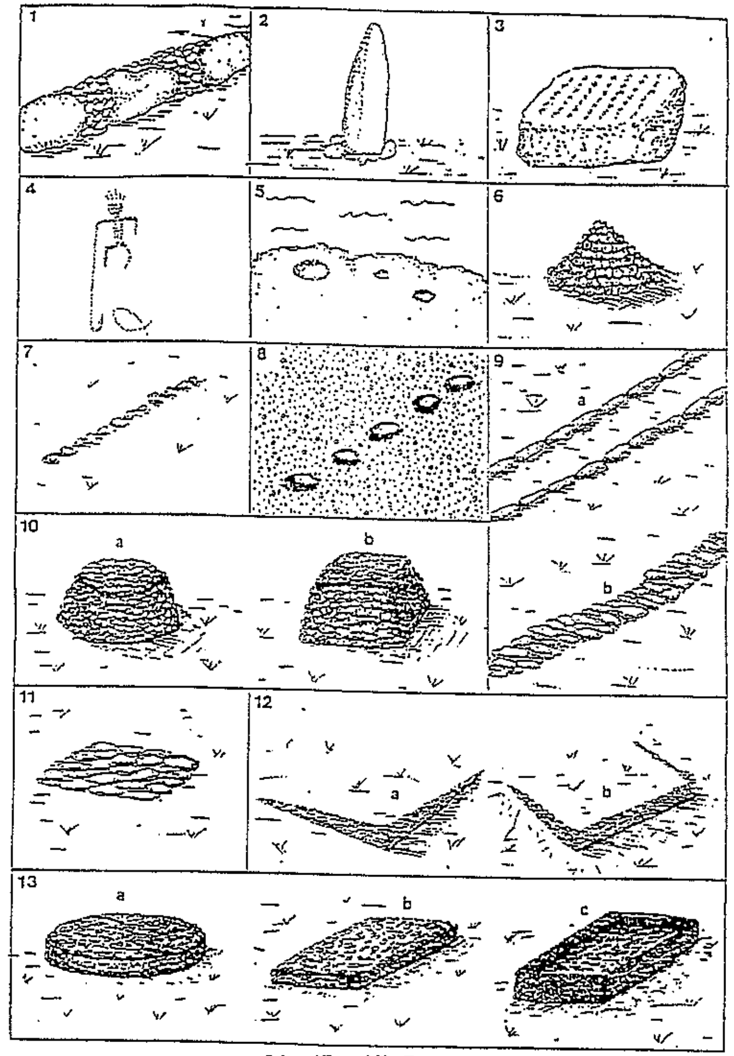
Structural

Informal

- 18 mound/pile (Fig. 6)
- 19 single-stone alignment (Fig. 7)
- 20 steppingstone trail on a'a. (Fig-.8)

Formal

- 21 curbstone trail (Fig. 9a)
- 22 paved trail (Fig. 9b)
- 23 cairn
  - circular/oval (Fig. 10a)
  - recrangular/square (Fig. 10b)
- 24 pavement (Fig. 11)
- 25 terrace
  - two-sided (Fig. 12a)
  - three-sided (Fig. 12b)
- 26 platform
  - circular/oval (Fig. 13a)
  - rectangular/square (Fig. 13b)
  - enclosed (Fig. 13c)



Selected Formal Site Types

Man-made

Structural

Formal (cont'd)

Wall Structure

Non Free-standing

27 stone border/facing/retaining wall (**Fig. 14**)

Free-standing

Stacked or Double-faced

28 linear wall (**Fig. 15**)

straight sided (**Fig. 15a**)

battered (**Fig. 15b**)

Open-ended Walled Structure (ws)

29 C-shape (**Fig. 16a**)

30 U-shape (**Fig. 16b**)

31 L-shape (**Fig. 16c**)

Closed-walled structure (enclosure/exclosure)

32 circular/oval (**Fig. 17a**)

33 rectangular/square (**Fig. 17b**)

Compound Structure

34 Homogenous integral components

platform (**Fig. 18a**)

open-ended wailed structure (**Fig. 18b**)

closed walled structure (**Fig. 18c**)

35 Heterogenous integral components

two types

platform/closed-ws (**Fig. 19a**)

platform/open-ws (**Fig. 19b**)

open-wa/closed-ws (**Fig. 19c**)

etc.

three types

platform/open-ws/closed-ws (**Fig. 20**)

etc.

four or more types

platform/open-ws/closed-ws/pavement

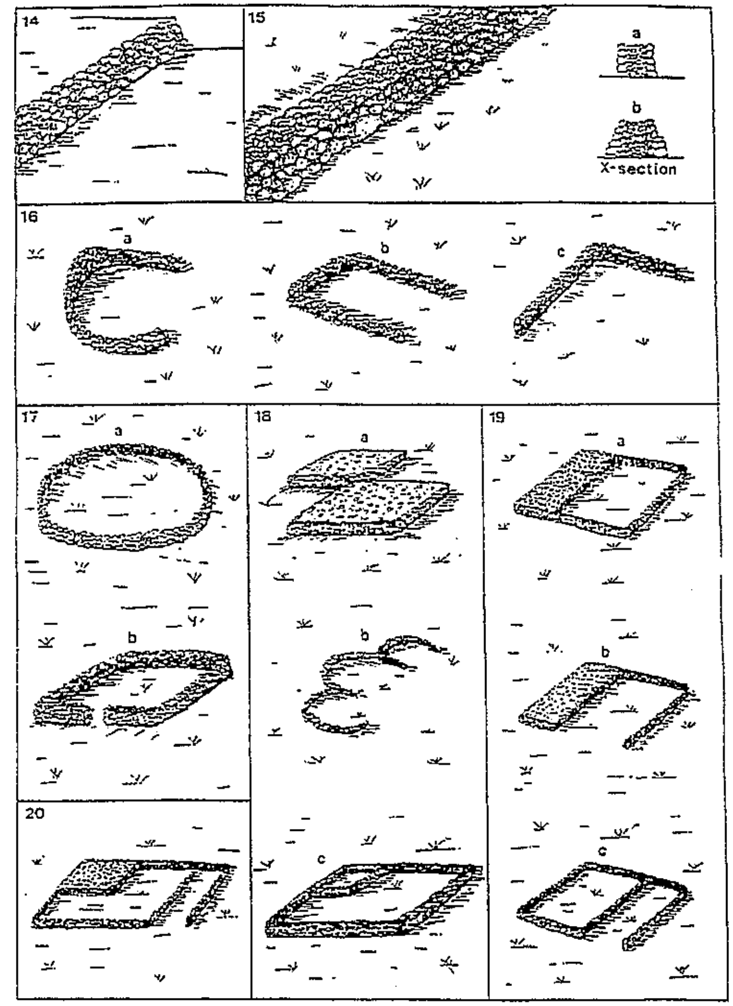
etc.

Others

36 Anomalous /Undefined structure

unknown type

undiagnostic structural remnant



Selected Formal Site Types

Legal Mandates

The historic preservation statutes in Hawai'i are basically modeled after the statutes established by the Federal Government. The initial Antiquities Act of 1906 has been followed by a host of other Acts and Executive Orders, all aimed at preserving cultural heritage in the United States. In addition to these formal statutes are regulations and guidelines adopted by government agencies in charge of enforcing these laws, such as the Advisory Council for Historic Preservation, the National Park Service of the Department of the Interior, and local counterpart agencies.

Although the primary intent of these laws, regulations, and guidelines is the protection of historically significant sites under public-sector jurisdiction, in actuality, much wider protection is afforded sites based on the application of public monies to a project or as conditional requirements for various regulatory permits. A review process identifies, investigates, and evaluates the significance of extant historic sites in order to determine the future disposition of specific cultural property.

In Hawai'i, the State Historic Preservation Division of the Department of Land and Natural Resources (SHPD/DLNR) is charged with historic preservation review. The State mandate is embodied in Title 1, Chapter 6E of the Hawaii Revised Statutes. Currently applicable Hawaii Administrative Rules primarily consist of Title 13, Subtitle13, Chapters 275-284 adopted in October 2002. These rules cover the procedures for historic preservation review; minimal standards for archaeological surveys and reports, for archaeological site preservation and development, data recovery studies and reports, monitoring studies and reports; procedures needed to be followed after inadvertent discoveries of historic properties; minimal professional qualifications for the archaeologists; and permits for archaeological work. It includes provisions for reviewing leases, permits, licenses, certificates, land use changes, or other entitlements for use issued by the State or its political subdivisions. Currently, the SHPD/DLNR conducts reviews on most city and county permit actions involving land alteration.

Once historic sites have been identified and documented, since the legal requirement for undertaking further mitigative actions are based on the historic property meeting at least one of the significance criteria, a brief discussion of the National Register Significance Evaluation Criteria would be appropriate. The National Register Criteria was established in order to standardize the evaluation process for site significance throughout the United States and involves considerations of aesthetics, style, period of origin, associated personages, the potential for data, and contemporary cultural value. The Hawaii State Register has adopted the Significance Evaluation Criteria established by the National Register and all sites that go through the historic preservation review process are evaluated based on these criteria.

The five criteria as adopted by the Hawaii State Register in conformance with the Federal criteria are that the site:

Criterion A: Be associated with events that have made an important contribution to the broad patterns of our history;

Criterion B: Be associated with the lives of persons important in our past;

Criterion C: Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

Criterion D: Has yielded, or be likely to yield, information important for research on prehistory or history; and

Criterion E: Has an important traditional cultural contribution or value to the native Hawaiian people or to other ethnic groups in the State.

Criteria A, C, D, and E are applicable to prehistoric sites, with Criterion D being the veritable catchall for most archaeological sites. Criteria A and B are applicable to historic buildings and sites, along with C, although, occasionally, association with a legendary or mythological person or being may merit consideration under Criterion B for prehistoric sites. Criterion E applies to burial sites, religious sites, and places of contemporary importance to native Hawaiian or other ethnic groups.

Archaeological Procedures

The following brief summary is presented to familiarize the reader with the normal phasing of progressively intensive archaeological procedures, from preliminary assessment to final alternative stages of mitigation. Usually in development-related situations, regulatory requirements call for completion of inventory-level archaeological survey prior to implementation of historic preservation review. Frequently, however, for the benefit of the client as well as the archaeologist, some preliminary assessment procedures that can better define the parameters of scope and budget are undertaken. The flowchart on page xxv illustrates the historic preservation process.

Assessment

The first stage of every archaeological undertaking consists of a literature and documents search which involves library and archival research to compile any available previous data regarding a subject area. This includes any previous archaeological survey reports, historic land use documents and maps, and archaeological data such as site files and other data bases. If available data indicates the presence of remains, a reconnaissance survey maybe conducted to determine the number and nature of sites to accurately budget and scope the inventory survey. If no data is available, an onsite surface assessment survey is conducted to determine the presence/absence of archaeological remains. If no sites are indicated from the results of previously completed studies, then other phases may be skipped and archaeological monitoring of construction activities may be slated next. However, if no data is available and a surface assessment locates no surface remains, based on the potential for subsurface remains, an inventory-level survey may be recommended.

Inventory Survey and the Preliminary Evaluation of Significance

Following the preliminary assessment stage, the completion of the next stage, or inventory survey, permits the formal evaluation of site significance and determination of disposition of the sites in the context of the potential adverse impacts of the proposed development. In order to properly undertake such an evaluation; data regarding the number, types, location, extent, function, and chronology of the extant sites is needed. The inventory survey, which is extensive in nature, involves recording verbal descriptions, mapping, and subsurface testing. The results of this phase, together with the compiled literature and historic research data, permit an initial determination of significance for each site. A preservation, data recovery, and/or monitoring plans are then prepared to mitigate the potential adverse effects of the proposed development for those sites that are determined to be significant.

Mitigation (Data Recovery. Monitoring, Preservation)

This final stage involves 2 major components designed to mitigate any adverse impacts to the significant sites identified during the previous phases. These two components, intensive data recovery and preservation, entail undertaking procedures designed to realize the significance of the sites with completely contrasting results. Intensive data recovery is undertaken at sites where the information content is considered important. From an archaeological context, these would include site types with adequate representation elsewhere, those with poor or no surface integrity, those of more recent origins, and those site types that require more information. However, sometimes, development plans can dictate the form of mitigation needed. For instance, golf courses can be flexible in avoiding some sites, but not all. On the other hand, a highway or utility project will not have the flexibility to avoid sites. The end result of intensive data recovery in some cases will be the destruction of the site.

Depending on the nature of a site, archaeological monitoring during construction activities may be implemented for the collection of additional unanticipated data. This procedure is appropriate when not all of the sites are included in the previous phases. Such circumstances can be due to the sampling design, the sheer numbers of sites, or the absence of surface site-indicators. Upon evaluation of these and other factors, the necessity for monitoring is determined in consultation with SHPD/DLNR. In rare instances, major mitigation efforts may be required to recover significant unanticipated findings and the recommended disposition of the site may have to be revised to accommodate preservation.

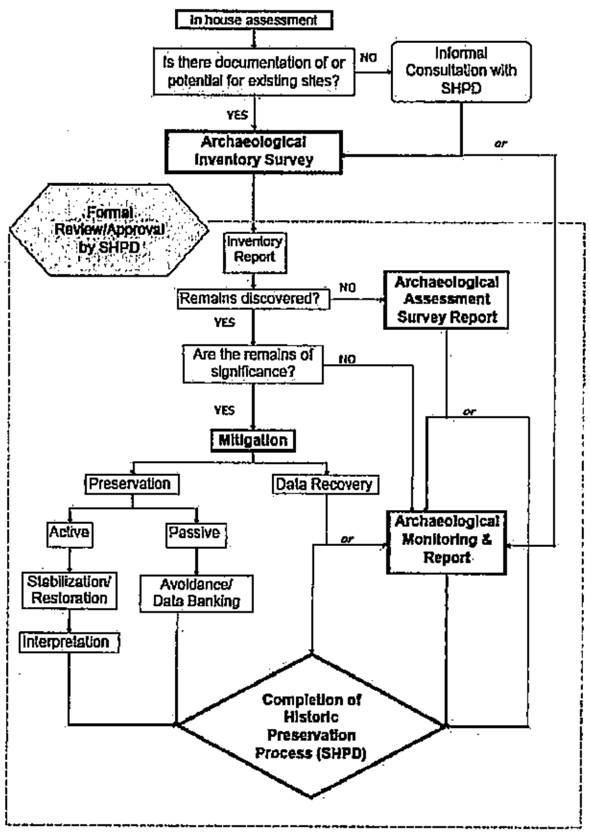
Preservation involves maintaining the site in its original location. This can be implemented in different forms for different purposes. Permanent, in-situ preservation is appropriate for sites that are unique, high-value, and possess contemporary cultural significance. *Heiau*, shrines, burials, specialized activity areas (quarry, holua, etc.), a representative feature complex, landmark sites (earliest known date, first archaeological research, etc.), or a settlement unit; fall under this category. Sites with good structural integrity, educational potential, and historical significance may be developed for public interpretation through stabilization, restoration, and reconstruction. This is often referred to as "active preservation." On the other hand, "passive preservation," ensures the maintenance of information. This is often referred to as "data banking," and may not be permanent; since as new research techniques and analyses technologies become available, further data recovery may take place and eventually the site may be destroyed.

In the past, preservation tended to involve only single structures, such as *heiau* and fishponds, being interpreted. The early attempts at preservation tended emphasize prominent or monumental sites. More recently, the recommended approach is the preservation of representative "precincts" or complexes where, not only the sites themselves, but their spatial relationships and the environment can be interpreted.

As more and more of the islands become developed, the effective and meaningful preservation of traditional Hawaiian as well as other early ethnic sites important to the history of, not only Maui, but the Hawaiian Islands, should be considered a priority.

The Regional Archaeologist for the Western Region of the U.S. National Park Service, Douglas Scovill, in a portion of his opening address for the Cultural Resource Management Conference in 1974 stated that:

> ...the successive layering of historic preservation law and policy, over time ever expanding, and ever further defining what we should or should not do to our national heritage, reflects that through the political process of a democratic society, the American people have made strong commitment to the conservation of the history of our Nation...But...let us remember that the same American people have said, "Go, multiply and fill the American earth with dams, highways, power lines, farms, canals, and cities." When placed in this broader context, the historic preservation laws say... "We want a balanced environment—not total development, and not total conservation (Lipe and Lindsay, Jr. 1974:2)."



(Flow Chart by ASC Converted into Excel by Jaime Kawamoto)

INTRODUCTION

Prepared at the request of Honua`ula Partners LLC, this Cultural Resource Preservation Plan (CRPP) addresses the preservation of archaeological and cultural resources within the proposed Honua`ula development area in compliance with conditions set forth by the Maui County Council as part of the conditional zoning for the proposed Honua`ula Project. Comments and input for the plan have been solicited from the public as stipulated in the conditions. This draft document provides background information regarding the project area and a preservation plan that incorporates pertinent public input. The public notice, solicitation document, all of the comments and input received, and our responses addressing the pertinent comments are included as Appendices A through D of this document.

PROJECT AREA

The development area for the proposed Honua`ula Project (hereafter referred to as the "project area"), encompassing approximately 700 acres (ca 670-acres plus the ca 30-acre Proposed Pi`ilani Highway Extension Easement and a Maui Electric substation), is located along the southwestern slopes of Haleakala, within the *moku* (traditional district) of Honua`ula, currently subsumed into the Makawao District, on Maui Island (Fig. 1). Occupying elevations ranging between approximately 320 and 720 feet, the project area (TMK: (2) 2-1-08: POR 56 & 71) incorporates portions of three *ahupua`a*, from Paeahu in the north, Palauea in the middle, to Keauhou in the south (Fig. 2).

PROJECT BACKGROUND

Proposals for development at the project area were first formulated in 1988 by former owners of the property. These plans contemplated a residential/resort community of more than 2,100 residential units, two 18-hole golf courses, a resort lodge, and six (6) acres of commercial property. To implement this proposal, the former landowner completed an EIS in 1988 and obtained several land use entitlements for the property, including a community plan amendment, establishment of Chapter 19.90 (referred to as the Kihei-Makena Project District 9 or "Wailea 670"), Conditional Zoning approval, Phase II Project District, Phase III Project District approval, and State Land Use District Boundary Amendment (DBA). The DBA was obtained in September 8, 1994.

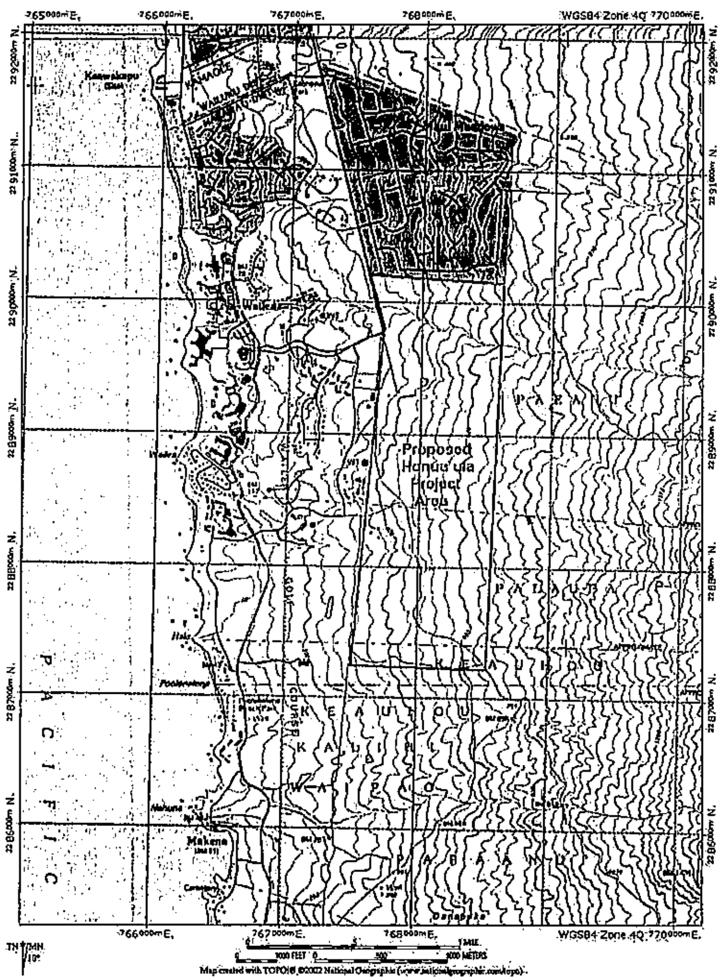


Figure 1. Location of Proposed Honua`ula Project Area on USGS Makena Quadrangle

In the mid-1990s an extensive community-based update of the Kihei-Makena Community Plan was completed, which resulted in the Project District 9 designation for the property being maintained. During this update process, the community reaffirmed that Project District 9 should be a residential community complemented with commercial uses, integrated with golf courses, and other recreational amenities (Fig. 3).

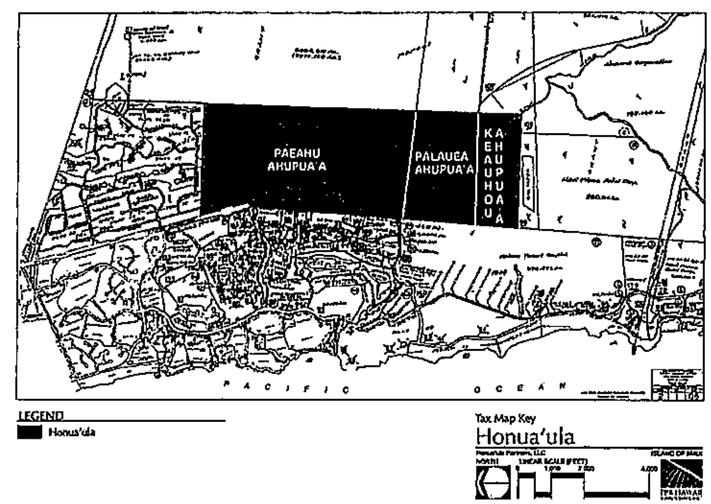


Figure 2. Tax Map of Project Area Showing Portions of the Three *ahupua`a*

The current owner, Honua`ula Partners, LLC, (formerly known as WCPT/GW Land Associates) purchased the project site in December 1999, resulting in the preparation of a revised plan for the property. The revised plan envisioned a master-planned community with no more than 1,400 homes, one golf course, open space and recreational trails, and village mixed use areas. While meeting the overall vision for Project District 9 as set forth in the Kihei-Makena Community Plan, the revised plan was considerably smaller in scale than the previously accepted Wailea 670 plan of 1988.

The subsequent Change in Zoning and Project District applications for this revised plan (to be known as the Honua'ula Project) were submitted to Maui County for processing in June 2000. The Change in Zoning and Project District Phase I applications were approved by the Maui County Council in March 2008. As approved by the Council, Project District 9 now includes provisions for 1,150 homes (including affordable workforce housing units in conformance with the County's Residential Workforce Housing Policy), village mixed uses, a single homeowner's golf course, a preservation easement, archaeological/cultural resource preservation areas, and other recreational amenities (Ordinance No. 3553 and No. 3554, approved April 8, 2008). The revised golf course design decreased the acreage to be graded for fairways in half.

CIZ Conditions

Throughout the period of review and deliberation of the entitlement applications by the Maui County Council, there was public testimony focused on the importance of defining an archaeological and cultural preservation program to ensure the long-term protection of significant cultural and archaeological sites at the project site for both present and future generations. In responding to these concerns, the following conditions were attached to the zoning approval:

Condition No. 13:

The Honua'ula Partners, LLC, its successors and permitted assigns, shall prepare a Cultural Resources Preservation Plan ("CRPP"), in consultation with: Na Kupuna O Maui; lineal descendents of the area; other Native Hawaiian groups; the Maui County Cultural Resources Commission; the Maui/Lāna'i Island Burial Council; the Office of Hawaiian Affairs; the State Historic Preservation Division, Department of Land and Natural Resources; the Maui County Council; Na Ala Hele; and all other interested parties. Prior to initiating this consultation process, Honua'ula Partners, LLC, its successors and permitted assigns, shall publish a single public notice in a Maui newspaper and a State-wide newspaper that are published weekly. The CRPP shall consider access to specific sites to be preserved, the manner and method of preservation of sites, the appropriate protocol for visitation to cultural sites, and recognition of public access in accordance with the Constitution of the State of Hawai'i, the Hawai'i Revised Statutes, and other laws, in Kīhei-Mākena Project District 9.

Upon completion of the CRPP, Honua'ula Partners, LLC, its successors and permitted assigns, shall submit the plan to the State Historic Preservation Division, Department of Land and Natural Resources, and the Office of Hawaiian Affairs for review and recommendations prior to Project District Phase II approval. Upon receipt of the above agencies' comments and recommendations, the CRPP shall be forwarded to the Maui County Cultural Resources Commission for its review and adoption prior to Project District Phase II approval.

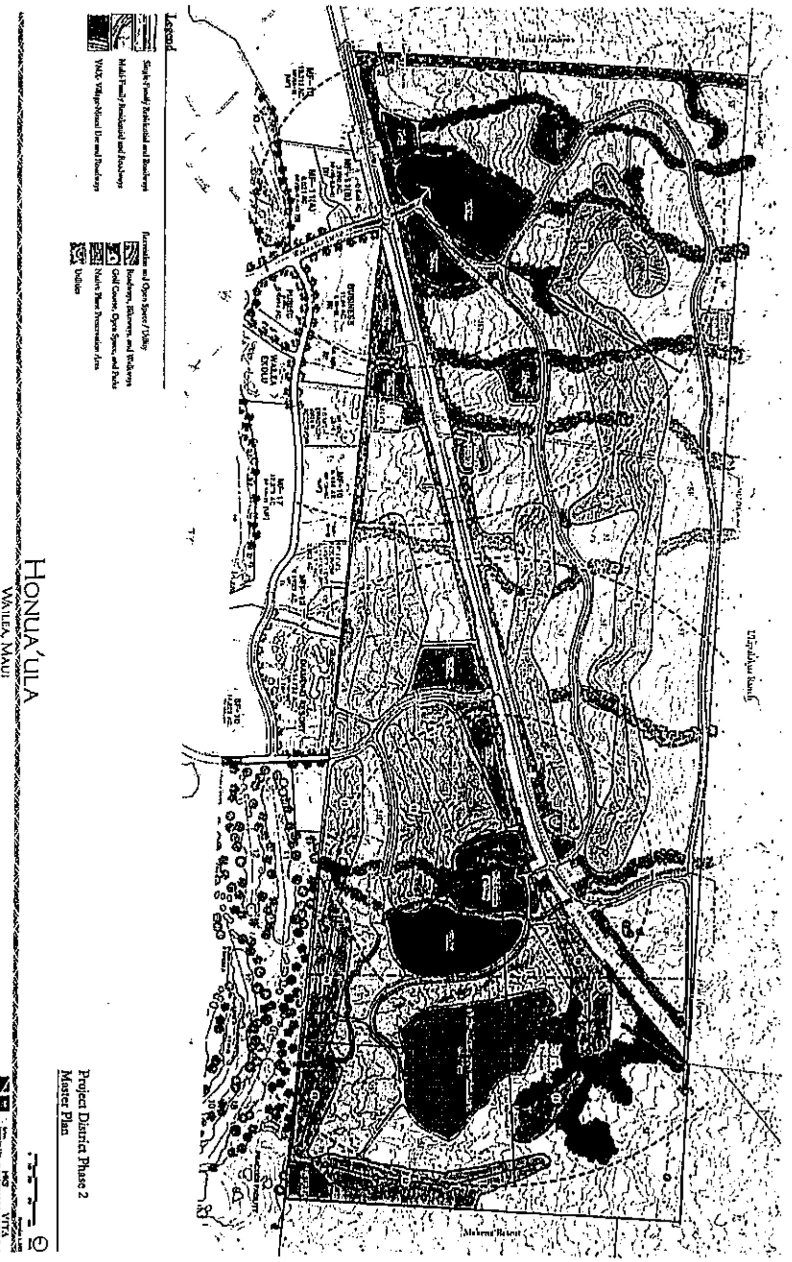


Figure 3 Conceptual Master Plan

Condition No. 26:

That Honua'ula Partners, LLC, its successors and permitted assigns, shall provide a preservation/mitigation plan pursuant to Chapter 6E, Hawai'i Revised Statutes, that has been approved by the State Historic Preservation Division, Department of Land and Natural Resources, and the Office of Hawaiian Affairs prior to Project District Phase II approval.

APPROACH AND METHODS

Pursuant to Conditions No. 13 and No. 26, this Cultural Resources Preservation Plan (CRPP) draws upon and supplements previous archaeological and cultural management efforts undertaken for the project site. The results of additional archaeological research and cultural consultation in accordance with the conditions support the formulation of a comprehensive plan for the preservation and interpretation of cultural resources in the project area.

Plan Objectives

The CRPP seeks to achieve the following objectives:

- *To define cultural parameters that will guide the preservation of archaeological remains and the interpretation of archaeological data.*
- *To document settlement patterns and timelines for the sites*
- *To consult with traditional/cultural practitioners with ties to the Honua'ula region and other interested parties*
- *To foster a more traditional and cultural land use perspective for the project site*
- *To ensure long-term consistency and integrity toward preservation efforts in the project area and the Honua'ula region*

Approach to Plan Formulation

During the course of CRPP formulation, reviews of pertinent archival data and existing literature were undertaken; interested parties were consulted; oral informant interview data was compiled; and the resulting syntheses of archaeological and cultural information were applied to determining the parameters and guidelines for the preservation and management of extant cultural resources within the project area.

Guiding Legislation

This CRPP is prepared in accordance with the requirements set forth by Chapter 6E, Hawai'i Revised Statutes (HRS), the State Historic Preservation Program, and Chapter 13-277, Hawai'i Administrative Rules (HAR), "Rules Governing Requirements for Archaeological Site

Preservation and Development". In order to ensure that all regulatory requirements are satisfied, pursuant to CIZ Condition No. 13 and Condition No. 26, SHPD will review and approve the methodology and recommendations set forth in the CRPP.

Plan Formulation Process

To ensure that all applicable cultural protocols are honored and respected, during the development and finalization of this CRPP, on going consultation with agencies, established cultural authorities, and other interested parties will be carried out. As previously mentioned, the CRPP is being developed in accordance with the consultation requirements defined in Condition No.13.

Phase I: Public Notification

The CRPP formulation process draws upon the input of government agencies and established cultural authorities as well as other interested parties. As required under CIZ Condition No. 13, a formal public notice was published in both the Honolulu Advertiser and the Maui News on January 23, 2009 soliciting the names and addresses of Hawaiian groups and other interested parties wishing to participate in the consultation process for the CRPP. To further promote opportunities for community involvement, a second public notice was also published in these newspapers on February 10, 2009. A public notice was also published in the February edition of the Office of Hawaiian Affairs' Newsletter, *Ka Wai Ola*, first date of issue on February 1, 2009 and the notice was also posted on the OHA online newsletter, *Ka Wai Ola Loa*, on February 19, 2009. Copies of these notices are provided in Appendix "A" of this document.

Phase II: Early Consultation

A consultation list was defined based on the list of agencies identified in Condition No .13 and the requests received in response to the public notices. A set of consultation documents and a questionnaire were distributed to all respondents. A copy of the consultation documents and the list of requestors are provided in Appendix "B". Consultation documents were distributed to the following agencies, community groups, and individuals for review and comment during the consultation phase of the CRPP preparation process.

Public Agencies and Organizations:

- *Members of the Maui County Council*
- *Maui County Cultural Resources Commission (CRC)*
- *DLNR-Na Ala Hele and the State Historic Preservation Division (SHPD)*
- *Na Kupuna O Maui*
- *Office of Hawaiian Affairs (OHA)*
- *The Maui/Lanai Islands Burial Council (MLIBC)*

Community Groups and Organizations:

- *Maui Tomorrow Foundation, Inc.*
- *Maui Unite*
- *Save Makena*
- *Sierra Club Maui Group*

Individuals:

- *Lee Altenberg*
- *Kala Babayan*
- *Dale J. Deneweth*
- *Chisa Dizon*
- *Pam Daoust*
- *Sylvia Clarke Hamilton*
- *Ed Lindsey*
- *Elden Liu*
- *Kehau Lu'uwai*
- *Cody Nemitt*
- *Eric Nielsen*
- *Allen Schipper*
- *Herbert Silva*
- *Janet Six*
- *Katherine Kama'ema'e Smith*
- *Gene Weaver*
- *LaJon Weaver*

All of the comments and the reply letters are included in Appendix "C." Comments received during the consultation phase were evaluated and pertinent sections of this CRPP were prepared incorporating appropriate input. Appendix D summarizes and addresses specific concerns expressed by the respondents.

Phase III: Agency Review and Recommendations

Upon completion of the consultation phase outlined above and the resulting Review Draft CRPP; Condition No. 13 requires the Review Draft CRPP to be submitted to SHPD and OHA for agency review and issuance of recommendations.

Phase IV: Cultural Resources Commission Acceptance

Upon receipt of these recommendations, a Final CRPP will be prepared with any revisions, as warranted. Following approval and concurrence by SHPD and OHA, the Final CRPP shall be submitted to the Department of Planning for final review and adoption by the Cultural Resources Commission.

Scope Of Work

Data and information guiding the development of the CRPP was compiled from a review of archival records, historic documents, previous cultural and archaeological studies, and input received during consultation on the plan. The existing data was supplemented through additional interviews with knowledgeable informants. The results of research and data collection were synthesized to distinguish key archaeological, cultural, and historic resources in the project area, and to subsequently define programs and parameters for the preservation and management of said resources. Specific tasks driving the development of this CRPP are described below.

Archival Research and Literature Review

During the course of the CRPP formulation, various libraries, archives, and other repositories of information were searched and pertinent materials were reviewed. Further reviews of such materials are anticipated to continue through progressive phases of investigation.

Oral Traditions

Oral traditions, such as *mele*, chants and songs, breathe life into the history of the Honua'ula region, as they are representations of the collective perspectives, sentiments, and experiences of the people whose lifestyle and culture were born of this land. A review of *mele* describing the land and environment of the Makena region provides an intimate understanding of the cultural practices and significant sites integral to this landscape. Importantly, these oral traditions embody the cultural context from which the criteria for preservation and management arise. A selected compilation of both traditional and contemporary *mele* and *oli* was undertaken. The texts and translations are interspersed in appropriate sections of this document and audio tracks are presented in the enclosed compact disc.

Early Historical Accounts

The islands and people of Hawai'i have been chronicled in stories and other written documents since travelers first arrived in the archipelago. Dating back to the late 1700s, early historical accounts describe a Hawai'i not yet influenced by foreign language, religion, and ways of life. As foreigners became established in these islands, historical accounts from succeeding points in time document changes in land use and lifestyles. A review of these historic writings permitted the distinguishing of key periods in the settlement of the Honua'ula region, and to subsequently construct a timeline tracing this evolution.

Previous Archaeological Studies

A number of archaeological surveys and investigations have been conducted within various areas of the project area, and include archaeological reconnaissance surveys, inventory surveys, and limited subsurface testing. A summary of the findings of these studies are provided in the CRPP.

This comprehensive review of the existing archaeological literature is intended to provide a basic understanding of the scope and magnitude of settlement patterns in the Honua'ula region, as well as providing one of the important aspects for consultation on how best to preserve significant resources in concert with the development of the proposed Honua'ula Project.

Previous Cultural Studies

Formalized project-area-specific cultural research began in Hawai'i relatively recently. The assessment of the potential adverse impact of specific development upon traditional culture and cultural practices did not materialize as a regulatory requirement until the latter part of the twentieth century. A Cultural Impact Assessment (CIA) was completed for the project site in January 2008 by one of the project's cultural advisors, Hana Pono, LLC. The histories, oral traditions, and the informant interviews enhance the depth of information upon which the CRPP is founded.

Cultural Informant Interviews

Often the interpretation of traditional practices and other aspects of a region require persons with long-term familiarity with the area. Individuals with family history and genealogical ties to the land are valuable and scarce resources today, since many elders have already passed away. There exist three types of sources from which information pertinent to a subject area can be obtained:

Old Interviews

There are a few repositories in Hawai'i, including the Bishop Museum and the University of Hawaii, that archive audio recordings of oral informant interviews that were conducted several decades ago, corresponding transcripts, and video recordings of more recent interviews. Scheduling and personnel shortages prevented searches of these repositories prior to the completion of this CRPP. However; these resources will be examined with special emphasis on the audio archives of the Bishop Museum for pertinent older interviews.

Existing Transcripts

The CIA conducted for the project area provided important interview data. The informants interviewed included both long-time residents of the area and individuals with genealogical ties to

the land, the majority of whom were of native Hawaiian descent. Summaries of the interview are included in the CRPP to interpret the experiences and memories of the interviewees as they relate to the land and history of the Honua'ula area. When appropriate, follow-up interviews may be pursued in the future.

New Interviews

In the interest of expanding the knowledge acquired through the interview process, additional interviews with key individuals were undertaken during the course of the current CRPP formulation process. The results provide additional insight into the cultural history of the Honua'ula region.

Synthesis of Archaeological and Cultural Information

As described above, the CRPP provides comprehensive analysis of the history and culture of the Honua'ula region using a variety of sources, including archival records, historical documents, archaeological studies, and cultural informant interviews. The synthesis of existing archival and historical data, cultural studies, and oral accounts serves as the cultural and historical backdrop for the region, providing a context for the understanding of settlement patterns and traditional practices associated with the project area.

Assessment of Preservation and Mitigation Measures

The CRPP provides strategies designed to preserve extant cultural resources located within the project area for both current and future generations. All recommendations and implementation of recommended measures shall be in keeping with pertinent historic preservation mandates.

Project Team

This CRPP is the product of collaboration among three (3) entities; Aki Sinoto Consulting for the archaeological component; Hana Pono, LLC for the cultural component; and Munekiyo & Hiraga, Inc. for summarizing the recent regulatory history of the property, production, and project coordination. PBR Hawaii, Inc. and VITA Planning and Landscape Architecture provided the conceptual plans and preservation buffer detail renderings for preservation sites. Eugene Dashiell, AICP provided post-processing of GPS data and produced GIS maps of the project area.

ARCHAEOLOGICAL SUMMARY

A summary of the available archaeological data is presented in this section, starting from the previous phases of work undertaken within the project area for former owners and also for objectives not directly associated with the development of the parcel. Then a summary of the extant sites is presented, followed by a brief synthesis of the available data.

Island-wide Studies

For Maui Island, there are three references that can be considered to form the basis for the archaeological investigations that followed. The seminal work is the 1931 survey by Winslow Walker that focused on prominent sites throughout Maui. In Honua`ula *moku* his survey documented 10 coastal heiau, four upland heiau, a number of fishing shrines (*ko`a*), a coastal village, and two fishponds. Sterling continued where Walker left off and undertook extensive surface surveys in various regions of Maui and collected valuable first-hand information from native Hawaiian *kupuna* that lived in the regions. Although Sterling's data was not published until 1998, the represented body of her work spanned a decade of research between 1960 and 1970. The third was the Maui Island component of the Statewide Inventory of Historic Places that took place during 1972-1973 under the auspices of the State of Hawaii, and completed an inventory of known sites on the island. The conditions and dispositions of sites previously recorded by Walker and Sterling were evaluated in the field by a team of archaeologists from the Bishop Museum accompanied by *kupuna* Charles Keau. Recommendations of nominations and eligibility to the Hawaii and National Registers of Historic Places were made and established the foundation for modern historic preservation initiatives on Maui and in the State of Hawaii. Although implementation did not take place until the mid-1980s, this undertaking also paved the way for establishing a computerized database of archaeological and historic records.

Previous Studies

In 1972, an archaeological survey for the right-of-way corridor for the proposed Pi`ilani Highway Extension project was conducted for the State Department of Transportation. The sites recorded were included in the Statewide Inventory database. In 1993, construction of a gravel haul road for the Wailea Resort Company prompted an inventory survey and monitoring procedures along the southern boundary of the current project area. Prior to 1998, the project area was under different ownership and two surveys were undertaken in conjunction with the previous development initiative.

Previous Archaeology within the Project Area

Four surveys have previously been conducted within the Honua`ula development area; two for the previously proposed Wailea 670 development, one for the proposed Pi`ilani Highway extension project, and one other for a cinder haul road paralleling the southern boundary (Fig. 4).

The earliest, conducted by the State archaeologist and completed in 1972, included a segment of the right-of-way easement corridor for the proposed Pi`ilani Highway extension in the 30-acre exclusion within the subject area (Walton 1972). Seven sites were recorded in the right-of-way corridor, all within the southern third of the project area. They are; Site 200, the large freestanding wall that forms the northern boundary of the southern third of the project area; Site 201, a complex of structural features; Site 202; a connected series of deteriorated walls near the northern boundary; Site 203, a deteriorated C-shaped enclosure; Site 204, two small platforms built against a bedrock ledge; Site 205; an enclosed overhang shelter; and Site 211, a single alignment of aa boulders constructed along the base of a rocky ridge. All of these sites were recommended for avoidance with no further work. Walton recommended data recovery for Site 201 if avoidance was unfeasible and preservation with public interpretation for Sites 204 and 205.

Seven years after Walton's work, the first survey to encompass the whole Wailea 670 project area was completed. The reconnaissance survey, completed in one day, did not locate any archaeological remains and failed to relocate Walton's sites, all of which were assumed to have been destroyed during the bulldozing of jeep roads (Hammatt 1979). Based on the purported absence of sites, archaeological "clearance" of the whole area was recommended without any further work including monitoring during construction. The large wall (Walton's Site 200) at the northern boundary of the 190-acre southern third of the project area was apparently mistaken as the southern project boundary, thus the southern third of the proposed development area was inadvertently left out of Hammatt's investigation.

The ensuing survey of the Wailea 670 property took place 9 years after Hammett's incomplete reconnaissance. This seven-day surface survey, which reportedly covered the whole area, both on foot and in a 4WD vehicle, also failed to relocate any of Walton's sites or record any new sites (Kennedy 1988). The report concluded that the bulldozing of the highway centerline had destroyed all of Walton's sites. Since no sites were located, no further work was recommended.

The survey for the cinder haul road, conducted in 1993, covered a corridor paralleling the southern boundary of the development area. Three new sites, a C-shaped enclosure (Site 3156) and two segments of free-standing walls (Sites 3157 and 3158), were recorded. Subsurface testing of the floor deposit of the C-shaped enclosure produced negative results. No further work and avoidance of these sites were recommended with monitoring of limited breaching of the walls for the cinder haul road (Sinoto and Pantaleo 1993).

Phases of Archaeological Work in the Honua`ula Development Area

Commencing in April 2000, archaeological inventory procedures were undertaken within the 190-acre southern portion of the Honua`ula project area. The results of this study were reported in May 2000 and the final revision was completed in October 2000 (Sinoto and Pantaleo). Following this initial report, after re-evaluating the previous work by Hammatt and Kennedy, the State Historic Preservation Division (SHPD) concluded that the negative findings may have resulted from inadequate fieldwork and an inventory survey of the northern two-thirds of the Honua'ula project area was recommended. At the same time SHPD requested additional walk-through transects to be completed within the 190-acre inventory survey area. The addendum survey addressing these concerns was completed during March through May 2001 and reported in June 2001 (Sinoto and Pantaleo). Only one site, an unmodified, natural overhang shelter (Site 29 / Site 50-50-14-5110) was found in a gulch within the northern two-thirds of the Honua'ula project area. The northern area was found to have undergone compounded extensive disturbances through historic and recent ranching activities and possibly some military activities during WWII. Within the southern third however, a total of 27 archaeological sites comprised of 43 component features were recorded during the course of the two surveys. In October of 2003, a GPS point survey was conducted in which all, but one of the sites recommended for *in situ* preservation was located. More transects sweeps were conducted during dry periods when ground cover vegetation was minimal. A total of 13 additional archaeological sites comprised of 17 component features were recorded during these subsequent procedures in the project area (Sinoto and Pantaleo 2008). Only one single-feature site is represented in the northern two-thirds of the project area, the remaining sites and features all occur within the southern third.

Extant Archaeological Sites and Features

A total of 40 sites comprised of 60 component features have been recorded within the project area. The northern section contains only 1 single feature site (Fig. 5). In the southern section, a total of 39 sites comprised of 59 component features have been recorded (Fig. 6). The extant sites range in type from small, isolated, single-feature sites to multiple-feature clusters and complexes with relatively prominent structural features. No burials or human remains have been found. Table 1 presents a summary of all of the sites in the proposed Honua`ula development area.

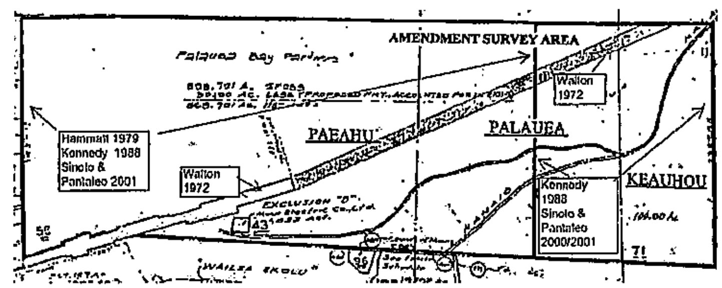


Figure 4. Map Showing Area Covered by Previous Investigations

Settlement Pattern Inferences Based on Previous Research

Researchers such as Kirch (1974) have asserted that later prehistoric expansion on Maui led to the occupation of harsher or more ecologically marginal regions. Chapman and Kirch (1979) proposed that a pattern of transience existed between coastal and inland areas. Inhabitants of the upland agricultural region may have utilized the coastal shelters as temporary or seasonal bases for expanding the range of resource exploitation. Trails linked these permanent upland habitation areas to coastal areas. Cleghorn (1975) suggested dual permanent settlement in both coastal and inland areas of Keauhou. Temporary habitation sites, located along trails linking upland and coastal settlements were used by travelers from upland residences to the coast in order to exploit the seasonal marine resources.

Sinoto (1978) and Gosser er al. (1997) argued that the presence of localized, environmentally favorable zones, such as areas with more rainfall, influenced permanent occupation and the types of activities that took place. In fact, for Wailea, the area immediately west of the Honua'ula Development area, only 20% of the sites recorded within a 187-acre project area was considered to have some agricultural function. These primarily consisted of mounds for sweet potato cultivation, but the low frequency led Gosser to conclude that agriculture in Wailea, "was not a primary pursuit" (Gosser et al.1993:248).

Table 1. Archaeological Sites in the Honua'ula Development Area

No.	Type	Feats.	*ahupua'a*	Period	Recorded	SIHP*	Signif.	Pres.	Data Rec.	NFW
1	wall	1	Palauea	historic?	1971	200	C,D	X		
2	complex	5	"	traditional?	"	201	A,D	X		
3	platform	2	"	"	"	204	D	X		
4	mod OH	1	"	"	"	205	"	X		
5	C-shape	1	Keauhou	"	1993	3156	nls			X
6	wall	1	"	historic?	"	3157	nls			X
7	"	1	"	"	"	3158	nls			X
8	U-shape	1	"	traditional?	2000	4945	D		X	
9	C-shape	1	"	"	"	4946	"		X	
10	mod OH	1	"	"	"	4947	"		X	
11	open area	1	"	historic?	"	4948	"		X	
12	mod OH	2	"	traditional?	"	4949	"		X	
13	C-shape	1	"	"	"	4950	"		X	
14	SS trail	1	Palauea	"	"	4951	C,D,E	X		
15	platform	1	"	"	"	4952	D	X		
16	walls	3	"	historic?	"	4953	nls			X
17	C-shape	1	"	traditional?	"	4954	D		X	
18	mod OH	1	"	"	"	4955	"		X	
19	"	2	Keauhou	"	"	4956	"		X	
20	complex	6	Palauea	"	"	4957	A,D	X		
21	enclosures	2	"	"	"	4958	D		X	
22	SS trail/pits	3	"	"	"	4959	C,D,E	X		
23	platform	1	Keauhou	"	"	4960	D		X	
24	wall seg.	1	"	historic?	"	4961	nls			X
25	lava blister	1	Palauea	traditional?	2001	5110	D		X	
26	platform	1	Keauhou	"	"	5111	"	X		
27	platform	1	Palauea	"	"	5112	"	X		
28	cluster	2	"	"	2003	na	"		X	
**29	OH	1	Paeahu	"	2001	5109	nls	X		
30	C-shape	1	Palauea	"	2008	na	D		X	
31	platform	1	"	"	"	"	"		X	
32	trail	1	Keauhou	"	"	"	"	X		
33	cluster	2	Palauea	"	"	"	"	X		
34	OH	1	"	"	"	"	"		X	
35	platform	1	"	"	"	"	"	X		
36	lava tube	1	Keauhou	"	"	"	"	X		
37	wall mod	1	"	historic?	"	"	nls			X
38	outcrop	1	Palauea	traditional?	"	"	D		X	
39	OH	1	"	"	"	"	"		X	
40	walls	2	"	historic?	"	"	nls			X
Totals		60						15	18	7

* State Inventory of Historic Places number (prefixed by 50-50-14-)
** Only site in the northern section

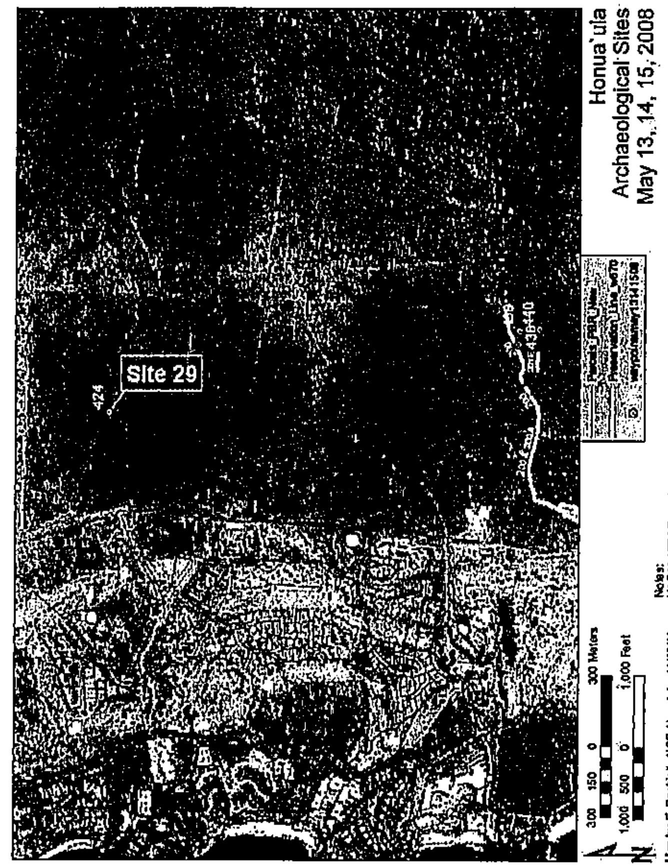


Figure 5. Location of Site 29 the Only Site in the Northern Section of the Project Area

Figure 6. Locations of 39 Sites in the Southern Section of Project Area

This pattern of only a few agricultural sites and features in Wailea contrasts strongly with Makena, the neighboring area to the south which exhibits the highest density of agricultural features with 70% of the recorded sites containing at least one agricultural feature. This difference in settlement pattern is attributed not only to environmental, but also political factors. The following conclusion is drawn by Gosser et al.:

> Settlement pattern data indicate that Makena differs in two aspects from the rest of the region: 1) settlement in the Makena region is denser with less indication of *ahupua`a* bounded settlement than areas to the north, and 2) land division in the Makena area is subdivided into land units below the *ahupua`a*-level (possibly *`ili*) while the area to the north is not dissected. Denser settlement may equate to greater population density, while land subdivision indicates older established communities (1997:437).

Following a review of previous reports completed to the year 2000, Haun compiled a listing of minimally 77 permanent habitation features, 192 temporary habitation features, 282 agricultural features, 8 human burials, 23 ritual features, and 11 trail segments in coastal Honua`ula from Keauhou to Onau *ahupua`a*.

Based on work undertaken in Wailea, Gosser et al. (1993) noted a strong *ahupua`a* constrained site distribution along the coastal areas between Paeahu and Papa`anui. Additionally, the coastal settlement of Palauea and Keauhou *ahupua`a* appeared to indicate that the earliest sites were permanent residential units and other structural features that may have had religious or ceremonial functions. In both Keauhou and Palauea, these site types occur near the central portions of the *ahupua`a*. In Keauhou, a site complex that extends from the coast to approximately 300 m inland (40-80ft. elevation) consists of four to six *kauhale* (residential compound), a *mua* (or men's house), a *heiau*, and a *ko`a* (fishing shrine).

Late prehistoric/early historic settlement in Palauea and Keauhou was characterized by permanent habitation along the coast and limited agricultural expansion into harsher, more ecologically marginal regions (Kirch 1977). Sites over a quarter-mile inland continued to be temporary habitation and agriculture, although scattered permanent habitation extended as far as a half-mile inland in certain localities (Schilt 1988). The presence of earlier permanent settlements on the coast has been recently discovered as well (Donham 1986 and Fredericksen 1999).

According to Cordy (1978), where the 30-inch rainfall zone exceeded distances of 6 to 7 miles inland, dual permanent settlement occurred. If it was less than 6 miles inland, permanent settlement would primarily be coastal. In the current study area, 30-inch rainfall occurs beyond 6 miles inland, thus suggesting permanent settlement both on the coast and further inland. The project area, situated between ca 300-700-foot elevations, represents the intermediate zone, traditionally considered by researchers primarily as a zone of transit between the coastal and inland areas during the prehistoric period and increasing agriculture-related permanent occupation during the early historic period.

In Paeahu, the regional pattern of habitation on the coast below the 150-200-foot elevations and at higher elevations above 3000 feet in areas with more rainfall appears applicable. The intermediate zone that lies between these two permanent settlement areas exhibits a much lower density of sites and smaller site type variation. Only marginal structural features such as modified outcrops, rock shelters, and stone mounds are common to this intermediate zone.

The foregoing pattern of occupation, in the general region of the project area, is applicable to the prehistoric and early historic patterns of traditional occupation. By the 1800s, with the advent of cattle and commercial agricultural enterprises; the introduction of the western concept of private ownership of land; together with the development of cart paths, roadways, and harbors; the traditional occupation pattern underwent major changes throughout this region as well as island-wide.

Current Insights on the Regional Settlement Pattern

As amply demonstrated by the preceding review of previous hypotheses regarding the nature of *mauka/makai* settlement, the prevailing conventional archaeological interpretation regarding the prehistoric settlement of this region has, until recently, held to two generalizations regarding the patterns of human occupation. One consisting of seasonal satellite settlements occurring along the coastal areas to exploit the marine resources, while permanent settlements occupied the upland areas to utilize forest products and cultivate agricultural resources in a more favorable climatic zone. The second consisting of permanent settlements in both the coastal and inland areas given certain environmental conditions. In both patterns, the area between the two activity loci, termed the "intermediate zone" was considered an area of transience represented by trails and exhibiting only a low number of marginal, temporary site types.

The progressive broadening of the archaeological knowledge base over the past two decades has shown that the conventional settlement pattern is applicable to some areas (*ahupua`a)*, but not to the whole Honua`ula region. The traditionally held generalization that the "intermediate zone" was barren, used only during transit between the inland and coastal areas, and lacked any

consequential occupation until the late prehistoric or historic periods, has been refuted by the results of investigations in the Wailea and Makena areas. Recent studies in the intermediate zone (Gosser et al. 1993 & 1997, Sinoto & Pantaleo 2008) highlight the importance of the intermediate zone in specific areas of the region and the wide range of site types representing various activities engaged in by the inhabitants of this zone.

As the foregoing discussion indicates, the interpretation of the human occupation of an extensive region such as Honua`ula cannot be generalized to any all-encompassing pattern. Each traditional land unit, the *ahupua`a*, needs to be first analyzed on the basis of its discrete characteristics. Only then can the nature of human occupation for the whole region be meaningfully interpreted and this can only be accurately undertaken with the availability of a broad knowledge base. The current availability of the necessary information permits such interpretations to be made only within the northern half of the vast Honua`ula region, where the majority of development-related investigations to date have taken place.

The current Honua`ula Project area occurs wholly within the intermediate zone, but exhibits two, rather disparate, environmental characteristics between the northern two-thirds and the southern third. The northern two-thirds of the Property, including portions of Paeahu and Paluea *ahupua`a*, exhibits an "intermediate zone" largely devoid of sites, dissected by dry gulches, and with seemingly more arid environmental conditions relative to the areas to the south. Thus, in the northern section of the Property, the major human activities appear to have been taking place in the inland and coastal settlements, with the "intermediate zone" primarily an area of transit between the two loci.

The southern third of the Property consisting of portions of Palauea and Keauhou *ahupua`a* with aa flows, a more undulating terrain, and cover vegetation indicative of less arid conditions; exhibit remains of a more diverse human occupation. In contrast with the northern section, the majority of the recorded sites occur within the southern section. Although further work, such as age determinations for specific sites are needed to make conclusive temporal interpretations (prehistoric or historic) of the occupation, the frequency of more prominent site types reflect permanent or seasonal recurrent occupation within the southern section.

During the historic period, permanent settlements in both the inland and coastal areas concentrated along the cart paths and roadways and the strong intra-*ahupua'a* based relationships declined as the movement of people and goods shifted to one that laterally cut across traditional land (*ahupua'a* and *moku*) boundaries. This shift in the settlement pattern reflected the cultural transition from a traditional subsistence economy to an introduced market economy that made the inhabitants progressively more dependent on imported goods and affected by global economic trends.

Unique Aspects of the Project Area

The project area includes portions of three *ahupua`a*; Paeahu, Palauea, and Keauhou, from north to south. The majority of the northern two-thirds occupies a section of Paeahu *ahupua`a* and roughly half of the width of a section of Palauea *ahupua`a*. This portion of the project area consists of undulating grass-lands with areas of exposed weathered bedrock outcrops and a few knolls. The area is also dissected by several gulches cut by intermittent streams. Only one site was recorded in all of the northern two-thirds of the project area and although there is ample evidence that the area had previously undergone compounded extensive disturbances, the paucity of archaeological remains is remarkable especially when compared to the southern third. The southern one-third consists of the remaining half of the width of a section of Palauea *ahupua`a* and a portion of Keauhou *ahupua`a*. This portion of the project area consists of large areas of aa flows with intermittent older pahoehoe flow ridges and there is much more vegetation cover in comparison to the northern portion. Due to the rough terrain, it appears that the earlier historic ranching activities attempted to keep the cattle out of this southern area and did not encroach south of the large wall (Site1/200) until a later phase of the ranching activities. Ninety-seven and a half percent (97.5 %) of the recorded sites occur within the southern one-third of the project area. Also, the presence of two sites representing feature complexes with some prominent structural features and the presence of 7 platform sites are relatively uncommon for the intermediate zone.

The 40 sites are distributed within the three *ahupua`a* thus; Paeahu-1, Palauea-23, and Keauhou-16. The two complexes and the majority of the platform sites are located in Palauea *ahupua`a*. The fact that the full width of only Palauea *ahupua`a* is represented in the project area may be one of the important considerations when comparing the number and assemblage of sites among the three *ahupua`a*.

Preliminary Site Chronology

No subsurface testing was previously undertaken in any of the previously recorded sites in the project area. Due to the lack of chronometric data from the project area and a marked scarcity from previously investigated sites occupying similar elevations in neighboring areas, the age of

the extant sites in the project area remains unclear. A date range of A.D. 1327-1889 obtained from three sites in the North Course of the neighboring Maui Prince Golf Course (Gosser et al. 2002:349) to the south and a date range of A.D. 1280 to 1650 from three lower elevation sites in the Wailea Golf Course (Gosser et al. 1993:258-259) to the west represent the closest dated sites to the subject area. Since similar age ranges occur from sites in the coastal areas, corresponding chronological ranges of A.D. 1300-1500 as early and A.D. 1600-1800 as late, may be tentatively postulated for the occupation of the subject area. The later prehistoric and proto-historic date ranges also suggest that the occupation may have continued into the historic period at certain sites.

Due to the absence of dated sites from the project area, the absolute ages of the sites are still unknown. However, based on the site type or the presence/absence of diagnostic artifacts, the relative periods of origin for the sites can be inferred. For instance, the walls can be attributed to historic ranching period, while the other features such as platforms and overhang shelters can be associated with the prehistoric period. Of the 40 total sites recorded, 32 can be categorized as traditional-type sites and 8 as historic sites. Table 2 below presents this breakdown by site type.

Limitation of Available Data

The foregoing regional site distribution and settlement pattern analyses are based on data primarily compiled from the various development driven studies undertaken in the subject region over the last three decades. There exists a marked paucity of data from inland areas beyond the upper limits of the current project. An exception may be the survey of two Hawaiian Home Lands subdivisions in Waiohuli and Keokea *ahupua`a* in the neighboring Wailuku District north of Paeahu *ahupua`a* around the 2000-foot elevation. A large complex of permanent habitation, intensive agricultural complexes, and a number of large ceremonial sites have been recorded. A similar demography of permanent occupation sites would be expected in the upper elevations of the current project *ahupua`a* as well. The vast majority of recent work has taken place within the coastal areas between sea level and up to around the 200 to 300-foot elevation from Paeahu to around Kanahena *ahupua`a*. This is graphically depicted by the GIS printout from the SHPD database (Fig. 7) on which the majority of the upper elevation sites are those recorded by Walker in the 1930s. Not much recent work has taken place further south.

In the northern part of the Honua`ula region, the Wailea development area, comprising multiple owners, encompasses the area between Paeahu and Keauhou *ahupua`a* from sea level to around the 300-foot elevation. The current project reaches furthest inland to just below the 700-foot elevation. In the neighboring Makena development area from Keauhou to Mo'oloa *ahupua'a*, the multiple ownership area; comprised largely of high-end, single-family, beach front, residential developments; rarely exceeds the 40 to 80-foot elevations. Inland of the main roadways, Makena Alanui and the Makena Keone'o'io Road between Keauhou *ahupua'a* on the north to Mo'omuku *ahupua'a* on the south and up to a maximum elevation of 1,200 feet in Papa'anui and Ka'eo *ahupua'a*; the expansive 1,832.4-acre area has been under a single owner for the past three decades with existing developed areas encompassing less than a third of the total acreage. Further south, single family residential projects continue along the shore to the Kanahena and Ahihi areas. The southernmost increment from Keone'o'io in Kalihi *ahupua'a* to Kanaio *ahupua'a*, without vehicular access along the coast, is devoid of development. The vast majority of the inland areas of the region is owned by Ulupalakua Ranch.

Table 2. Site Type Frequencies

Site Types	
Traditional Type	**Number**
cluster	2
complex	2
C-shape	5
enclosure	1
lava blister	1
lava tube	1
mod OH	5
mod outcrop	1
OH	3
pits	0.5*
platform	7
SS trail	2.5*
U-shape	1
total	32
Historic Type	**Number**
open area	1
wall	7
total	8
Total	40

**the pits and one of the trail segments occur together and are counted as 1 site*

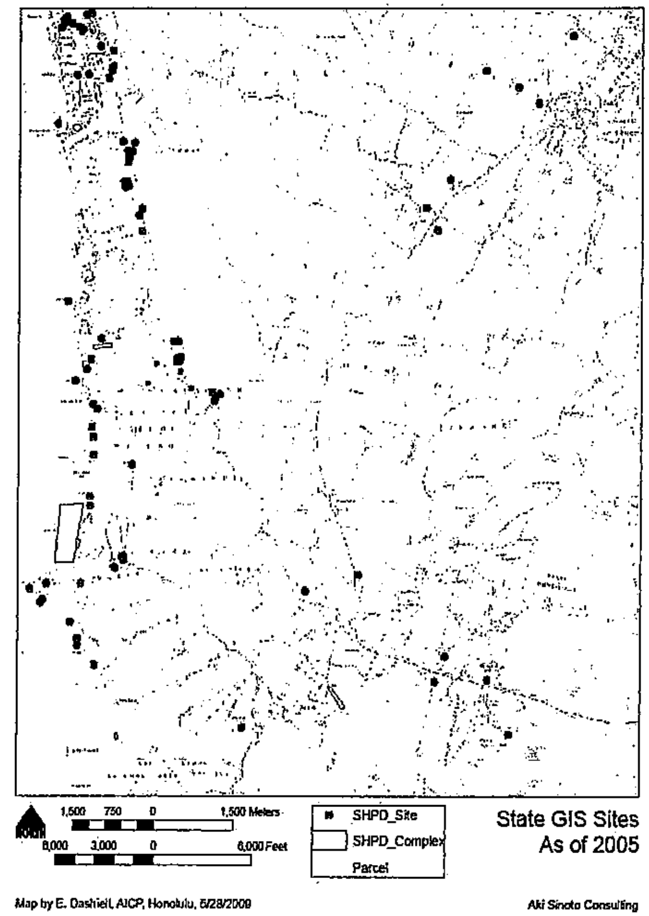


Figure 7. Distribution of Sites in the SHPD Database as of 2005

CULTURAL IMPACT STUDY

A Cultural Impact Assessment, prepared by Hana Pono (Kapahulehua and Tau'a 2008) included oral traditions, informant interviews, and information regarding the current status of traditional practices in the vicinity of the project area.

Description of Region

The Honua'ula District was one of twelve ancient *moku* or districts of Maui Island. The literal meaning of the name is "red earth" or "red land," which may have been in reference to the distinctive red dust of Haleakala (Handy et al. 1991:44). There are a number of alternative explanations for the name. In the Cultural Impact Study for Honua'ula, Tau'a and Kapahulehua state that the name connotes sacred earth based on the sacredness of the color red (2008:3). Sterling in *Sites of Maui* includes the following account, by Fornander, of the chief, Moikeha, who brought back companions from his voyage to Tahiti:

> "His canoes were equipped forthwith under the superintendence of Kamahualele, his astrologer and seer (Kilokilo), and with a goodly company of chiefs, retainers, and relatives, they set sail for Hawaii...The legends differ somewhat to the names of the followers of Moikeha, but they all agree that a number of places in the Hawaiian group were named after such or such companions of Moikeha, who were permitted to land here and there as the fleet coasted along the island shores, and who succeeded in establishing themselves where they landed. Thus were named the district of Honuaula on Maui (1998:214)."

Two traditional Hawaiian sayings regarding Honua'ula recorded by Mary Kawena Pukui in *'Olelo No'eau, Hawaiian Proverbs and Poetical Sayings* speak of the wind of the region (1983:113, No. 1058) and describe the character of the inhabitants (No. 1059) as given below:

> *Honua'ula, e paluku 'ia ana na kihi po'ohiwi e na 'ale o ka Moa'e*
> Honua'ula whose shoulders are pummeled by the Moa'e wind
> (A poetical expression for a person being buffeted by the wind. Honua'ula, Maui, is a windy place.)
>
> *Honua'ula kua la'ola'o*
> Callous-backed Honua'ula
> (Said of the people of Honua'ula, Maui, who were hard workers. The loads they carried often caused callouses on their backs.)

In the years following the Great Mahele in 1848, various configurations of these twelve districts were implemented and revised. In 1901 and 1932, the current district divisions with Honua'ula subsumed into Makawao was established. Of these boundary modifications, R. D. King, in Sterling, stated:

> "Since the advent of legislative government, or from about 1846, many modifications have been made of the ancient district boundaries and there are

O Wākea iā Papa Hānau Moku
Traditional

In the "Hawaiian Antiquities" by David Malo (1951:243) we find the short version of the Kumulipo.

O Wākea noho iā Papahānau moku	Wākea (Sky Father) lived with Papa (Earth Mother)
Hānau o Hawai'i he moku	Born was Hawai'i an island
Hānau o Maui he moku	Born was Maui an island
Ho'i hou o Wākea noho 'ia Ho'ohōkūkalani	Wākea returned to live with Ho'ohōkūkalani
Hānau o Moloka'i he moku	Born was Moloka'i an island
Hānau o Lāna'i ka ula he moku	Born was Lāna'i the red island
Lili-opu-punalua o Papa iā Ho'ohōkūkalani	Jealous anger flowed with Papa
Ho'i hou o Papa noho iā Wākea	Papa returned to live with Wākea
Hānau o O'ahu he moku	Born was O'ahu an island
Hānau o Kaua'i he moku	Born was Kaua'i an island
Hānau o Ni'ihau he moku	Born was Ni'ihau an island
He ula a o Kaho'olawe	Lastly born a red island was Kaho'olawe

E Kini o ke 'kua
Traditional; From: *Na Pule Kahiko:Ancient Hawaiian Prayers* (Gutmanis 1983:13).

"Wherever man walks, there too the gods can be found. Not just the four great gods or the four hundred mighty gods but also the four thousand and the four hundred thousand, who all together are called the *kini akua*. As the names of many of these gods are sometimes forgotten, and to avoid offending a god that might have an interest in one's affairs, even if unknown, prayers and offerings are directed to the *kini akua*. The following prayer is for all the gods."

E kini o ka 'kua	Ye forty thousand gods
E ka lehu o ke 'kua	Ye four hundred thousand gods,
E ka lālani o ke 'kua,	Ye rows of gods,
E ka pukui akua,	Ye collection of gods
E ka mano o ke 'kua,	Ye four thousand gods,
E kaikua'ana o ke 'kua,	Ye older brothers of the gods,
E ke 'kua muki,	Ye gods that smack your lips,
E ke 'kua hawanawana,	Ye gods that whisper,
E ke 'kua kia'i o ka pō,	Ye gods that watch by night,
E ke 'kua alaala o ke aumoe,	Ye gods that show your gleaming eyes by night,
E iho, e ala, e 'oni, e 'eu,	Come down, awake, make a move, stir yourselves,
Eia ka mea 'ai 'oukou la, he hale.	Here is your food, a house.

Ka Mo`olelo o Mō`ikeha
The Story of Mo`ikeha

Mahele I
`O Māweke ka hāku
`O Muli`eleali`iaMāweke ka makuakāne, a `o Wehelani ka makuahine
Hānau `ia mai `o Kumuhonua
Hānau `ia mai `o `Olopana
Hānau `ia mai `o Mō`ikeha nona ka mo`olelo nei
He ali`i puni le`ale`a `o ia, noho ma Tahiti
He pua ali`i mai Kapa`ahu, mai Moa`ulanuiākea Kanaloa

`Āpiki `ia ke kaiko`eke, ka punalua `o Lu`ukia e Mua
Komo `o ia i ka pā`ū kapa `ia `o Lu`unāko`aikamoana
Hūnā `ia ka piko o ka `aha, `a`ohe hemo
Mū wale nō
Koi `o Mō`ikeha, mū wale nō.
No kona na`au`auā, ha`alele ke ali`i, holo i Hawai`i
`E`e, kau i ka wa`a, holo i Hawai`i

_`Ī akula `o ia,_
"Nalo kaupoku o ku`u hale `o Lanikeha nei lā
A laila pau ka manao `ana lā Tahiti."

Section I
Maweke is the ancestor
Mule`ileali`iMāweke is the father, Wehelani is the mother.
Born was Kumuhonua
Born was `Olopana
Born was Mō`ikeha for whom this story is for.
He was a chief delighting in sport and pleasure, he lived in Tahiti. A royal scion of Kapa`ahu, from Moa`ulanuiākea Kanaloa.

His sister-in-law, `Olopana's wife, Lu`ukia, was tricked by Mua. She put on the skirt called Lu`unāko`aikamoana. The beginning of this chastity belt was hidden, no way of opening it. She sat sullenly without speaking. Mō`ikeha urged her to speak, yet she sat sullenly. For this grief the chief left, he sailed to Hawai`i. He boarded and got into his canoe and sailed to Hawai`i.

He said, "When the rooftop of my palace called Lanikeha is gone from sight then shall I know that I'm far from Tahiti."

Mahele II
Pae lākou i Kalae, ma Ka`ū
Noho `o Moa`ula i laila ma Punalu`u
Ma Punalu`u o Kuapu`u, ma ka `ao`ao o Paliluka
Ma ka wai hū ō Kaulia, ma nā wai mānalo o Moa`ula
Ma kēia `āina kaulana i ka lū`au me ka mai`a `a`ala o Kopu `o Moa`ula i noho ai.

Noke lākou a puni ka moku
Kū lākou, Mahalo lā Hilo
Kū mai `o Kamahu`alele, kūkala lā Hilo:

Noi `o Kumukahi lāua `o Ha`eha`e
"E Ku`u lani ē, e Mō`ikeha
Na māua kēia `āina e noho ai"
Ho`onoho `ia lāua e ke ali`i
Noke `o Mō`ikeha mā i kapakai `ākau
Hiki ma Kōhala

Noi ke kahuna `o Mo`okini
Noi `o Kaluawilinau
"E ku`u lani ē, e Mō`ikeha
Na māua kēia `āina e noho ai"
Ho`onoho `ia lāua e ke ali`i

Section II
They all landed in Kalae at Ka`ū
There Moa`ula stayed, at Punalu`u
At Punalu`u at Kuapu`u on the side of Paliluka. At the bubbling waters of Kaulia, at the fresh waters of Moa`ula. At the land famous for its lū`au and fragrant banana of Kopu is where Moa`ula stayed.
So they continued to circuit the island.
They all stood and admired Hilo
Kamahu`alele stood and proclaimed the following:

Kumukahi and Ha`eha`e request of him
"Oh heavenly one, oh Mō`ikeha
We would like this land to live upon."
So they were settled there by the chief
Mō`ikeha continued on to the northern coast.
They arrived at Kōhala.

The kahuna, Mo`okini, requested
Kaluawilinau also requested
"O heavenly one, oh Mō`ikeha
We would like this land for the two of us to live upon. And so they were so settled.

Cont'd

Mahele III
"Eia Hawai`i, he moku, he kanaka, he kanaka Hawai`i Ē
He Kanaka Hawai`i, he kama na Tahiti, he pua ali`i mai Kapa`ahu.
Mai Moa`ulanuiākea Kanaloa, he mo`opuna na Kahiko lāua `o Kapulanakēhau
Na Papa i hānau
Na ke kamali`i wahine a Kūkalaniehu lāua `o Kahakauakoko.
Nā pulapula `āina i Paekahi
I nonoho like i ka hikina, komohana
Pae like ka moku i Lālani
I hui aku, hui mai me Hōlani."

Section III
"Here is Hawai`i, an island, a man Hawai`i is a man; a man is Hawai`i. A child of Tahiti. A royal flower from Kapa`ahu. From Moa`ulanuiākea Kanaloa.
A grandchild of Kahiko and Kapulanakēhau.
It was Papa who begat him.
The daughter of Kukalaniehu and Kahakauakoko.
The scattered islands are in a row.
Placed evenly from east to west
Spread evenly is the land in a row
And joined on to Hōlani.. "

Mahele IV
Ha`alele `iā Kōhala, holo malila ma ka `ao`ao hikina o Maui
A hiki i Hāna
Makemake a`e la kekahi mau kānaka e noho
Ho`onoho ke ali`i iā Honua`ula nāna e mālama

Section IV
They left Kōhala and sailed until they reached the eastern shore of Maui.
Some passengers wanted to stay.
So the chief left Honua`ula in charge of those who stayed.

Mahele V
Ma Lāhaina ho`i lākou i noke ai
I ka wai hū ma nā ōpū pili,
Ma nā pū mai`a o Wai`anae,
Ma ka wauke uluwale o Pae`ohi,
Ma kahi lua o nā honu o kai
Ma lele lāua `o Pāha`a me Pana`ewa i noho ai
`Ae, ma ka māla `ulu a`o Lele!

Section V
To Lāhaina is where they continued on
To the bubbling waters hidden amongst the pili clumps. Amongst the banana clumps of Wai`anae. Amonst the luxurious growth of the wauke and Pae`ohi. Amongst the respids of the sea turtle. It was there at the Lele that Pāha`a and Pana`a dwelt. Indeed, at the breadfruit grove of Lele!

Mahele VI
Noke lākou i O`hu
Ho`maha iki na`e ma Haleolono ma Kaluako`i
Ua pi`i ka `i`ini i loko o La`amaomao e noho
Ho`onoho `ia `o ia e ke ali`i `o Mō`ikeha ma laila
I ka makani Ikioe o Ho`olehua,
Ma nā wai mānalo o Waikāne,
Ma ka `uu`uu pa`akea o Haleolono
Ma Halelei`i o nā i`a li`ili`i, nā loli `ele`ele o Pālā`au
Ma laila i noho ai `o La`amaomao

Section VI
They persisted on to O`ahu
But rested a little at Haleolono at Kaluako`i. A desire arose within the La`amaomao to stay there. So she was established there by Mō`ikeha. In the Ikioe wind of Ho`olehua. Amongst the potable waters of Waiakāne. Amongst the coral stands of Haleolono of Haleki`i of the little fish and the black sea cucumber of Pālā`au. That is where La`amaomao stayed.

Mahele VII
_Ha`alele iā Moloka`i_
Hala `o Kalā`au iā lākou a hiki i O`ahu
Ma kahi lae i ka hikina o ia `āina
Noi nā kaikuahine `o Makapu`u `o Makaoa
"E ku`u lani ē, e Mō`ikeha
Na māua kēia `āina e noho ai
E hiki ke `ike i nā ao e lewa ana i Tahiti
Ma muli o kona aloha iā lāua
Ho`onoho `ia lāua ma laila

Mahele VII
They left Moloka`i
Kalā`au Point passé them as they arrived on O`ahu. At a point on the eastern side of the island the sisters, Makapu`u and Makaaoa asked, "Oh heavenly one, oh Mō`ikeha, We would like this land for ourselves. For we can see the clouds floating to Tahiti, our homeland"
Due to his love for them, he settled the two there.

Cont'd

Mahele VIII
Ua hiki mai lākou ma Wai'anae
?O Wai'anae i ka pā aheahe o ke Kaiāulu
ma nā wai mānalo o 'Eku
ma Pāhoa o ka poi māno'ano'a, ma Lehano me Kūāiwa o ka poi pī
ma Kamaile o ka poi 'ono loa
ma Wai'anae o ka i'a aku nahu pū
?O Wai'anae o ka lā kapakahi
Ma laila i noho ai 'o Pōka'i lāua 'o Mō'eke

Mahele VIII
They arrived at Wai'anae
Wai'anae in the gentle breeze of Kaiāulu
Of the potable waters of 'Eku
At Pāhoa of the thick poi, Lehano and Kūāiwa of the stingy poi,
and Kamaile of the most delicious poi
At Wai'anae of the aku tidbits
Wai'anae of the crooked sun
It is there that Pōka'i and Mō'eke dwelt.

A koe akula 'o Mō'ikeha
Kāna keiki hānai 'o Kamahu'alele
Nā hoe uli 'o Kapahi lāua 'o Moanaikaiaiwe
A 'o Kipunuiaiakamau me kona hoa
A 'o Kaukaukamunolea me kona hoa

Remaining was Mō'ikeha
And his adopted son, Kamahu'alele
The paddlers Kapahi and Moanaikaiaiwe
And Kipunuiaiakamau and his companion and
Kaukaukamunolea and his companion.

Ha'alele lākou iā O'ahu
'Ō'ili mai 'o Hā'upu, 'o Kalalea
Hāpai 'ia a'e la e Nounou ma ka maka o Puna
Holo akula a hiki i Wailua
Pae lākou ma Waimahanalua ho'i
Waiho 'ia nā lako ma ke one o Kapa'a

They left O'ahu
Hā'upu hill sprang up, so did Kalalea
Cradled in the bosom of Nounou in the center of Puna. They sailed to Wailua.
And landed at the river, Waimahanalua
They left their belongings on the sands of Kapa'a

Hūnā 'ia ma ke kalukalu o Kēwā nō ho'i
Aia nā kānaka ma ka he'enalu
Ma ka nalu o Makaīwa
Ma laila ho'i nā kamāli'iwahine 'o Ho'oipoakamalanai lāua 'o Hinau'u
Hō'ao 'o Mō'ikeha iā lāua he punalua.
Puka mai 'o Ho'okamali'i
Puka mai 'o Haulaninui'aiākea
Puka mai 'o Kila
'Ae, 'o Kila ka mea nāna i ki'i iā La'amaikahiki

Hidden in the kalukalu grass of Kēwā
There beyond were men surfing
At the surfing spot called Makaīwa
It was there where the princesses,
Ho'oipoakamalanai and Hinau'u.
Mō'ikeha took them as wives
Thus was born Ho'okamali'i
Thus was born Haulaninui'aiākea
Thus was born Kila
Yes, Kila the one who fetched La'amaikahiki

"Puni ka moku iā Kaialea ke kilo
Nahā Nu'uhiwa, lele i Polapola
'O Kahiko ke kumu 'āina
Nāna i māhele a ka'awale nā moku
Moku ke aho lawai'a a Kaha'i
I 'okia e Kūkanaloa
Pauku nā 'āina, nā moku
Moku i ka 'ohe kapu a Kanaloa
'O Haumea kahikele
'O Mō'ikeha ka lani nāna e noho
Noho ku'u lani iā Hawai'i
Ola! Ola! Ola Kalanaola!
Ola ke ali'i! Ola ke kahuna!
Ola ke kilo! Ola ke kauwā!
Noho ku'u lani a lūlana
A kani mo'opuna i Kaua'i
'O Kaua'i ka moku
'O Mō'ikeha ke ali'i"

"Kaialea the seer went round the island, split apart
wa Nu'uhiwa, they landed in Polapola.
Kahiko is the base of the land.
The one who divided and separated the islands.
Broken is the fishing line of Kaha'i that was cut
by Kūkanaloa. Broken into pieces were the lands,
the islands cut by the sacred knife of Kanaloa of
Haumea, bird of Kahikele.
Mō'ikeha is the chief who will reside.
My chief will reside on Hawai'i.,
Life, life, o buoyant life!
The chief and the priest shall live!
The seer and the servant shall live!
Dwell on Hawai'i and be at rest and
increase the generations on Kaua'i.
Kaua'i is the island
Mō'ikeha is the chief.

He Pua Ali'i
by Keli'i Tau'ā

This *mele hula* is a brief story of the life of one of the great chiefs named Mō'ikeha that sailed back to Hawai'i from Tahiti in the early years of the Polynesian Migration with his family. He left from Kapa'ahu, Moa'ulanui-ākea Kanaloa and landed at South Point with a family named Kalae, sailed to Hilo then to Kawaihae with *kahuna* Mo'okini. Crossing the 'Alenuihāhā Channel, he briefly stopped at Hana, Maui then continued around to Honua'ula, Lahaina, and island-hopped to Moloka'i, O'ahu, and Kaua'i where he finally settled.

He pua ali'i mai Kapa'ahu lae
mai Moa'ulanui'ākea Kanaloa la,
ea la, ea la ea,
noho iho ho'i, noho iho ho'i

A great chief from Kapa'ahu.
Moa'ulanui'ākea Kanaloa
Living there

Holo 'o Mō'ikeha i kona wa'a lae
me kona 'ohana nunui loa la
ea la, ea la ea, i laila ho'i, i laila ho'i

Chief Mō'ikeha sailed on his canoe
With his large family

Pae a'e lākou i Hawai'i lae
I laila noho kamo 'o Moa'ula la
Ea la, ea la ea, i laila ho'i

After arriving in Hawai'i,
the Kalae and Moa'ula family
resided there

Ha'alele 'o Mo'ikeha mā i Maui lae
Ma hope, holo i Moloka'i la
O'ahu la, Kaua'i la ea, ha'alele Ho'i, ha'alele ho'i

The Chief then sailed to Maui
Next he went to Moloka'i
Followed by O'ahu and Kaua'i

A kani mo'opuna nui i Kaua'i lae
'O Kaua'i i noho ai ka pua ali'i la
ea la, ea la ea Kaua'i ho'i, Kaua'i ho'i

Great were his grandchildren on Kaua'i
Kaua'i became the Chief's permanent residence
with his retinue

many instances where other names have been substituted for the old district names. Some of these changes were made for political reasons and others for convenience, but the principal changes in boundaries were caused by movements in population reflecting new uses of the land areas. These new district boundaries did not always conform to the *ahupua'a* boundary and there are examples today of an *ahupua'a* beong situated in more than one district where no such condition existed in ancient times...(Sterling 1998:3)."

The traditional Honua'ula District, located between Kula to the north and Kahikinui to the east and south, included the following 19 known *ahupua'a* from north to east; Paeahu, Palauea, Keauhou, Kalihi, Waipao, Papa'anui, Ka'eo, Maluaka, Mo'oiki, Mo'oloa, Mo'omuku, Onau, Kanahena, Kualapa, Kalihi, Papaka-kai, Kaunuahane, Kalo'i, and Kanaio. Honua'ula has 18.5 miles of coastline and at Papa'anui *ahupua'a* reaches the summit of Haleakala.

Po`oti`eti`e
by Keli`i Tau`ā/ Melody by Nalei Paepae Kūnewa

The intent of this song was to honor some of the great gods of the world which Hawaiians recognized and worshipped such as Kāne, Kū, Lono, Kanaloa, and Iesu. They all served their purpose in each Hawaiian heart.

O Tane te po`oti`eti`e	The great god, Tane
Te atua o te wai	The god of water
O Tane te po`oti`eti`e	The great god, Tane
Te atua o te wai	The god of water
`Elima nā po`oti`eti`e	Five great gods
Nā atua o ta po`e o Hawai`i nei	The gods of the Hawaiian people
O Tū te po`oti`eti`e	The great god, Tu
Te atua o te taua	The god of war
O Tū te po`oti`eti`e	The great god, Tu
Te atua o te taua	The god of war
`Elima nā po`oti`eti`e	Five great gods
Nā atua o ta po`e o Hawai`i nei	The gods of the Hawaiian people
O Lono te po`oti`eti`e	The great god, Lono
Te atua o ta oi hana mahi`ai	The god of agriculture
O Lono te po`oti`eti`e	The great god, Lono
Te atua o ta oi hana mahi`ai	The god of agriculture
`Elima nā po`oti`eti`e	Five great gods
Nā atua o ta po`e o Hawai`i nei	The gods of the Hawaiian people
O Tanaloa te po`oti`eti`e	The great god, Tanaloa
Te atua o te tai	The god of the ocean
O Tanaloa te po`oti`eti`e	The great god, Tanaloa
Te atua o te tai	The god of the ocean
`Elima nā po`oti`eti`e	Five great gods
Nā atua o ta po`e o Hawai`i nei	The gods of the Hawaiian people
O Iesu te po`oti`eti`e	The great god, Jesus
Te atua o te ao nei	The god of the world
O Iesu te po`oti`eti`e	The great god, Jesus
Te atua o te ao nei	The god of the world
`Elima nā po`oti`eti`e	Five great gods
Nā atua o ta po`e o Hawai`i nei	The gods of the Hawaiian people

Handy and Handy describes the Honuaula region thus:

> "On the south coast of East Maui, from Kula to `Ulupalakua, a consistently dry and lava-strewn country, Makena and Ke`oneo`io were notable for good fishing; this brought many people to live by the shore and inland. There were some patches of upland taro, not irrigated; but this was a notable area for sweet potato, which, combined with the fishing, must have supported a sizable population although it cannot be counted as one of the chief centers (1972:272)."

Human settlement of the Honua`ula region dates back to pre-historic times and continues today.

The following pertinent information is noted in *Sites of Maui* (Sterling 1998), *Hawaiian Planter* (Handy 1940), and *Native Planters of Old Hawaii* (Handy & Handy 1972).

> "In Honuaula, as in Kaupo and Kahikinui, the forest zone was much lower and rain more abundant before the introduction of cattle. The usual forest-zone plants were cultivated in the lower upland above the inhabited area. Despite two recent (geologically speaking) lava flows which erupted from fissures below the crater and only a few miles inland and which covered many square miles of land, the eastern and coastal portion of Honuaula was thickly populated by Hawaiian planters until recent years. A few houses are still standing at Kanaio where the upper road (travelling eastward) ends but only two are now occupied. A number of Hawaiian families whose men are employed at Ulupalakua Ranch have homes near the ranch house. Above these native homes a little dry taro is cultivated. Formerly, there was much dry taro in the forest zone (Handy 1940:113)."

> "Between Kihei and Makena there was probably very little settlement in former times. Today along this dry coast there are a few settlements and houses and a few gardens with sweet potatoes.
>
> Makena is today a small community of native fishermen who from time to time cultivate small patches of potatoes when rain favors them. Formerly, before deforestation of the uplands, it is said that there was ample rain in favorable season for planting the sweet potato, which was the staple here. A large population must have lived at Makena in ancient times for it is an excellent fishing locality, flanked by an extensive area along shore and inland that was formerly very good for sweet potato planting and even now is fairly good, despite frequent droughts.
>
> Between Makena and the lava-covered terrain of Keoneoio (another famous fishing locality) the coastal region includes the small *ahupua`a* of Onau, Moomuku, Mooloa, Mooiki, Maluaka, Kaeo. According to an old *Kamaaina*, these *ahupua`a* had in former times a continuous population of fisher folk who cultivated potatoes and exchanged their fish for taro, bananas, and sweet potatoes grown by the upland residents of the Ulupalakua section. A few Hawaiians still live here. One living near Puu Olai has a sizable sweet potato patch in the dusty soil near the shore; another raises fine potatoes in a low flatland of white sand near the abandoned schoolhouse of Makena (Handy 1940:159)."

> "Kou was planted from seed in hot southern and leeward localities, chiefly near settlements. The wood was highly prized for making bowls, and the flowers were favored for necklaces and were used as medicine for thrush (*ea*). It is said

that there were one many kou trees on the *kula* land above Makena, Maui (Handy 1940:196)."

Paka'a & Kuapaka'a
Traditional

Aia la, aia la,
ke kau mai la ke ao makani,
O ka pali ale kō Hilo makani,
He paki'ele o Wai'ākea,
He makani kō Hana he ?ai maunu,
He kaomi, he kapae.
He ho'olua, he lauawaawa,
He apiolopaowa, he halemau'u,
He kū, he kona,
He Kohola-pehu kō Kipahulu,
Kohala-lele iho no ilaila,
'Ai loli kō Kaupo,
He Moa'e kō Kahikinui,
He papa kō Honua'ula,

He nāulu a'e i Kanaloa,

Hina ka hau i ka uka o Kula,
Kō laila makani no la,
Ka noke ami'la i ke pili,

'Ualena i Pi'iholo,
'Ūkiu kō Makawao,
Ka ua Pu'ukoa i Kokomo,
Ka ua 'Elehe'i i Liliko'i.

There! There they are! The wind blown clouds are appearing
Hilo's wind is Kapali'ale
Wai'ākea's is Paki'ele
Hana's wind is 'Ai-Maunu(bait eating)
Kaomi, Kapae
Ho'olua, Lau'awa'awa
Api'olopa'owa, Halemau'u
Ku and Kona
Kipahulu's wind is Kohola-pehu
Kohola-lele blows there also
'Ai-loli wind belongs to Kaupo
Kahikinui possesses Moa'e
Honua'ula proudly hails the low blowing wind, Papa
Towards Kanaloa blows the showery sea breeze, Nāulu
Hau blows steadily in the Kula uplands.
This wind blows there
Persistently whirls the pili grass
The wind of Kula of the Na'u
'Ualena is at Pi'holo
The 'ukiu wind belongs to Makawao
The Pu'ukoa rain is at Kokomo
The 'Elehe'i rain is at Liliko'i

Ke Lei Mai La
Traditional

Ke lei mai la o Ka'ula i ke kai, e.
Ke malamalama o Ni'ihau, ua malie.
A mālie, pā ka Inuwai.
Ke inu mai la nā hala o Naue i ke kai.
Nō Naue, ka hala, nō Puna ka Wahine.
Nō ka lua nō i Kilauea

Ka'ula wears the ocean as a wreath;
Ni'ihau shines forth in the calm;
After the calm blows the wind Inuwai;
Naue's palms then drink in the salt.
From Naue the palm, from Puna the woman
Aye, from the pit, Kilauea

Ke Kanu Nei Au
Traditional

Ke kanu nei au
Aia 'ia 'oe, ka ulu

I plant.
And the growth is yours.

Sterling names the following ten fishing grounds for Honua'ula and 8 through 10 are closest to the project area (1998:215-216):

1. Pahua is first and is located at Kanaio.
2. Hiu is another fishing ground.
3. Keahua is another.
4. Kalawa is another fishing ground.
5. Pohaku-ula is another fishing ground.
6. Kiele is another, it is situated at Lualailua.
7. Papuaa is another fishing ground. In Kahikinui.
8. Koa-hau is another. When the hill of Keoneoio appears above Puu-olai that is its upper landmark.
9. Na-ia-a-Kamahalu is another one. When Hoaka, which is in the upland of Kahoolawe on the western side appear to be in line with the cape of Ke-ala-i-kahiki that is the upper land mark. When the hill of Keoneoio appears to be in line of the seaward side of Puu-olai, that is the lower landmark.
10. Na-ia-a-Kamalii is anther one. When the cave on Makena appears to be close to the point of Paopao at Puu-olai, that is the upper landmark. The cave at Pali ku in Keoneoio is the other landmark. When it appears between the two stones at Mokuha and Kanahena, that is the lower landmark.

Sterling also lists two fishponds, a fishing shrine or *ko'a*, and Pohakunahaha heiau in coastal Makena, in Kaeo and Keauhou *ahupua'a* (1998:231).

The sweet potato or *'uala* was the important agricultural crop of the Honua'ula region and together with the marine resources comprised the staple food of its inhabitants. Handy and Handy's *Native Planters in Old Hawaii* (1972) includes a detailed description of sweet potato cultivation and a discussion of varieties. Three advantages of sweet potato cultivation over taro are described thus:

> "Although taro has a greater adaptability to both sunlight and moisture (too little sun or too much rain quickly spoils the potato), the sweet potato is the more valuable of the two staples in three ways: it can be grown in much less favorable localities, both with respect to sun and soil; it matures in three to six months (as against nine to eighteen months for taro); and it requires much less labor in planting and care in cultivation (Handy and Handy 1972:127)."

A footnote regarding feral sweet potato varieties stated in part:

> "...In Kaupo, I was told that the variety named *aehaukae* is actually a wild potato, which was found in many localities before the days of ranching. Cattle relish sweet potato leaves and vines, consequently there is small chance of collecting vines running wild or native to forest or *kula* (1972:127 footnote)."

Nā Māno
Traditional; From *Nā Pule Kahiko: Ancient Hawaiian Prayers* (Gutmanis 1983:15)

The name of this *`aumakua* Kamohoali`i ties back to Pele's elder brother with the same name who traveled with her when she came to Hawai`i. The accompanying chant is dedicated to the Lua`ehu *`ohana*.

Akahi ka māno, puka mai ka māno	One shark, the shark comes forth
`Alua ka māno, `ea mai ka māno	Two sharks, the sharks appear
`Akolu ka māno, puka mai ka māno	The third shark, the third shark comes forth
`Aha ka māno, `ea mai ka māno	The fourth shark, the sharks appear
Lima ka māno, puka mai ka māno	The fifth shark, the fifth shark comes forth
Ono ka māno, `ea mai ka māno	The sixth shark, the sharks appear
Hiku ka māno, puka mai ka māno	The seventh shark, the seventh shark comes forth
Walu ka māno, `ea mai ka māno	The eight shark, the sharks appear
`Aiwa ka māno, puka mai ka māno	The ninth shark, the ninth shark comes forth
O lele-hauli, o ka i`a kele `au moku	Greatly stirred is the fish that swims all around the islands
O ka hauli o ka i`a Kele`ahana	The spirit of the fish Kele`ahana that swims
O Kane ma Kua o Kanaloa	Kane and Kanaloa
Ea Ku-hai-moana, ka i`a i ke ale	Arose Ku-hai-moana, the fish in the ocean waves
Puka Ku i`a me ka i`a papani moku	That came with schools, that hid from view the island
Ea mai Lua`ehu, ka i`a kanaka mea	Arose Lua`ehu the fish like a man with reddish skin
Kapa`i a Ku, kappa`i a Lono	Kapa`i of Ku, of Lono
Ea kini o ke kua; ka māno o`ke kua	Arose the 40,000 deity, the 4,000 deity
E - O Lua`ehu a me Kamohoali`i	Hail to Lua`ehu and Kamohoali`i

`O Hi`u
Traditional; From *Sites of Maui* (Sterling 1998:10)

`O Hi`u noho i Keanae	Hi`u resided in Keanae
Keli`i hue wa`a noho i Hana	Keli`i-hue-wa`a lived in Hana
Puhi noho i Kipahulu	Puhi was stationed at Kipahulu
Ke`ala noho i Honua`ula	Ka`ala-miki-hau guarded Honua`ula
Kamohoali`i ke ali`i nui a puni o Maui	King Kamohoali`i watched over all Maui

The planting season and method are described thus:

> "...at Ulupalakua and Makena on southwestern Maui, where, after continued drought unbroken even in the winters of 1932, 1933, and 1934, heavy rains came in the late spring of 1934, bringing conditions favorable to planting. At Kaupo on southeastern Maui planting is begun in August, when showers generally start, and done planting is done after April, when drought usually begins....(Handy and Handy 1972:128)."

> "Clay appears to be the only soil to which sweet potatoes cannot adapt themselves. They grow wild on eastern Maui in forest-land humus...They are planted in dried terraces on western Maui. They flourish in the red soil of the *kula* on all islands...in Kaupo (Maui) and Kona in the gravelly semi-decomposed lava...and at Makena (southwestern Maui) in white coral sand mixed with red soil.
>
> Sweet potato patches in stony places, like many in southern Maui (Kaupo, Kahikinui, and so on) and in Kona, Hawaii, were called *makaili* (Fornander 1919-1920:164). Even small pockets of semi-disintegrated lava are utilized and potatoes are grown by fertilizing with rubbish and by heaping up fine gravel and stones around the vines. Such cultivation produces inferior potatoes, they are said to be rather tasteless and ridged (*`awa`awa`a*) or wrinkled (Handy and Handy 1972:128-129)."

> "The ancient Hawaiians planted potatoes in mounds (*pu`e*). Where soil is powdery and dry, as at `Ulupalakua and Makena on Maui, the earth is heaped up carelessly into low mounds spaced with no particular precision or care. The slips are planted two or three in a mound, being placed vertically in holes made with the digging stick...After the entire field is planted, the mounds are covered with mulch to hold the moisture. The potato leaves are not covered....
>
> Where potatoes are planted in crumbling lava combined with humus as on eastern Maui...the soil is softened and heaped carelessly in little pockets and patches utilizing favorable spots on slopes. The crumbling porous lava gives ample aeration without much mounding...(Handy and Handy 1972:130-131)."

An interesting point is made regarding storage of the potatoes:

> "...Actually, the ground of his field was the Hawaiian's storehouse for his potatoes; his system of planting and harvesting to meet current needs and to take advantage of regular and occasional rains, combined with the ability of the tuber to remain good in the ground for several months after maturing (Some varieties much longer), enabled him to dispense with storage (Handy and Handy 1972:134)."

The following is a portion of the description regarding the ritual associated with the `uala:

> "...Perhaps because sweet-potato planting was most prevalent on the southerly (leeward, hence dry) sections of each of the islands, where those for whom the *`uala* was the main source of sustenance were almost completely dependant upon rainfall, a much greater body of lore has grown up around its cultivation than around taro or other food plants, and this lore centers in rain-making rituals (Handy and Handy 1972:137)."

E Nā `Aumakua I
Traditional

E nā `aumakua mai ka la hiki a ka la kau
mai ka hoku'i a ka halawai
nā `aumakua la Kahinakua la Kahina'alo
Ia ka'a akau i ka lani
`O kiha i ka lani, `owe i ka lani
Nunulu i ka lani, kaholo i ka lani
Eia ka pulapula a `oukou, nā po`e o Hawai`i
E malama `oukou la mākou
E ulu i ka lani, E ulu i ka honua
E ulu i ka pae `aina o Hawai`i
E hō mai ka `ike
E hō mai ka ikaika
E hō mai ka `akamai
E hō mai ka maopopo pono
E hō mai ka `ike papalua
E hō mai ka mana
Āmama ua noa.

To the ancestral deities from the rising sun to the setting sun,
from the zenith to the horizon,
The ancestral deities who stand at our back and at our front
a breathing in the heavens
an utterance in the heavens
a clearing ringing voice in the heavens
a voice reverberating in the heavens
here are your descendents, the people of Hawai'i
safeguard us
That we may flourish in the heavens
that we may flourish on the earth
that we may flourish in the islands of Hawai'i
grant us knowledge
grant us strength
grant us the intelligence
grant us the understanding
grant us the spiritual insight
grant us the power
the prayer is lifted, it is free

E Nā `Aumakua II
Traditional

E nā `aumakua mai ka la hiki a ka lā kau
mai ka pa`a iluna a ka pa`a ilalo
nā `Aumakua i ka pō
nā `Aumakua i ke ao
nā kupuna a pau loa i ka pō
pale ka pō, panopano puka i ke ao
hōmai he `ike
hōmai he loa`a nui
aka pulapula e noho ana i ke ao nei
Āmama ua noa
Eia ka wai

Ancestral gods from the rising to the setting of the sun. From the highest to the deepest.
Gods in the dark
Gods in the light
All the ancestors in the dark
Ward off the dark clouds and break into the light
Bring knowledge.
Bring great knowledge.
The shadowy firmament that sits in the light
The prayer is lifted, it is free
Here is the water

A prayer attributed to Kaupo, Maui; given by a *kahuna* was said to accompany sweet-potato planting in the arid lands:

> "O Kamapua'a-kane and Kamapua'a-wahine, O Ku and Hina,
> O Kamapua'a-kane and Kamapua'a-wahine, here is our patch,
> Dig only in our patch, excrete only in our patch,
> Do not excrete in the patch of others,
> Lest you be stoned and hurt,
> Dig and excrete only in our patch, you will not be stoned,
> All the boundaries of this patch are ours. Amen (from *Ka Nupepa Ku'oko'a*, March 8, 1923 as translated by Kawena Pukui in Handy and Handy 1972:137)."

> "...The phrase 'excrete in our patch' has reference to the conception or playful fancy that some sweet potatoes were the excrement of Kamapua'a (Handy and Handy 1972:138)."

A bit of information that may be archaeologically significant involved the use of marine shells and stone for weeding the sweet potato patch:

> "...In the olden days, weeding the patch after planting was done by hand by some people, and with a pearl shell (*iwi pa*), *'opihi* [cowrie] (sic) (*should be limpid*) shell or stone by others (in *Hoku o Hawaii*, September 7, 1911 as translated by Pukui in Handy and Handy 1972:109)."

Together with marine shells that may have been used for fertilizer, such shells employed as agricultural implements could be misinterpreted as food refuse in the archaeological record.

Description of Project Area

The Honua'ula Development area includes sections of three *ahupua'a*; Paeahu, Palauea, and Keauhou from north to south. Only the section of Palauea *ahupua'a* includes the total width; Paeahu includes less than two-thirds of its width, and only about a third of its width is included for Keauhou *ahupua'a* (see Figs. 1 & 2).

The *ahupua'a* of Pae'ahu is significant for many reasons. Literal translation of the name is a "row of heaps" (Pukui et al. 1974:173), the heaps referring to *ahu* (a stone mound – see site classification section at beginning of this document). Pae'ahu holds multiple meanings, all having to do with the concept of *ahu*. The area is significant for its connection to Kealaikahiki, the pathway to Tahiti and the voyaging of our ancestors. Pae'ahu signifies a place of embarking on a journey or disembarking after a journey. To this day, this *ahupua'a* is connected with *wa'a*, the outrigger canoe, and the voyages of our people. Traditionally, when fishing or on a sea voyage, but within sight of shore; reference points on land were used to determine the off-shore location or maintain a certain course. This worked much like lining up a set of lights to enter a harbor channel today. Natural land-marks were used, but often, *ahu* or stone mounds were constructed for this purpose. *Ahu* were also used to guide travelers on land as well.

The *ahupua'a* of Palauea is a large land section. Literally, the name means "lazy" (Pukui et al. 1974:176). One of the oral traditions passed down about this area refers to laziness.

The *ahupua'a* of Keauhou is a large land division of which only a small section lies within the current project boundaries. The name literally means "the new era" or " the new current" (Pukui et al. 1974:104). It is connected to the currents that flow around and between the islands, Na Kai Ewalu, and the channels that carried the ancestors to and from their destinations.

Informant Interviews

Informant interviews with eight (8) local residents were conducted by Keli'i Tau'a and Kimokeo Kapahulehua of Hana Pono as part of a Cultural Impact Assessment that was prepared for the Honuaula Project in January 2008. The individuals interviewed were; Mr. Douglas Wayne "Butch" Akina; Ms. Marie Doreen Alborano; Mr. Edward Quai Ying Chang, Jr.; Mr. Stanley Ahana Chock; Mr. Eugene C. "Herman" Clark, Sr.; and Mr. Kevin Mahealani Kai'okamalie; Mr. Randsom Arthur Kahawenui Piltz; and Ms. Mildred Ann Wietecha. An additional informant, Mr. Jimmy Gomes, was interviewed by Kimokeo Kapahulehua of Hana Pono LLC on March 12, 2009.

Summary of Interviews

The complete transcript for each interview is appended to the Cultural Impact Assessment document produced by Hana Pono under separate cover. Interested readers are referred to that document. For the purposes of this Preservation Plan, summaries of these interviews appear below:

Douglas Wayne "Butch" Akina

Douglas Wayne Akina goes by the name of "Butch" and at the time of the ineterview was sixty three years old. Born in 1943 after the 2nd World War, he is the youngest of eight (8) siblings from the Akina family of Kihei, Maui. He is the last surviving son of his father Alex Akina. Following graduation from Saint Anthony high school in 1962, Butch decided to make the move over to Anaheim, California to obtain work as a foreman for Kentucky Fried Chicken. His work during this period of approximately seven (7) years primarily consisted of making spices such as Black Pepper. Prior to his departure from the mainland Mr. Akina opened his own company, a mobile home maintenance service business. He returned to live on Maui in 1970 to assist in the operation of the family school bus business and has lived on the island ever since. Mr. Akina

recalled that the business has been in operation for over 80 years now and was initially started by his father in 1928. Prior to leaving the mainland to return home, he helped his father transport a used bus all the way from Chicago to California for shipping to Maui. Since his return to Maui, Mr. Akina a self-proclaimed entrepreneur has owned and operated a variety of small businesses including school/tourist bus, fishing, airplane, rooter, cesspool extraction and fishing net companies.

During the interview, Mr. Akina recalled the memories of his life growing up in Kihei and emphasized just how much things have changed since the good old days. When he was a small boy, Mr. Akina remembers Kihei as a very small place and noted that much of lands in the area were owned by his family. He also reflected on the Seaside Tavern that was owned and operated by his father during the Second World War. This store was located in the area known as Kamaole I today and benefited from being in close proximity to a neighboring military training camp. During the plantation days, Mr. Akina remembered visiting a general store in the area that had an open air theater, known at one time as the Suda Store. He also noted that school bus service that had been started by his father collected children throughout the Kihei area and transported them to the schools in Wailuku and Kahului.

Mr. Akina emphasized the importance of fishing practices to the livelihood of his family. His father, at one time, had owned a successful fishing business. The fishing trips had often culminated in the hauling of large catches of fish, which were either sold to local businesses or given to local families and friends. Recognizing the importance of fishing to local families, Mr. Akina at one time had also started a fish net sales business on Maui which involved buying cheap nets from Taiwan and selling them to local families on the island. He also recounted his enjoyment of having the opportunity to spend many a day at family and friends homes drinking and teaching people how to make and use fish nets.

Aside from concerns related to State-imposed fishing regulations, the use of traditional fishing grounds for commercial ocean recreational activities and the inability of local families to keep pace with escalating property taxes, it did not appear that Mr. Akina had any specific concerns related to the proposed Honua`ula project.

Marie Doreen Alborano

Marie Doreen "MD" Alborano was born and raised in Kihei, Maui in June 1935. Her maiden name was Miranda. Mrs. Alborano attended and graduated from St. Anthony School in Wailuku. Her father was born in Wailuku but moved the family to Kihei. Her paternal grandfather was an entrepreneur and purchased property around Maui as well as owned Miranda Store in Wailuku. The family property in Kihei was in the vicinity of where the existing Welakahao Road is located today. Her father received 56 acres, where he raised farm animals for sale such as chickens, ducks and pigs. They would also cut and sell kiawe wood on the property to heat *furos* (Japanese baths) and collect the kiawe tree beans to sell as livestock feed.

Ms. Alborano recalled that growing up in Kihei, there were very few neighbors around the area. She recalled that the nearest neighbor may have lived at least a mile away. She would work on the family farm before school and after school. On the weekends after chores were done, she could go to the beach to swim or play basketball at home. On Sundays, she would go horse back riding with her father.

She also recalled that when it rained, some areas of Kihei would flood such as the area near the existing Longs Drugs store. She also noted that some of the lands were wetlands, such as the area where the existing McDonald's Restaurant is today. There was a ditch along the road near St. Theresa's Church, where her family would go and catch Samoan crabs to eat. Mrs. Alborano remembered the Tomokiyo Store, located across South Kihei Road from Kalama Park. Tomokiyo Store had a gas pump and she remembered that no one ever paid for anything as it was all put on credit. She stated that the Tomkiyo's sold the business to Bill Azeka. At that time, South Kihei Road ended at Kalama Park. She also noted that once the Puunene plantation camps began shutting down, many of the residents came to live in Kihei because she thought the land was cheap. When that happened, there were many local people around.

After the United States entered World War II, Ms. Alborano recalled that life in Kihei changed. She noted that there were a lot of different people around. The military would have U.S.O. performances at Kalama Park. She was a student of renowned hula teacher Aunty Emma Sharpe. Aunty Emma Sharpe would have her students perform for the U.S.O. shows at the gazebo in Kalama Park. Ms. Alborano would perform with the hula halau, and recalled after performances, that the servicemen would throw money on the stage. She also recalled a Mr. Johnny Ventura who was a postmaster, would organize the children in the area to perform musical plays at the Kihei theater. The theater was located near the former Suda Store in North Kihei and was an open air theater.

Ms. Alborano recalled that there were cattle that were brought in from Kahoolawe by boat to the Makena area. Her father was friends with the people who lived on Kahoolawe and would help bring in the cattle from Kahoolawe.

Ms. Alborano was concerned about gated communities. She felt that they encourage a distinction between people which was not a positive thing. She also felt that as she was born and raised in Kihei and that she should have clear access to the ocean. She noted that she was upset with people who put up boulders along the shoreline to try and protect their property as it prevents access to the ocean. She wanted to insure that public access to the Makena area and shoreline would be continued.

She also shared concerns about local families being forced to sell their property because they are not able to afford the property taxes. She was unhappy about having to sell the remainder of the family property in Kihei. Further, she shared her concerns about the attitude of new residents towards the long time residents.

Aside from concerns related to access to the Makena area and the shoreline as well as the concern for gated subdivisions and its suggested "division" of the community it did not appear that Mrs. Alborano had concerns related to the proposed Honua`ula project.

Edward Quai Ying Chang, Jr.

Edward Quai Ying Chang, Jr. was born in 1928 in Wailuku. He moved to Makena when he was four or five years old. He went to Ulupalakua School and later to Lahainaluna School. He graduated from Lahainaluna School in 1949 and went to the mainland for school and later in the army where he met his wife, the former Laureen Sakugawa. Mr. Chang has a degree in Biological Science with a minor in Plant Pathology and went to graduate school at Southern California. He worked for Leber Brother and lived on the mainland for 39 years from 1949 to 1988.

Mr. Chang's ancestors have lived in Makena since 1883, 40 years after the Mahele, when his great great grandfather John Kukahiko bought the Makena lands. The Kukahiko family owned much of the land along the shoreline from Makena Surf to Makena Landing. The property Mr. Chang resides on near Makena Surf was bought by his father from the Kukahiko family.

Mr. Chang remembers that in the old days access to Makena was from the old Ulupalakua Road. His neighbors were mostly family, like his great-great grandmother who was a Haihai and her sister Moloa who lived down Makena Landing. During World War II all the houses at Makena Landing were demolished. During World War II the army built the road from Kihei.

Mr. Chang recalls that Makena Landing was used to transport cattle from Ulupalakua Ranch by sea. Where the restrooms are located at the park at Makena Landing there was a cow pen. They chased the pipi (cow) inside and then they chased them out to the beach to the launches. They would strap one cow to each side of the launch and drag them out to the boats. The cows would swim out and they would lift them into the boat.

Ulupalauka had a big slaughter house in the area. It was first at Kana'ena where the lava flow stops where all the people go snorkeling. Then it moved to Makena Landing. The slaughter house attracted too much sharks which was about the time they stopped utilizing Makena Landing to transport cattle.

Mr. Chang recalled that the area where the Eardmen family lives now was called Apuakehau (translated to "where the hau tree is"). The area fronting the Eardmen family's house has a fish pond. During his childhood, Mr. Chang would go down there with a bag pole (net has two poles), throw stones and make a lot of noise, and the Weke or Pananuu would go inside. The area is no longer as good because the inlet has been ruined. Mr. Chang suggested that the wall be reconstructed.

Mr. Chang noted that at one time, Maui had a road completely circling the island – the Kahakai Trail on the ocean side. He recalls the controversy over the old King's Highway involving the old road fronting the Maui Prince Hotel. His father along with Dana Hall, Leslie Kuloloio and George Ferreira through Hui Ala Nui O Makena fought to keep the King's highway open. Today it is a walkway providing access. Cultural access continues to be an issue in areas such as Olowalu in West Maui and Holokai Road in Haiku.

Mr. Chang remembered Makena as an open space area before people started living there. You were able to come to the area and not feel like you were trespassing, but you feel like you are trespassing now. People behaved differently back at those times. When you came to Makena you picked up your opala (rubbish) after you left and kept the place clean. Today, people go down to Makena and dump their cats, dogs, rubbish and all their old junk. People just dump rubbish out of their car. Mr. Chang expressed concern that we are losing the old Hawaiian names for the places in Makena. The names of the places in Makena have changed. You need to know the areas that are named separately as you go along this place. Mr Chang suggested keeping the old place names instead of adopting new names. Some of the coastal place names that he recalled are shown on Figure 8 that precedes this page.

Aside from general comments related to coastal development on Maui it did not appear that Mr. Chang had concerns related to the proposed Honua`ula project.

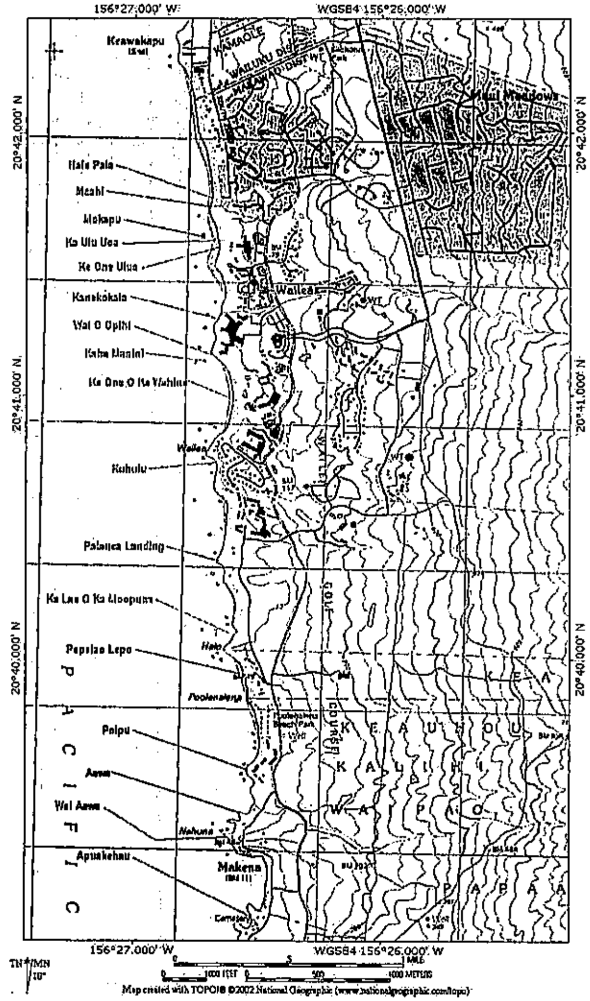


Figure 8a. Traditional Placenames for Coastal Areas in the Honua'ula Region (north) Recorded by Mr, Eddie Chang, Jr. (blue) and by Ms. Inez Ashdown (red)

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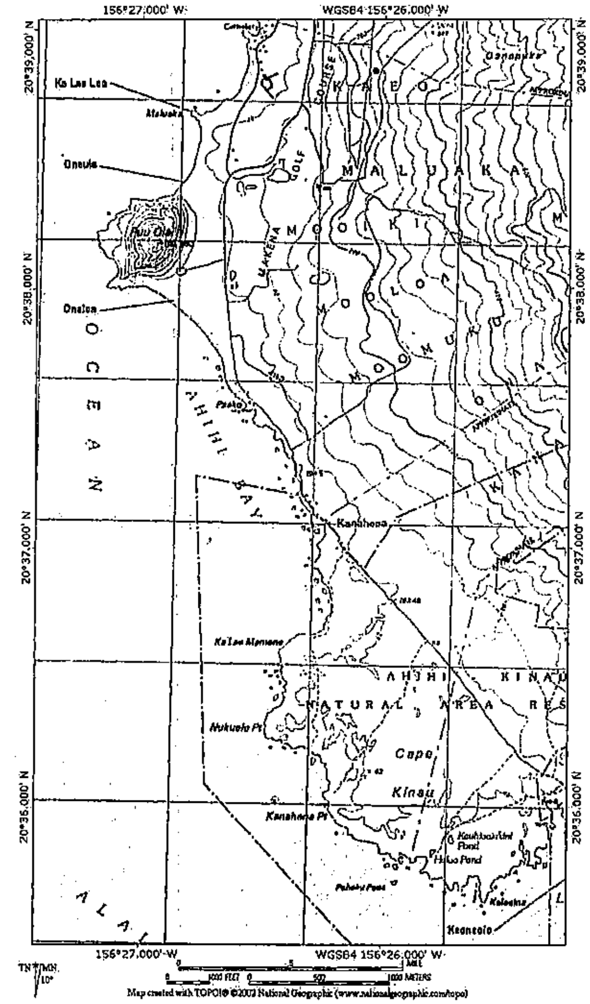

Figure 8b. Traditional Placenames for Coastal Areas in the Honua'ula Region (south) Recorded by Mr, Eddie Chang, Jr. (blue) and by Ms. Inez Ashdown (red)

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Stanley Ahana Chock

Mr. Chock was born in Honolulu, Hawaii on May 13, 1933 and given the name Stanley, Ahuna Chock by his parents Patty Lou Kanoho and Clarance Ahana Chock. Shortly after he was born, he was sent to live in Pulehu'iki in Kula, Maui to live with his mother's sister, Hattie Kanoho. Mr. Chock also spent most of his childhood in Kahakuloa, in the northwest region of Maui. His uncle, Chares Kanoho is buried a Keawala'i Church in Makena.

As a young boy, Mr. Chock would visit his mother and father in Kihei. He recalled visiting his parents who lived near the Suda store in north Kihei. He also recalled using one main road to travel down to Kalama Park.

Mr. Chock also recalled visiting his Uncle Charlie who lived in Makena. Mr. Chock reported that his Uncle Charlie lived in a home located along the shoreline. During the interview, Mr. Chock recalled looking from the kitchen of his uncle's home and being able to look straight down the ocean. He also remembered heading to Makena on a dirt road to go fishing with other boys from Kahakuloa. After catching fish, the fishermen would soak the fish with salt found on the beach. Mr. Chock indicated that he and his friends and other boys would fish for 'Uhu and Palani in Makena. He remembered an abundance of fish in this area and using harpoons to spear fish from the reef. Other than fishing, there was no mention of other cultural practices that occurred in the region during the interview with Mr. Chock.

During the course of the interview, Mr. Chock did not appear to have any specific concerns related to the proposed Honua'ula project.

Eugene C. "Herman" Clark, Sr.

Eugene C. "Herman" Clark was interviewed by Kelii Taua of Hana Pono LLC on October 30, 2008. At the time of the interview, he was seventy-seven years old and was practicing the art of reflexology (healing with hands) through the Chinese-Hawaiian way.

> *'I do massages; I do lomilomi and all that. I do adjustments and all too. And then in '98 before my boy died I went up to Spokane, Washington and fixed a broken hip for a woman who called for me and I saw the x-rays and all that. I put her broken hip back I stay one month up there I have to work twice a day so don't get blood clots. Until today every Sunday she call me up, "Jean I'm all right and I'm walking, I'm dancing." I said, "Good." And nothing is bothering her and I'm really happy about that.'*

Mr. Clark's mother was born on Kaua'i and was of Chinese-Hawaiian ancestry and his father was Sergeant Clark who was part of the Hawaiian National Guard back in 1935. Mr. Clark has lived on Maui since 1935 when his family moved to the island. He went to school at St. Anthony and Maui Vocational School. Upon finishing school, Mr. Clark worked for 3-4 years (during the war) in the Ammunition Depot at Pearl Harbor before returning to Maui for employment. He married Margaret Mahi from Iao Valley and together they had six (6) children, one of whom passed away at a young age.

Mr. Clark lived in the Kihei region when he was attending school. As a child, he used to spend a lot of time helping his parents with the breaking of rocks in the yard of this home on what is now known as Kenolio Road:

> *'All rocks, blue pohaku and I learned how to at 11 years old. I used an 18 pound sledgehammer. I dig 'em out, I put the bar in there I move 'em, I move 'em, I move 'em. I crack 'em all then I get this old pickup truck, my father myself and my brother we converted that 1934 Chevrolet into a truck. And then I put all the rocks on it and I stuck it all behind by the end of the property. Then was so high already- was about 8 feet high already so my father decides to give to the County because he was good friends with the County and all that. So he tell them come get them and they made the stone wall in Kalama Park. You know where the parking lot all the blue rock?'*

> *'They see me how I work cracking rocks and all that and one was Kenolio's son and tell me, "Jean boy you're a strong boy." I said, "My mind is to help and clean up the property." That's how I felt. Even my own children I no let them go down the pool hall and all that, no. Think about your hands and what your hands bring in for you. Fishing, I take them on my father's boat going fishing and we always get extra fish we sell for make expense back for repair the boat, paint the boat and all that there. And get extra money I give them. That's how life was. Same with catering, I cook for the Stouffer Hotel for 22 years doing luaus. One night we had to do four luaus in one night.'*

He recalled that Kenolio Road was, at that particular time, the main road through Kihei:

> *'Never get the front street in the south road no more this was the main street. This was only sand and oil, sand and oil. They throw the oil they throw the sand on it. Then only few houses over here down to Maui Lu and then it cuts back down. Go by where Maui Lu used to be and then go short distance and then get sand again before Azeka's and all that. Before you go to Maui Sunset and all that sand and oil, sand and oil that's how it was.'*

During the interview, Mr. Clark recalled that, as a child, the Kilohana Street area (in the vicinity of the Honuaula project area) of Kihei/Wailea was barren with boulders and kiawe.

In talking about the lands to the south of Kihei, Mr. Clark remembered driving down in a truck to the Makena area when the only form of access to the area was a sand and dirt road that went all the way to La Perouse Bay.

> *'All dirt road then when you come down to the lava flow it's all, you know gravel like from the rock.'*

He also remembered a man called Sam Po who was a caretaker a home near La Perouse Bay. Sam Po was a big man who used to be a fisherman:

> *'...he used to throw net a lot in Mākena Beach and that's how all the farmers used to come down bring vegetables he go throw net catch manini and stuff exchange. That's how it was.'*

He noted that the people from Kula would either walk or drive down the Old Ulupalakua Road to the coast to exchange goods such a fish and vegetables near the old Chang Store in Makena.

Mr. Clark was also a keen fisherman during his youth and fondly recalled the times when he would used to go on fishing and camping trips with friends and family:

'....sometimes we as boys, we go and camp all one night you know. Because we go diving, we young yet, we like dive and bring fish home for eat. That was our, my mother said you always, if you going for something you always don't say you going fishing or whatever you say holoholo that's the Hawaiian way. You come home with fish, with squid like that there but never say you going fishing for fish or squid because you going come home white washed. Right?

'I loved to fish with my father. I put the, I take a tube I put a little ply board make it round tie 'em up with the tube put my okala inside there and swim up to shore and I go throw net. Young, I was young age yes. My uncle made me a throw net so he taught me how to throw net and I catch Moe, Holehole. I not going throw on any kind fish I look. He said, "You look for that fish, you look that fish the color you can tell. But when the fish stay over there all get coral head. You try go pick up the net you no go stick your hand inside there-too much puhi. (Laughter) Broke the coral the net stay tangled with and then you can get 'em." That's what he tell me so that's how I do. No go stick your hand inside there because all white water yeah?'

Mr. Clark noted that he would spend much of his time along the coast in Kihei but, once in a while, would venture Upcountry to chase girls. In talking about the increase in deer population in the region:

'Ah, the deer was coming in-I think was back in the late '80's. That's the last time I remember because they was raising sheep's up there then the deer came in. Whoever brought it- I don't know who brought it and that's terrible now.'

In discussing his thoughts about the Kihei area in general, Mr. Clark expressed concern about the level of development around his home in Kihei.

'....the place is all developed now with houses or condominiums coming up. Too much down here and we don't have too much water our water pressure dropped down quite a bit. And how the County making that problems, right? Why somebody getting paid under the table? That's what I feel, I feel something that it's wrong. That's how I feel brother, I going to tell you that here, it's too much. And the traffic and the road is not set for all the traffic and all that there on the South Kihei Road and that's how I feel. Why they should develop so much in Kihei? Like sometimes I think number 2 Waikiki we going be.'

'...A lot of places I know a lot of white man who got money and you cannot even go down to the beach to go and swim and walk on the sand. They're all trying to put a stop to that. That's no good, the beaches all for everybody.'

During the interview session, it did not appear that Mr. Clark had any specific concerns regarding potential cultural impacts related to the proposed Honua`ula project.

Jimmy Gomes

Mr. Gomes, 61 years old at the time of the interview, was born in Puunene on Maui and is married with three (3) children (1 boy and 2 girls). Mr. Gomes has been employed by the Ulupalukua Ranch for the last 6 years and is currently its Operations Manager. Aside from his

employment activities, he has visited the lands owned by the ranch for the past 50 years – from the time when the Baldwin and Erdman families still owned the land.

In discussing the current business activities of Ulupalukua Ranch, Mr. Gomes stated that the ranch covers approximately 20,000 acres stretching from 6,000 feet down to sea level and spread across 10 miles from East to South. The ranch currently runs 2,300 cows and calves and is involved in a breeding operation through a firm called The Maui Cattle Company which raises cattle from infancy to slaughter. Mr. Gomes noted that The Maui Cattle Company represents a partnership of local ranchers including Haleakala Ranch, Ulupalukua Ranch, Kaupo Ranch, Hana Ranch, and Nobriga Ranch. This collaborative effort by the ranches was undertaken in an effort to develop a sustainable local beef market and to avoid the escalating shipping costs of exporting cattle to the mainland and beyond. Mr. Gomes hinted at the success that the Maui Cattle Company is presently enjoying by saying that demand now exceeds what the company is able to bring to market. In addition to the cattle in the breeding operation, Mr. Gomes also mentioned some other business ventures currently being pursued by the ranch including the Tedeschi Winery and a 123-strong elk breeding operation, the meat of which is sold in various forms in the Ulupalukua Ranch Store as elk burgers, steaks, and loins.

During the interview, Mr. Gomes also took the opportunity to describe a dry land restoration project that has been ongoing at the ranch for the last 25 years which includes the replanting of Koa and A'ali'I on the upland portions of the property. The ranch has also been able to form a lumber company as a derivative of this conservation program, which uses the eucalyptus, koa, and cypress pine harvested from the ranch lands. He said that the material is harvested, milled, and used in the local production of sustainable flooring and paneling products and also in the manufacture of bookcases and furniture. Mr. Gomes said that this lumber operation has proven to be a successful business venture for the ranch. He also proudly announced that the main office was recently renovated using over 90% of these locally produced sustainable products.

Mr. Gomes went on to talk about the importance of Paniolo or cowboy culture to the upcountry areas of Maui. According to Mr. Gomes, some of Ulupalukua Ranch's employees are third or fourth generation cowboys whose ancestors worked the lands at the ranch:

"We have Ikua Purdy, who is a well-known Paniolo that went to Cheyenne, Wyoming in 1908 and won the steer-roping championship. Well, you have his sons that worked here on the ranch at Ulupalukua. You have his grandsons that have worked here at the Ulupaluakua Ranch. That's three generations."

Though ATVs are now also used to access certain portions of the ranch characterized by old lava flows and other rough terrain, the majority of the land is still accessed and worked by cowboys on horseback. There was reference made during the interview to the sheer natural beauty of the ranch and surrounding lands and that workers at the ranch feel fortunate to have the opportunity to be a steward of the land:

"Where can you go and pop a gate open and all that you hear around you is just animals? The view that you have to see, such a beautiful place to be in. The quality of life, you know? Is such a blessing to be here. It's not really work to be here. To come onto the aina and be stewards of it and try to see that you would like to have it when you leave maybe a little better place than when you came. Be a better land steward, keep the land, malama pono the aina."

When asked about the Honuaula project area, Mr. Gomes noted that the land was formerly owned by Ulupalukua Ranch a number of years ago. He also mentioned that the ranch has been granted authorization by the current owners to use a portion of the land for raising cattle in the interim while development plans for the project are finalized. The use of the land for cattle grazing has the additional benefit of reducing the amount of fuel available for potential wildfires during the summer months.

Though not in opposition to the Honuaula project, Mr. Gomes did mention that the lower slopes of the Haleakala are considered very suitable grounds for raising cattle. This is mainly due to the warmer temperatures and the prevalence of nutrient-rich grasses, such as Buffalo Grass, at lower elevations.

> *"We like that country down there to raise our steers and our heifers. It's a shame if it ever becomes development that we can't run cattle in it and keep more open space. But as I say, I work for a ranch and I'm proud of it, but I'm prejudiced to say it. I believe in sensible development. I believe that everybody needs to do what they need to do. I'm not against it, but for us, we love to put cattle where we know we can get the best gains for the buck."*

Aside from discussing the suitability of the land for grazing activities, it did not appear that Mr. Gomes had any specific concerns related to the proposed Honua`ula project

Kevin Mahealani Kai'okamalie

Kevin Mahealani Kai`okamalie was born in Keokea on Maui and, at the time of the interview, Mr. Kai`okamalie was in his early forties. He was raised in the Honua'ula region, but also lived in a variety of locales on Maui. His family on his father's side has resided the in the region for at least seven (7) generations. Mr. Kai`okamalie noted that Honua`ula encompasses Keokea to Kanaio and all the ahupua'a in between, including Paeahu and Papa`anui.

Mr. Kai`okamalie's recollection of the region was the existence of many native plants, which were endemic to Hawaii. He took an interest in botany from when he was roughly 11 or 12 years old and was able to learn from noted local botanists. Mr. Kai`okamalie recalls trekking through gulches in the region and finding endemic plant life, such as an uncommon Hawaiian fern. However, he noted the ruin of much of the native plant life in the region over the last few decades with the introduction of pigs, goats, cattle, and deer to the area.

Mr. Kai`okamalie did not mention any specific, culturally significant practices occurring in the region. In general terms, he felt that the existence of a wide variety of endemic plants contributed to the cultural significance of the area. Mr. Kai`okamalie stated that the region is culturally valuable "not just because of the cultural sites that exist there but the botanical treasures. And it separated us [Hawaiians], the plants separated us and it allowed us to have a culture."

Based on the cultural value of the area, it is Mr. Kai`okamalie's opinion that development should be concentrated in areas where there will not be further desecration of the Hawaiian culture. He prefers that future development occur on lands cultivated in sugar rather than at Honua`ula. Mr. Kai`okamalie noted, "places like Honua`ula, Kahikinui, Kaupo, again should be taken out of the development realm. Just because it's the last Hawaiian places on the island of Maui, in my opinion."

Randsom Arthur Kahawenui Piltz

Randsom Arthur Kahawenui Piltz was interviewed by Kelii Taua and Kimokeo Kapahulehua of Hana Pono LLC on February 15, 2006. The following is a summary of his interview:

At the time of the interview, Mr. Piltz was 66 years old and married with two children - a 37 year old son who worked as an electrical engineer in Honolulu and a 34-year old daughter who worked in the family's electrical contracting business as an estimator.

Mr. Piltz was born on February 20, 1939 at Maui Lani Hospital in Wailuku (at the present site of Hale Makua) and was raised on Maui up until graduation from high school. After attending Kamehameha High School in Honolulu, he attended the University of Dayton in Dayton, Ohio where he studied Business Management. Following graduation from college, Mr. Piltz held several positions before starting work for an electrical contractor in Dayton. After aquiring skills in this area of expertise, Mr. Piltz and his family made the move back to Maui in September 1993 to start working for his father's business, Piltz Electric.

During the interview, Mr. Piltz noted that he had served on the Maui Planning Commission and was currently serving a one-year term on the State Land Use Commission. He also stated that he had recently submitted an application to extend his time on the SLUC by another four (4) years at the request of the governor and that the appointment was pending approval by the State Senate.

In discussing his family roots, Mr. Piltz said that he was part of the 130-member Kukahiko family which has roots in the Makena Landing area of Makena.

> *'Well, you know when my mom was mainly, they lived mainly in Kihei. But their family was right down there in Makena, near the Makena Landing and involved with the Kukahiko's and, you know, John Kamaka, John and Kamaka Kukahiko.'*

> *'We relate back to the lands that they owned back there and a lot of it was right there at the Makena Landing. In fact, we have a gravesite near there where we now have the Kukahiko family built a beach home. And I was involved in trying to save that piece of property and making sure that we have this piece of property that will be there in perpetuity. We're finding it very difficult now because we had one piece of property that we had to sell because of taxes. And later on we had to sell another piece of property because of taxes. And there was one piece left there, right next to the grave, and with the money on the sales of those properties, we were able to build this home. And that's for family use. But the real problem that we're having now is that before we built a house the taxes were twelve thousand dollars a year. This year it's thirty two thousand dollars. Our interest for the property, what it was, two thousand dollars. This year it's eight thousand so we're looking just on those two items, taxes and interest, forty thousand dollars. For a Hawaiian family to try to retain beachfront property, you have to have an unlimited amount of funds, or have some way of making money. And it's very difficult. Most of the family members that we have can't afford to spend or help pay for this. So we have to go out and raise funds, one way or another, so that we can retain this in perpetuity. It's going to be difficult.'*

In recalling memories from his youth in the Kihei-Makena region, Mr. Piltz stated that certain parts of Kihei and the Makena area were difficult to access during the wartime. He remembered there being a military guard station at Auhana Road which prevented unauthorized people from traveling into the Makena area.

'Past there you had to go up Ulupalakua and if you were in good graces with Ulupalakua Ranch then you could get the keys and you could come on down and make your way down to the landing.'

He also added that many of the beach parks known today as Kamaole I,II and III and Kalama were used as exclusive recreational areas for military officers and other personnel and that there were many buildings along the beach in these areas. Mr. Piltz recounted the days when they would used to dress-up in helmets that they would find following beach landing exercises that the military used to conduct along the beaches in the area.

In relation to the Honuaula area in particular, Mr. Piltz noted that a road had been built by military to facilitate access between Kihei/Makena and the upcountry areas. This road went right up to the old Fong Store.

'Well, a lot of it was trails with cattle making their way down. And then eventually Ulupalakua Ranch made their roads. And then there's one road that goes pretty close to where Honuaula is and that was built by the military to get up to Kula. And it goes right up to the Fong Store. So there's a direct road that comes straight on down, right behind Fong Store. You can see that it's still there.'

'A lot of those roads were built by the military and it was just so that they could get into the area and they can protect it.'

'...you know at one time that road from Ulupalakua down to Makena was opened. And even though it was unpaved dirt road and the Ranch, all they asked for was that the County hold Ulupalakua Ranch harmless on insurance. And that never happened.'

'And even at one time a lot of people had keys to the gates to get in and they'd go hunting and all that kind of stuff. But because of many abuses by some of those people, they'd make copies and give it to somebody else and then they destroy the land and injure the animals in the area. So they just stopped it.'

During the interview session, it did not appear that Mr. Piltz had any concerns regarding potential cultural impacts related to the proposed Honua`ula project:

'I don't recall any (cultural sites) that my parents ever talked about in that particular area, especially in Honuaula. Most of it was in scrub land and the only time any of the land was being used, from what I understand, was when the military came in for their exercises. And that was later in the fifties.'

'You know, I saw this (Honuaula Project) when they brought it to, you know I was on the planning commission for five years. And when they first came to us and reviewed they told us of the original plans which was a lot bigger in size. Two golf courses and now it's downsized to one golf course and just home sites. Had I been the ruler of the land I would look and say this is good because it can provide. If you look at what the taxes you can get out of it. Most of these homes

will be used for part time residents. They're less impact on the environment because they're not going to be here all the time. But it provides employment because somebody's gotta take care of the property while they're not here. And the taxes that's generated out of this is something that too many times those that do not want development come in and say, 'well it's no good, you're raping the land. We don't want you using up our resources.' On these type of developments you have to look further than what's going to be built. It's what they can produce to us that live here. We're requiring them to do affordable housing.'

Toward the end of the interview, Mr. Piltz offered the following comments about the need to adequately plan and provide for Maui's growing population:

'......I think our County government has taken the step forward in correcting itself. But it's not, no more building because here's one of the things that too many people failed to recall. If nobody else came to Maui to live or build, there's still going to be growth. Children are still going to be born. Children are going to graduate from High School. People are going to need jobs. And that's growth. And you have to provide for what's growing. And now with an influx of new people coming in, they've gotta pay their fair share.'

Mildred Ann Wietecha

Mildred Ann Wietecha is a lifelong resident of Kihei. Her mother was Violet Thomson of the Thompson Ranch in Kula and her father was Alex Akina of Akina Bus Service. One of her brothers, Douglas Wayne Akina, now runs the Akina Bus Service.

In relation to the Kihei area, Ms. Wietecha recalled that her grandfather had once donated some of the family's land on South Kihei Road to both the Mormon and Catholic churches. In addition to other businesses, Mildred noted that her father had a wood cutting business, which involved harvesting kiawe in the area and supplying it to the plantations.

During the interview Ms. Wietecha did not recall any other Hawaiian families living in the Kihei area, except the Hoopii family that lived by the cove. She did note, however, the Plantation Store in Kihei that was managed by the Ventura family and which sold men's shirts and fabrics. She also remembered the Tokokio Store which sold groceries and was located on the current site of the Foodland supermarket.

Ms. Wietecha emphasized that while the Wailea area was not considered part of the plantation and consisted mainly of pasture lands, there were several plantation housing communities (Japanese, Filipino and Portuguese) in the area. The workers living in these areas would have had to commute to Puunene to work in the plantation fields. In speaking specifically about the Honua'ula property, she noted that there were never any homes in this area of Kihei/Wailea and that it was characterized by kiawe trees. The beans were often picked from these trees for use as pig food.

In regards to cultural activities in the area, Ms. Wietecha said that her father had a successful fishing company and that he had provided employee housing for his boat crew in the Kamaole area of Kihei. She recalled helping with the pulling in of the nets as a small child.

It did not appear that Ms. Wietecha had any specific concerns related to the proposed Honua'ula project.

Discussion of Findings

Each of the individuals interviewed had something to contribute about life in the Honua'ula District and the surrounding areas. The three most knowledgeable individuals regarding the subject region were; Messrs. Edward Chang Jr., Kevin Ka'iokamalie, and Ransom Piltz. These three individuals, all related to the Kukahiko family of Makena, grew up in different time frames, lived separate lifestyles, but all three speak the same language about the land and the ocean of the Honua'ula region. Mr. Eugene Clark interestingly spoke of the relationship between the upland farmers and the coastal fishermen, a traditional pattern of life that continued over centuries in the Honua`ula region.

The concerns raised by the oral interviews addressed the deleterious effects of development in general on the region and no specific concerns were raised that related to the proposed Honua`ula project. These concerns included impact on coastal fishing, the rising property taxes that make it difficult if not near impossible for Hawaiian families to maintain any coastal property in the subject region, shoreline access in developed areas, gated communities, the loss of traditional Hawaiian place names, the potential loss of good grazing land for cattle, the desecration of Hawaiian culture, and the desire to keep new development out of the region. None of the interviewees shared any proprietary knowledge about specific traditional cultural resources or practices within the boundaries of the project area.

CULTURAL RESOURCES PRESERVATION PLAN

Historic preservation initiatives must take into consideration the most effective, yet practicable, means of meeting the various needs of the community including those that pertain to; the land-owner, neighboring residents, regulatory bodies, Native Hawaiian organizations, and other interested parties and individuals. Generally, the implementation of these initiatives must also follow regulatory compliance guidelines.

What becomes clear upon reviewing many previous archaeological reports and their recommendations, are the changing perceptions and philosophies that have taken place over a fairly short period of time; two to three decades, regarding preservation of archaeological resources in the modern era. The earlier convention, from the 1950s and 70s, shows a tendency for preservation of only "prominent" or "aesthetic" sites, often in isolation, with very little surrounding buffers. Hindsight shows that such "simple accommodation" of cultural resources served primarily to save selected sites from destruction, but did not contribute much more to interpreting the prehistory or history for the general public. In the 1980s and 2000s, the focus, reflecting a more "environmental approach," appears to have shifted to the preservation of larger complexes, sometimes referred to as "precincts," that better embody, not only the functions and spatial relationships among the various remains, but also retain a sampling of the surrounding environment. The emphasis shifted from simply preserving "sites" to preserving representative portions of a "cultural landscape." More recently, these initiatives have further evolved to encompass, cultural and biological landscape restoration, such as exemplified in the number of proposed preservation plans for the subject Honua`ula Development.

At the same time, related changes have come in the manner in which members of the community perceive the various elements of preservation and take a more active role in planning, implementing, and at times driving the preservation initiatives. The potential for educational, academic, cultural, and traditional practice opportunities are being actively explored and pursued. Thus, in the twenty-first century, the emphasis is towards a more pro-active coordination among the cultural and archaeological proponents together with the owners and developers, so that the archaeological elements can be viewed and interpreted as one of the components that define the cultural context of a region. Care must be taken to make a clear distinction between folklore and contemporary fable.

In the Honua`ula development area, the accumulated body of archaeological data is available and the extant sites have been protected in a large private holding of an owner who is highly amenable to not only mitigating, but avoiding when feasible, the potential adverse effects of proposed development on the cultural resources. These factors facilitate planning and implementation of historic preservation-related activities and ensure continuity of a consistent process. Current protection of the resources is also enhanced by restricted access and future disposition through more flexibility in avoiding significant resources and the increased capacity for accommodating *in situ* preservation strategies.

PRESERVATION PLAN VIEWPOINTS

Two viewpoints for the current, as well as all, cultural resources preservation plan(s) can be described as follows:

Regional

On a broader perspective, this plan takes into account the archaeological and cultural context of the whole region and considers site distribution within traditional land-use boundaries, not modern land ownership boundaries, when evaluating and recommending sites for preservation and possible interpretation. Thus, knowledge of the site-types represented in the preservation initiatives of neighboring land-owners is an important aspect guiding the preservation program for the Honua`ula Development Area.

Project Area

On a project-area-specific level, this plan, following conventional regulatory requirements, necessarily evaluates the extant sites within the context of the discrete project area. Criteria such as age and function, as well as frequency of site-type representation, shall be applied towards the evaluation and selection of sites for various types of preservation from within the population of extant sites in the project area.

Chronological Context

One of the key considerations is the age of the remains being preserved and interpreted. In an area such as Honua`ula with traditional life-ways and land-use being impacted relatively early in the historic period through events such as the arrival of cattle, age determinations of extant remains are extremely important. This is important not only for the accurate representation of the time period being interpreted, but in understanding the foundational shift in land-use from essentially shoreline to mountaintop within the bounds of an *ahupua`a* to circum-island, lateral movement across multiple *ahupua`a* and *moku* boundaries. Thus, recognition of the changes in settlement patterns, site densities, and site types is essential for accurate and meaningful preservation planning. Careful archaeological data gathering, for those sites with no associated oral

information, is often the only way that such age determinations can be made; as an example, to determine the individual ages of the various components of a multi-feature complex that may have been continuously occupied over an extended time period.

IDENTIFICATION AND DESCRIPTION OF RESOURCES

Knowing the types and numbers of elements that make up the available resources is an important initial step in formulating a preservation program. There are two main classes of resources; cultural and archaeological. These are briefly identified and described in the following sections.

Cultural Resources

Although archaeological resources comprise a part of the cultural resources and are more readily identified, quantified, and evaluated; other aspects of cultural resources are sometimes not as apparent and not as easily identified and evaluated. This is especially true of non-material regional resources, such as place names and specialized protocols, since the expertise is only found in persons with intimate or long-term knowledge of the subject region or particular locality. These individuals must first be identified, searched out, and consulted, if acquiescent.

Cultural Consultation

During the initial planning stages of the proposed Honua`ula development, several on-site tours and discussions involving the archaeological and cultural components were held with various members of the community. An informational presentation was given to the Maui Cultural Resources Commission. Pertinent input, received informally at these sessions was taken into consideration to come up with provisional recommendations and after further consideration was included in the current plan. An example is the recommended preservation of the Site 1/200 wall.

Specific input was also sought from key individuals and Na Kupuna O Maui. A number of valuable recommendations resulted from initial discussions with an in-house cultural group consisting of Ms. Hokulani Holt Padilla, Mr. Kimokeo Kapahulehua, Mr. Keli'i Tau'a, and Mr. Clifford Naeole. The Native Hawaiian organization, Na Kupuna O Maui, under the leadership of Mrs. Pattie Nishiyama and their regional representative, Mr. Kimokeo Kapahulehua, retains the primary role in consulting with the owner and in interacting with other Hawaiian organizations regarding matters related to cultural preservation, protocols, and practices. Following a series of Maui County Council hearings, conditional zoning was granted for the Honua`ula Project. To fulfill one of the stipulated conditions, public input was sought prior to preparation of the current plan. Upon evaluation of the responses, pertinent factors were addressed in the current plan.

I Kū Mau Mau
Traditional

An ancient chant that was used by our ancestors: It was also used by KCC members in the upland forests of Maui as we pulled out the *koa* log which then became our *koa* canoe, Ku Koa Manutea. This chant carries a lot of *mana* and provides spiritual uplifting. Today, we continue to chant *I Ku Mau Mau* with an understanding of *kaona* ("hidden, double meaning"). Although we are no longer in the forest of the uplands, this chant still brings us together and asks us to work together to accomplish our goals.

One: *I kū mau mau*	One: Stand up in couples
All: *I kū wa*	All: Stand in intervals
One: *I kū mau mau*	One: Stand in couples
All: *I kū wa*	All: Stand in intervals
One: *I kū mau mau I kū hulu hulu i ka lanawao*	One: Stand in couples. Haul with all your might. Under the mighty trees.
All: *I kū wa*	All: Stand in intervals
One: *I kū lanawao*	One: Stand up among the tall forest trees.
All: *I kū wa* All: *I kū wa huki I kū wa kō I kū wa a mau* All: *A mau ka e ulu e huki e* All: *Kūlia!*	All: Stand in intervals. Stand in intervals and Pull. Stand at intervals and haul. Stand in place and haul. Haul the branches and all. Haul now. Stand up my hearties. Hold your breath now. It moves, the God begins to run.

Oral Traditions

Starting from mythology and legends that included references to places in the region, there are other well-known stories and folklore recounted for generations by the inhabitants. Two such sayings are cited in a preceding section. The compilation of not only this conventional folklore, but the recording of individual stories and experiences of area *kupuna* are invaluable resources that aid in interpreting the unique aspects of a particular region. Much information regarding traditional place names, protocols, practices, as well as glimpses of daily life were gained from oral interviews conducted in conjunction with both the current plan and the cultural impact study.

Maui Ke Kupua
by Keli'i Tau'ā

Maui in ancient times was a super-demigod throughout the Pacific Islands and received much praise for all his feats. When speaking of Maui the demigod, he and his brothers were identified as Maui-mua, the eldest; Maui-waena, the second; Maui-iki-iki, the smallest and Maui-akamai, the smartest. Maui-akamai was given credit for all of the great deeds.

Hui – 'O wai 'oe ? *Maui ke kupua*	Hey, who are you? Maui the demi-god
Eia au o Mua ka hiapo	I am Mua the eldest
Maui ke kupua *Makua kane Akalana* *Wahine Hina-a-ke-ahi* *O luna, o lalo, o uka o kai* *Eia no mākou*	Maui the demi-god I am the father I am the mother We are above, below, in the uplands and the sea Here we are - o Maui
Maui ke kupua *Eia au o Waena ka hua*	Maui the demi-god I am Waena the second
Maui ke kupua *Makua kane Akalana* *Wahine Hina-a-ke-ahi* *O luna, o lalo, o uka o kai* *Eia no mākou*	Maui the demi-god I am the father I am the mother We are above, below, in the uplands and the sea Here we are - o Maui
Ola ka hana 'āpiki kolohi o Maui	Here are the rascal activities of Maui
O ka ua mua ia, paio haka, hina ua kia'i *O ka ua alua ia, Ki'i ka pu awa hiwa* *O ka ua akolu, ke ka'eka'e o ka 'ahu'awa* *O ka ua aha, o ka 'ohe o Kane a Kanaloa*	First, quarrel, fall, guard Second, take the black awa Third, the sedge Fourth, the bamboo of Kane & Kanaloa
Maui ke kupua *Eia au o Ki'iki'i ke kolu*	Maui the demi-god I am Ki'iki'i the third
Maui ke kupua	Maui the demi-god
Makua kane Akalana *Wahine Hina-a-ke-ahi* *O luna, o lalo, o uka o kai* *Eia no mākou*	I am the father I am the mother We are above, below, in the uplands and the sea Here we are - o Maui.

Maui ke kupua	Maui the demi-god
Ela au o Akamai ka muli loa	I am Akamai the last son
Maui ke kupua	Maui the demi-god
Makua kane Akalana	I am the father
Wahine Hina-a-ke-ahi	I am the mother
O luna, o lalo, o uka o kai	We are above, below, in the uplands and the sea
Eia no makou	Here we are o Maui
Ola ka hana `a-piki kekahi o Maui.	Here are the rascal activities of Maui
O ka ua alima, o ka paehumu	taboo enclosure at chief house or heiau high place
O ka ua aono, o ka nu`u	fishhook
O ka ua ahiku, me ka Manai-a-ka-lani	hook the islands
Iou (a) na o nā moku, e hui ka moana kahiko	catching the mudhen of Hina
ki`i ana ka `alae nui a Hina	
O ka ua hope, kilika ke kaua a Maui i ka Lā	the last wrestling w/the sun
Lilo makali`i i ka Lā, lilo ke kau la Maui	Winter was the suns, summer Maui
O kaua i ka ho`āpā`āpā	rubbing up & down
Puni Hawai`i, Puni Maui, Puni Kaua`i, Puni O`ahu	circling Hawai`i, Maui, Kaua`i O`ahu
Hā`ule i Hakipu`u i Kualoa	passed at Hakipu`u, Kualoa
O Maui-a-ka-malo	Maui of the Malo
O ka ho`okala kipua o ka moku	releasing the islands
he moku – no	An island
`ā hui hou o Maui	We will meet again

Cultural Practices

The variety of cultural activities known from the region, not only includes indigenous Hawaiian practices such as the planting of *`uala* and the associated rituals, but also those that were introduced historically by other ethnic groups that immigrated to Hawai`i. The following discussion shows that some of these were continuation of traditions and practices associated with a specific cultural group, while others came about as a reaction to local environmental conditions or other unique situations, such as Haleakala's rain shadow or the roaming herds of wild cattle. Many traditions were modified and adapted. A few had tremendous and long-term impact on Hawaiian culture and history.

E Hele Mai Nei Au
Traditional

E hele mai nei au

E noi ia `oe e Kane

E la`au e ola ai ka`u kino o pu`uwai
I ulu iluna

I ku iluna

I lala iluna

I liko iluna
I `opu iluna
I mohala iluna
I pua iluna

I hua a `o`o iluna
I pala iluna o e
Amama, ua noa

I have come
to request you o Kane
Medicine for my body
that grew above
that stood above
that branch above
that opened its flowers above
that budded and leafed above
that full-bloomed above
that flowered above
that bore fruit & matured above
that ripened above

Eia ka `ai
Traditional: From *Sites of Maui* (Sterling 1998:10)

Eia ka `ai	Here is the food
Eia ka i`a	Here is the fish
Eia ke kapa	Here is the kapa
Nou e Ka`ala-miki-hau	For you, Ka`ala-miki-hau
Nana ia`u kau pulapula	Look upon me your devotee
I mahi`ai	That I can cultivate the ground
I lawai`a	That I may fish
Kuku kapa	And beat the kapa
`A`e ola ia`u, Kanui	Grant life to me, Kanui

Traditional Hawaiian

As told by the persons interviewed as well as through the results of other research, the Honua`ula region was noted for an abundance of different types of fishing and gathering from the ocean. The fish caught involved shoreline, reef, and pelagic species. The deep ocean fishing was done using the *wa`a*—outrigger canoe. The ancient Hawaiians used nets as well as hook and line methods with tools made from plant, animal, and lithic raw materials. Maly in *He Mo`olelo `Aina No Ka`eo Me Kahi `Aina E A`e Ma Honua`ula O Maui,* cites articles from a native newspaper in 1902 that described two kinds of net fishing, *Hoauau* and *Hoomoemoe* (2005:41).

Due to the arid climate, the variety of agricultural products was relatively limited and the inhabitant probably depended on exchanges with inland farmers for some of their staples. The dominant cultigen appears to have been sweet potato, although dry land taro, sugar cane, and yams are also mentioned. Honua'ula produced sweet potatoes enough for the local families as well as Irish potatoes for exporting to California during the Gold Rush and the Irish potato blight.

Evidence of recurrent seasonal habitation as well as some permanent and temporary habitation can be found in the archaeological record. There also seem to be localized innovations of site types and exploitation of zones of micro-climatic variations.

Paniolo

The *paniolo* or cowboy was introduced into the district with the advent of ranching in the mid-1800's. The original *paniolo* (meaning "Spanish," probably a transliteration of the word *espanol*) came from Spain. They came to teach the Hawaiians how to become cowboys. At that time Hawaiians did not have horses and had no understanding of how to manage large numbers of cattle. The *paniolo* came to teach horse-riding, herding, and other ranching skills. Some Hawaiian individuals excelled as cowboys and are still remembered today as Champions of National Competitions on the mainland United States. The introduction of horses and other beasts of burden, namely donkeys and oxen not only facilitated the transportation of people and goods from place to place, but influenced changes in the traditional *mauka-makai* concept of land division and use into circum-island, lateral patterns.

Chinese

Eddie Chang, one of Hana Pono's interviewees, is a son of a Chinese immigrant. His lifestyle is a testament to the assimilation of the Chinese into Hawaiian society early in the historic period.. The inter-marriage of Chinese male to Hawaiian females provided the Chinese with the opportunity to build on and possess Hawaiian lands. All foreigners into the islands recognized that, in order to build their lives and their wealth it was imperative to own land. On the other hand, the Hawaiians, whose values were different, never questioned the foreigners' intentions.

Other Ethnic Groups

Probably resulting from early attempts at commercial agricultural pursuits involving sugar-cane ceasing relatively earlier and never experiencing the large-scale growth when compared to other areas of the island, ethnic groups associated with plantation labor was not well represented in the subject region. Plantation camps, affiliated with large-scale sugar cane and pineapple cultivation,

with communities of Filipino, Japanese, and Portuguese were located in Wailuku, Puunene, and Lahaina. Some Portuguese *paniolo* lived and worked in the *mauka* portion of the region in Ulupalakua. Thus, ranching became the commercial activity with longevity in the Honua'ula region.

Archaeological Resources

Generally, the archaeological resources of an area can be divided into two major categories based on their period of origin; prehistoric and historic. In Hawai'i, the prehistoric period ends in A.D. 1778 and the historic period is defined as starting from that year to an ever-changing sliding scale of fifty (50) years preceding the current year (ie. for 2009, any remains dating from 1959 and older is legally defined as "historic").

Prehistoric Period

The sites representing this period can be defined as Indigenous Hawaiian or Traditional Hawaiian and consist solely of features constructed of indigenous materials such as earthen terraces; dry-masonry, stone structures; or modified natural features such as overhang and lava tube shelters. Sites from this period may range in chronology from around A.D. 400 to A.D. 1778 in different parts of the Hawaiian islands, but in Honua'ula the early part of the range, with a few exceptions, is more likely around A.D. 800-1000. Researchers have subdivided the prehistoric period into smaller increments that represent the progression of human adaptation and occupation, from Polynesian discovery to Western contact, on each of the major islands and for the Hawaiian archipelago in general. As discussed in an earlier section, 32 of the 40 sites are provisionally interpreted to represent traditional-type sites (see Table 2). Fourteen (14) of the fifteen (15) sites, recommended for preservation, are also in this category (see Table 1).

Historic Period

The sites representing this period, generally exhibit the largest diversity in form and type. Although during the early years of the historic period, not much change was seen from the traditional or indigenous Hawaiian site types in areas other than those localities that experienced early Western contact and subsequent urbanization. The earliest indicators of the advent of the historic period were the artifacts and the exotic materials they were made from; glass, metal, and ceramics. The time lag in the distribution of these goods can often be seen in direct proportion to the distances from the dispersal centers. After a few decades, the style of structural features, the various components of sites, and building materials were influenced by the outside world. One rather unique aspect of the Honua'ula region was the introduction of cattle during the early historic period. Because the cattle were gifted to a high chief, they were considered *kapu* and could not be harmed. Thus, allowed to roam and graze freely over the land, the wild cattle quickly became a scourge to farmers and other inhabitants of the region. A localized site type, the exclosure wall, developed as a reaction to the marauding herds of wild cattle. Thus, many sites from this period are protected by a perimeter wall surrounding areas of varying sizes from single dwellings to whole complexes occupying several acres in size.

With the decline of traditional life-ways, land boundaries, and religious practices; tremendous changes took place in the towns, villages, and hamlets throughout the islands. The introduction of cattle, commercial agriculture, private ownership of land, advent of Christianity, and Western mercantilism brought irreversible changes to the landscape as well. People from Asia, Europe, and other parts of the world immigrated to Hawai'i.

In the project area, 8 of the 40 sites are interpreted to represent historic period sites (see Table 2). One site, the long wall that separates the southern portion from the northern portion of the project area has been provisionally recommended for preservation (see Table 1).

SUMMARY AND DESCRIPTION OF PRESERVATION METHODS

A cultural resource management program that is well-planned and judiciously implemented balances the preservation component with a data recovery component that will contribute to the available body of archaeological data and enhance the interpretive value of the *in-situ* physical remains. Eighteen (18) of the 40 total sites have been recommended for data recovery and 7 have been slated for no further work (see Table 1). A data recovery plan articulating the scope and methods for each site designated for further data recovery shall be prepared for review by SHPD and submitted under separate cover.

A summary of the conventional preservation methods are presented in this section. The various procedures and considerations described guide the formulation of appropriate criteria and guidelines for the historic preservation program involving the proposed Honua'ula Development area. In the current project area, a total of fifteen (15) archaeological sites are recommended for *in situ* preservation. Fourteen (14) of these occur within the southern section (Fig. 9) and one solitary site occurs in the northern section (Fig. 10). Each of the sites are briefly described along with the recommended preservation measures for each site.

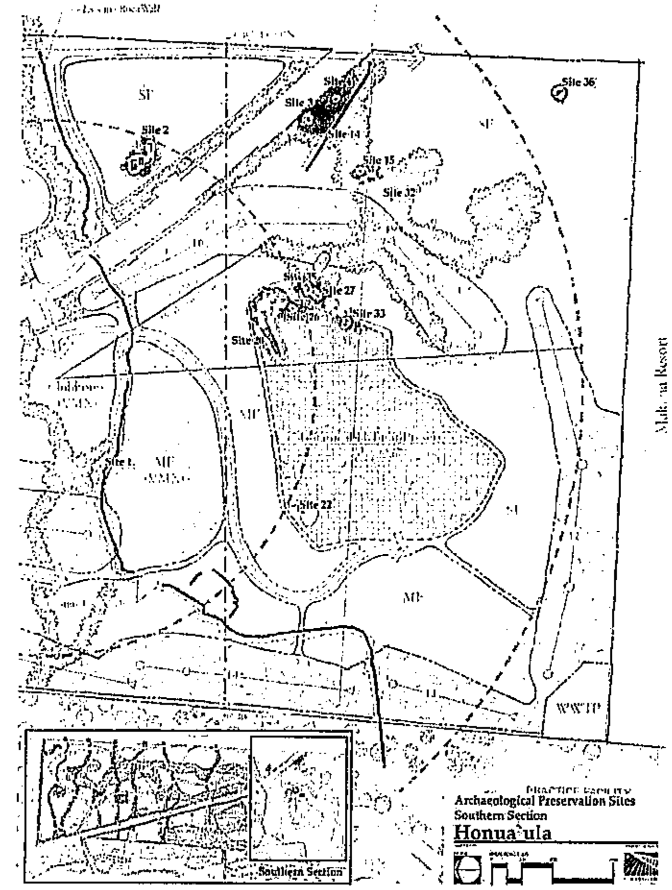

Figure 9. Locations of All 14 Sites Slated for Preservation in the Southern Section

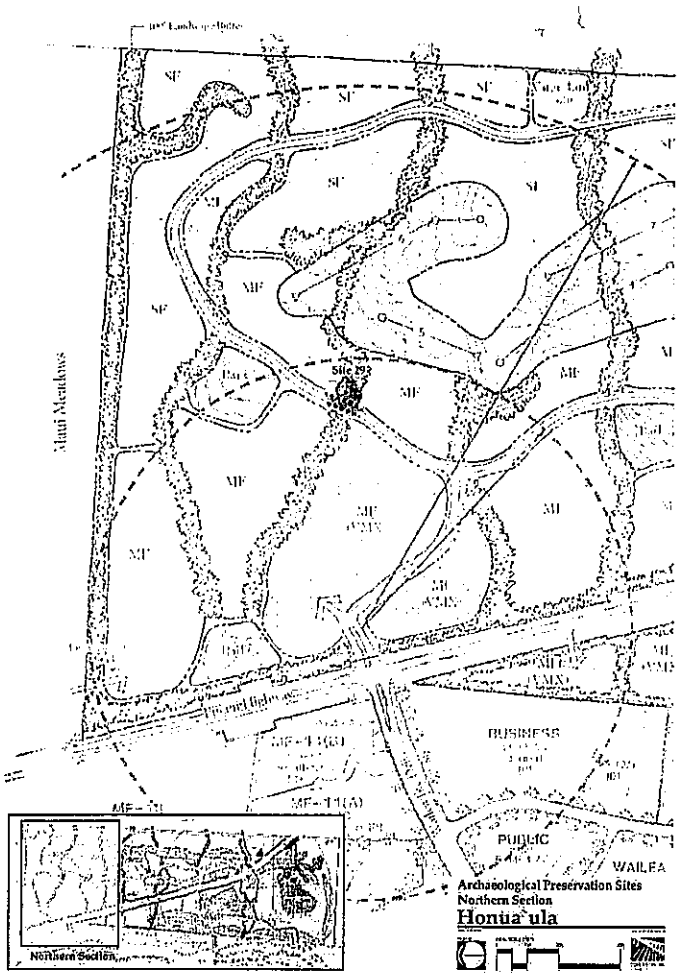

Figure 10. Location of Site 29, the Solitary Site in the Northern Section

Selection Criteria

Fifteen (15) of the 40 total sites are recommended for preservation. The current procedure presented an opportunity to revisit these recommendations in the context of input received from the public solicitation, thus Site 29 the solitary site in the northern sector was added to the preservation category. The criteria for selection of sites for preservation include the following:

1. The selection of sites and complexes for permanent *in situ* preservation that best represent particular chronological periods, functions, and the specific intermediate inland activity zones and micro-environments of the subject region;
2. The selection of areas with easier and safer accessibility when such choices are available and warranted;
3. The preservation of sites and localities that can be used for an integrated interpretive program throughout the property, *ahupua'a*, and its neighboring areas;
4. The preservation of religious and confirmed burial sites (currently none) with restricted or exclusive access for Native Hawaiian and confirmed descendent visitation;
5. The selection of sites and complexes for further data recovery procedures in order to enhance the archaeological data base and the interpretation, as well as the interpretive value of the preservation areas;
6. The selection of those sites that best represent the assemblage of sites present in the project area and
7. The selection of those sites that occur in areas that will not be impacted by proposed activities and have potential to yield additional data for data banking.

Preservation Alternatives

The nature of preservation can vary based on the desired disposition of those sites slated to be preserved. Generally, appropriate measures are articulated in a preservation plan that is reviewed and cannot be implemented until approved by the State Historic Preservation Division. The identification and implementation of appropriate short-term or interim site protection measures are important to minimizing the potential adverse effects of construction activities and inadvertent encroachment during construction. Likewise the identification and implementation of long-term or permanent site protection measures are important to the continued protection of archaeological and cultural resources. The alternatives are discussed in the following section.

Short-Term Preservation Measures

The following tasks are important primarily in ensuring that, during construction, inadvertent damage or other adverse impacts do not befall sites slated to be preserved. These include:

1. Pre-commencement meetings to inform all pertinent parties regarding the locations and buffer zones for all sites slated for preservation in or near areas of potential effect (APE),

2. The erection of temporary construction fencing (orange plastic) or other visible markings defining the no encroachment buffer zones around the perimeter of sensitive areas,

3. If warranted, the installation of protective supports or covers to better protect the integrity of fragile or delicate features,

4. Regular monitoring of preservation sites and construction activities; and

5. Following completion of construction, ensure transition to permanent preservation measures.

Long-term Preservation Measures

The two typical categories of the long-term or permanent preservation method are passive and active as described below:

Passive Preservation

Sites in this category do not undergo any interpretive development, occur in areas that can be avoided by development, and are left as is. This category is sometimes referred to as "data banking." Most sites in this category are not intended to be permanently preserved, but are anticipated to undergo data recovery procedures in the future, presumably when more improved data gathering techniques and refined analysis technologies are available or on large tracts of land where development is intended to take place in incremental phases.

Active Preservation

Sites in this category are chosen for their interpretive potential. Their selection may be based on aesthetic, academic, or cultural representation values. Different levels of interpretive development may be undertaken, including; stabilization, partial or complete restoration, and/or reconstruction. Signage maybe involved and details regarding access and protocols will need to be worked out. Religious and burial sites will have restricted access by appropriate practitioners and lineal descendents.

Technical Aspects of Preservation

Specific aspects regarding preservation have resulted from incorporating some of the public input into the draft preservation plan. The elements of the plan for which community input, especially from Native Hawaiian groups, are incorporated include:

1. The mode of preservation, passive or active, recommended for specific sites;
2. The nature of access to religious, ceremonial, and confirmed burial sites;
3. The determination of appropriate traditional protocols and practices;

4. The size and types of buffer zones and appropriate protective barriers;
5. The need for any stabilization or restoration;
6. Whether signage is appropriate and if so, the type, design, and content of the signage;
7. The types of native flora to be used for landscaping or barriers; and
8. The establishment of educational and community stewardship programs.

All of the queries that have been addressed will be evaluated for inclusion with the site-specific recommendations. However, details such as the design, type, and contents of signage; as well as determination of the appropriate native flora to be used for landscaping need to be finalized for property-wide application also conforming to design guidelines of the development. A selection of native flora, represented in the area and considered suitable for use as vegetation buffer includes: *'a'ali'i* (*Dodonaea viscose*), *awikiwiki* (*Canavalia galeata*), *'ilima* (*Sida fallax*), *kolomana* (*Senna surrattensis*), *maiapilo* (*Capparis sandwichiana*), *ma'o* (*Abutilon grandifolum*), and *naio* (*Myoporum sandwicense*). In general, the site type, site number, a brief narrative, and wording requesting respect for the site shall be included in all signage. Final approval for signage will also be based on SHPD review and concurrence to the narrative contents.

The wording for the signage shall be similar to the following templates:

SIHP No. 50-50-14-4951
Hawaiian Steppingstone Trail for Traversing Aa Lava Lands
Pre-contact Period
Palauea *ahupua'a*, Honua'ula *moku*, Maui Island
Please Respect and Protect this Significant Cultural Heritage

SIHP No. 50-50-14-200
Land Boundary or Cattle Exclosure Wall
Historic Period
Palauea *ahupua'a*, Honua'ula *moku*, Maui Island
Please Respect and Protect this Significant Cultural Heritage

The size and types of buffer zones and even the necessity for protective zones around a site varies greatly with each site, the existing topography, or proposed land use of the surrounding areas. In some instances the natural topography or vegetation zones will constitute adequate protection from casual encroachment. In other areas, buffer zones may require a more clear demarcation, such as a wall, fencing, or plantings. Specific rules regarding golf play for sites in and around the golf course will be developed in conjunction with the course management and owner. Continued consultation with Native Hawaiian organizations, in coordination with Na Kupuna O Maui, regarding the implementation of proper cultural protocols for pertinent elements of the plan, will be maintained.

SITE SPECIFIC PLANS

This section presents site-specific, short-term and long-term preservation measures for each of the fifteen (15) sites slated for *in situ* preservation. Illustrations and photographs of thirteen of the fifteen sites recommended for preservation, with preservation buffer detail drawings, are presented in Figures 10 through 34. Two trail segments (Sites 22 & 32) are not illustrated since Site 14 provides the best representation of the steppingstone trail type. The site numbers cited in the captions follow the sequence of numbers (1-40) in the left-most column of Table 1.

Site 1: Long Free-standing Wall

This is the roughly 2700-meter long, free-standing wall that runs along the northern and western boundaries of the southern third of the project area (Fig. 11). This site traverses across Golf Course, Naturalized Landscape, Multi-Family Residential, and Village Mixed Use designated areas within the southern section of the Honua'ula development area. Generally, at the east/west trending segment of the wall, a roadway parallels the wall on the northern side at distances ranging from 2.0 to 30.0 meters away from the wall. In areas, the wall traverses along outcrop ridge-tops, especially at the *mauka* segment of the wall. This well-constructed, free-standing wall extends beyond the eastern and western boundaries of the project area. It appears to have served to prevent cattle going into the aa lands that comprise the southern third of the project area and is interpreted to originate during the early historic ranching period.

Buffer Zone

A no encroachment zone of three (3.0) meters on each side of the wall, comprising roughly a six (6.0) meter wide corridor with the wall in the center is recommended for this site. In areas where the wall is constructed atop outcrop ridges, the ridge formation can serve as the buffer. Grading will be limited across this corridor, with the exception of existing breaches for roadways, the Pi'ilani Hwy extension corridor, and at four fairways. Any vegetation removal should be done manually.

Short-term or Interim Protection Plan

The six (6.0) meter wide corridor should be clearly marked on the ground with stakes and flags or orange plastic fencing during the duration of construction activities to prevent any accidental damage to the wall. Special care should be taken to mark the wall ends at existing breaches to prevent further damage to the intact segments of the wall. The markings or fencing should be periodically monitored to ensure that they are in place and clearly demarking the buffer zone.

Figure 11. View of the Site 1 Wall Near Its Western Terminus to East

Long-term or Permanent Preservation Plan

The Site 1 wall shall be preserved by incorporation into the landscaping design and also within golf course roughs. Sections tumbled by deer and both ends at existing breaches should be stabilized and restored.

Site 2: Feature Complex

This five-feature complex (Figs. 12-13) is located east of the Pi'ilani Highway extension corridor and consists of a roughly 4100 square meter area. The component features consist of a meandering low wall; a low, oval clinker platform; parallel wall segments; a large terrace platform; and a small, walled overhang. This site complex occurs in an area designated for Single Family residential development near the northeast corner of the southern area.

Buffer Zone

A no encroachment zone five (5.0) meters from the exterior of the outer-most features shall be continuously delineated to define a perimeter around the complex (Fig. 14). In some areas, natural topographic barriers such as steep ridge-sides shall be incorporated as buffers.

Short-term or Interim Protection Plan

The perimeter of the complex should be clearly marked on the ground with orange plastic fencing during the duration of construction activities to prevent accidental encroachment by heavy equipment. The fencing shall be periodically monitored to ensure that it is in place and clearly demarking the buffer zone.

Long-term or Permanent Preservation Plan

The Site 2 complex, representing a probable agricultural/habitation compound, is suitable for permanent *in situ* preservation and interpretive development. Signage and possible inclusion in a self-guided walking tour trail network is envisioned. Depending on the immediate surroundings, either a vegetation or constructed barrier shall define the perimeter of this complex.

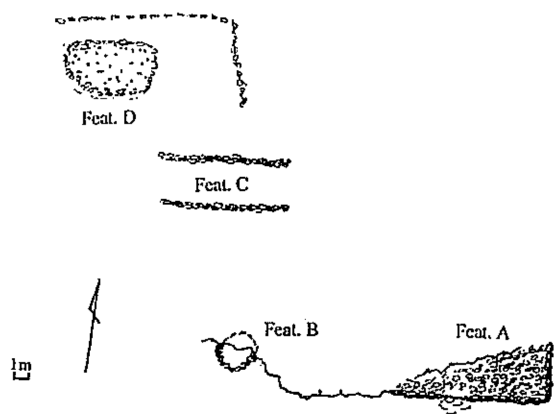

Figure 12. Plan View of Site 2* (201) Complex

Figure 13. (top) Site 2 Feature A Platform to West

Figure 13. (bottom) Site 2 Feature C Parallel Walls to East

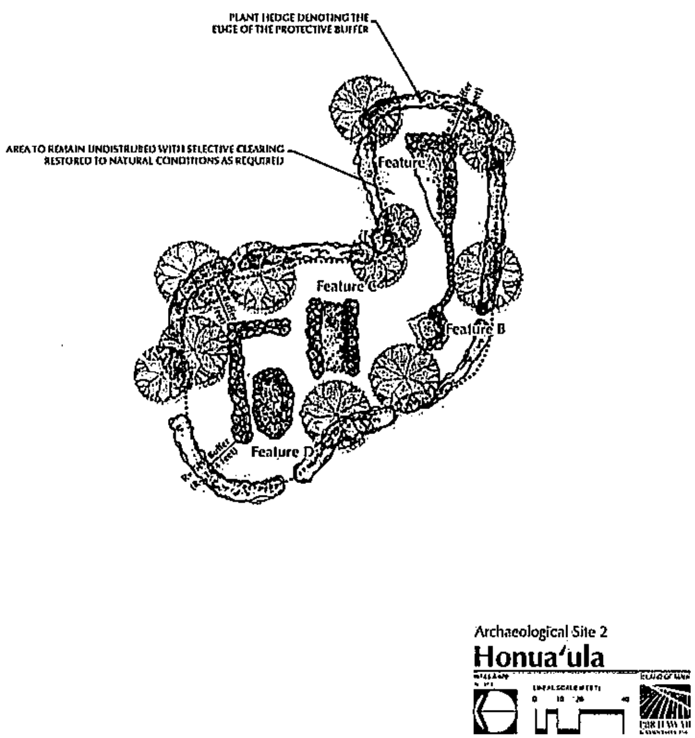

Figure 14. Conceptual Buffer for Long-term Preservation for Site 2

Site 3: Terrace Platform and Paved Area

This site consists of a terrace platform (5.5 m long, 3.9 m wide, and 1.2 m high) and a small paved area (2.0 by 1.0 m and one stone high) located 6.0 m north of the platform (Fig. 15). The platform is constructed along the northern base of a sloping outcrop ridge and the paved area occurs fronting the platform in a low-lying, level soil area. This two-feature cluster occupies a portion of the Native Plant Conservation Area located within the Single Family residential area near the central portion of the eastern boundary of the southern area.

Buffer Zone

A no encroachment zone five (5.0) meters from the outer-most extent of both features shall delineate the perimeter around this small two-feature cluster (Fig. 16).

Short-term or Interim Protection Plan

The perimeter of this cluster shall be clearly marked on the ground with orange plastic fencing during the duration of construction-related activities. The fencing shall be periodically monitored to ensure that it is intact and clearly demarking the buffer zone.

Long-term or Permanent Preservation Plan

The Site 3 cluster, representing a probable habitation site, is suitable for permanent *in situ* preservation. Signage and possible inclusion in a self-guided walking tour trail network may be a possibility. Depending on the immediate surroundings, either a vegetation or constructed barrier shall define the perimeter of this cluster. If feasible, Site 4, the neighboring modified overhang shelter site should be included within an expanded preservation area with Site 3. The occurrence of Site 4 within the existing Pi`ilani Highway extension easement corridor facilitates the combined preservation of the adjoining sites.

Site 4: Modified Overhang Shelter

This site is an overhang shelter measuring 3.7 m wide, 1.5 m deep, and 0.85 m high at the entrance. The area fronting the opening is modified by a 3.0 by 4.0 m level soil area enclosed by a U-shaped wall ranging in height from 0.2 to 0.8 m (Fig. 17). The exterior of the western portion of the wall is tumbled. This site is located roughly 30 m east of Site 3 in the same archaeological preserve within the Native Plant Conservation Area adjacent to the Ulupalakua Ranch easement corridor.

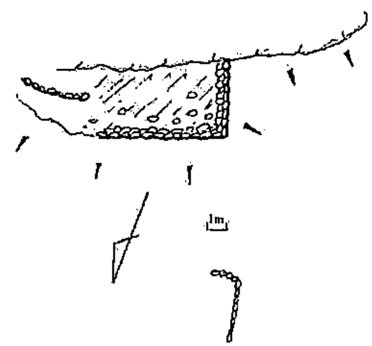

Figure 15. Plan View and Photo of Site 3*(204) Platform to East

Figure 16. Conceptual Buffer for Long-term Preservation for Site 3

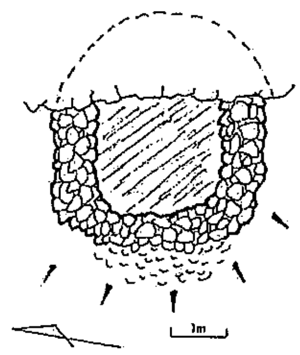

Figure 17. Plan View and Photo of Site 4* (205) Modified Overhang Shelter to East

Site 4 cont'd

Buffer Zone

A no encroachment zone five (5.0) meters from the outermost extent of the feature as well as the outcrop ledge into which the shelter intrudes shall define the perimeter around this site (Fig. 18).

Short-term or Interim Protection Plan

The perimeter of this site shall be clearly marked on the ground with orange plastic fencing during the duration of the construction activities. The fencing shall be periodically monitored to ensure that it is intact and clearly demarking the buffer zone.

Long-term or Permanent Preservation Plan

Site 4 is a good example of a modified overhang shelter used for traditional agricultural/seasonal habitation and appropriate for permanent *in situ* preservation. Signage and possible inclusion in a self-guided walking tour trail network may be a possibility. Depending on the nature of development in the immediate surroundings, either a vegetation or constructed barrier shall define the perimeter of this cluster. It may be feasible to interpret Site 4 within an expanded preservation area combined with Site 3.

Sites 14, 22, and 32: Steppingstone Trail Segments in Aa Flow

Site 14 is a discontinuous string of intact segments of a steppingstone trail located in an open aa flow near the boundary between Palauea and Keauhou *ahupua'a* at the eastern portion of the southern third of the Honua'ula Project area. The trail continues *mauka* into Ulupalakua Ranch property beyond the eastern boundary of the project area. Within the project area, this upper segment of the trail is discontinuous, but discernible over a length of roughly 200 meters by flat basalt slabs placed at 0.5 to 1.0 m intervals (Fig. 19). The alignment is oriented from southeast to northwest and several shorter discontinuous segments and/or branch trails also occur in open aa flows in *makai* portions of the project area. The steppingstones occur only within the aa flow areas and no formally marked trails are present along the pahoehoe outcrop ridges that are interspersed within the aa flow. This site, representing the longest of the remnant trail segments, occupies the same Native Plant Conservation Area as Sites 3 and 4.

Site 22 consists of two intersecting segments of steppingstone trails with four shallow, circular pits located in an aa flow in the central portion of the western area within the southern third of the project area, *makai* of the main jeep road. The north/south segment measures about 15 meters in

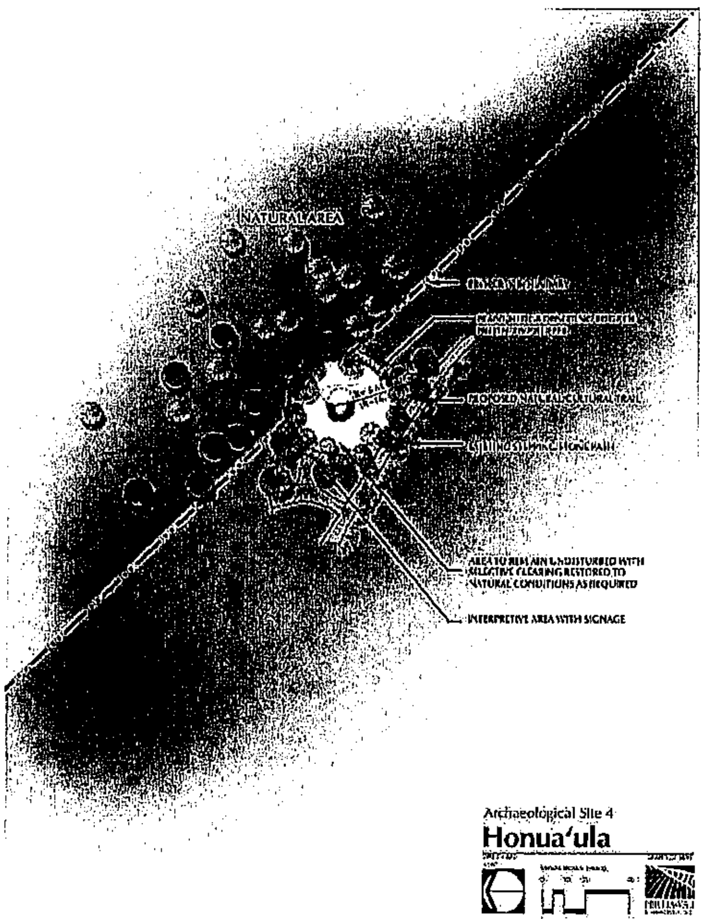

Figure 18. Conceptual Buffer for Long-term Preservation for Site 4

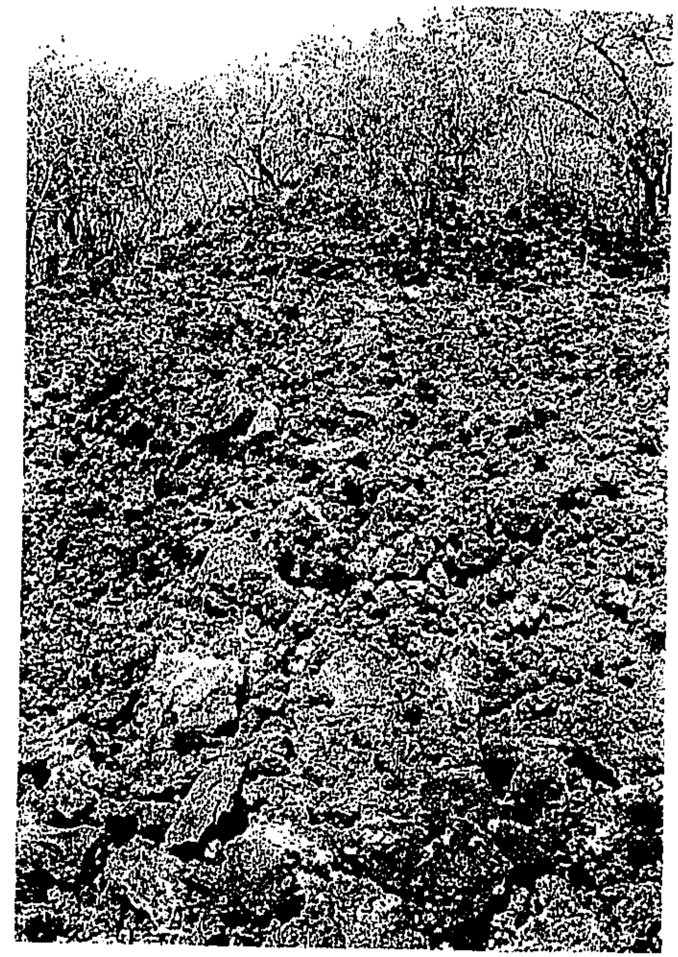

Figure 19. Photo of Site 14* (4951) Steppingstone Trail in Aa Flow to West

length. The east/west segment measuring roughly 20 meters in length may be a continuation of Site 14 which is located *mauka* on the same flow. At the western or down-slope end of this trail, are 3 to 4 shallow, circular pit features in the aa. These apparently artificial pits, resulting from removing aa rocks and clinkers to form symmetrical shallow depressions, range in diameter from 1.0 to 1.5 m and between 0.5 to 0.7 m in depth. They vary in appearance from pits left by dead trees. This site occupies a small area in a northwest portion of the main Native Plant Preservation Area.

Site 32 is a short segment of a steppingstone trail located on an aa flow in the Native Plant Conservation Area east of the break between Fairways 10 and 11 in the southern third of the project area (see Fig. 8). This segment, oriented north/south, measures 5 meters in length and only 4 stepping stones are visible. This short segment of a steppingstone trail remnant will be preserved within Fairway 13 of the golf course.

Buffer Zones

The eastern ca 200-meter segment of the Site 14 steppingstone trail will be included within the 14-acre Secondary Native Plant Management and Enhancement Area. Thus, a dedicated physical buffer zone would not be necessary since a large portion of the aa flow surrounding this site will be maintained intact.

A ca 400 square-meter no encroachment area shall be reserved around the two intersecting trail segments of Site 22 to protect the trail segments as well as the adjacent pits. Site 22 will also be incorporated within the boundaries of the ca 22-acre main Native Plant Preservation Area.

Site 32 shall be protected by a 5-meter wide no encroachment area surrounding the short trail segment. The buffer zone will encompass roughly 150 square meters.

Short-term or Interim Protection Plan

The eastern-most end of the trail and plant preserve near the fence-line along the east boundary of the project area pose special concern since a roadway is proposed to be constructed paralleling the east boundary. Roughly 5 meters of the trail and the terrain west of the fence-line have previously been disturbed during clearing and installation of the existing fence-line. The upper or eastern end of the native plant preservation area shall be clearly defined with orange plastic fencing to prevent further disturbance and encroachment during roadway and other general construction activities. Clearly marking the perimeters of both the Secondary Plant Management and Enhancement Area as well as the primary Native Plant Preservation Area will ensure the

protection of Sites 14 and 22 during construction. Orange plastic fencing shall be installed around the perimeter of the buffer zone surrounding Site 32. All marked perimeters shall be periodically monitored to assess the condition and ensure the integrity of the no encroachment zones.

Long-term or Permanent Preservation Plan

Sites 14 and 22 steppingstone trails are suited for permanent *in situ* preservation and public interpretation. Signage and inclusion in a self-guided walking tour trail network may be appropriate due to its accessibility and occurrence within native plant preservation areas. Site 32 would be reserved for passive preservation.

Site 15: Small Platform

This site is a small platform (2.3 m long, 1.5 m wide, and 0.7 to 1.3 m high) built against the northern face of an outcrop ledge (Fig. 20). This platform occurs in a low-lying area within the gently-sloping, central portion of the eastern half of the southern third of the Honua'ula project area. This small site will be preserved within the Native Plant Conservation Area adjacent to the east of Fairway 10 Green of the golf course.

Buffer Zone

A no encroachment zone five (5.0) meters from the exterior of each side of this rectangular feature shall define the perimeter around this site (Fig. 21).

Short-term or Interim Protection Plan

The perimeter of this site shall be clearly marked on the ground with orange plastic fencing during the duration of the construction activities. The fencing shall be periodically monitored to ensure that it is intact and clearly demarking the buffer zone.

Long-term or Permanent Preservation Plan

The morphological similarity of this site to some recently encountered burial sites further south in the Makena Resort property deems this site a candidate for permanent *in situ* preservation. Depending on the nature of development in the immediate surroundings, either a vegetation or constructed barrier may be appropriate to define the perimeter of this site. Based on the affinity of the morphology of this site to burials found in other areas of the region, passive preservation may be appropriate for this site. Limited exploratory testing to confirm the functional aspects of this site is recommended.

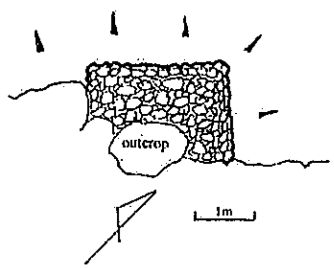

Figure 20. Plan View and Photo of Site 15* (4952) Modified Outcrop Platform to Northwest

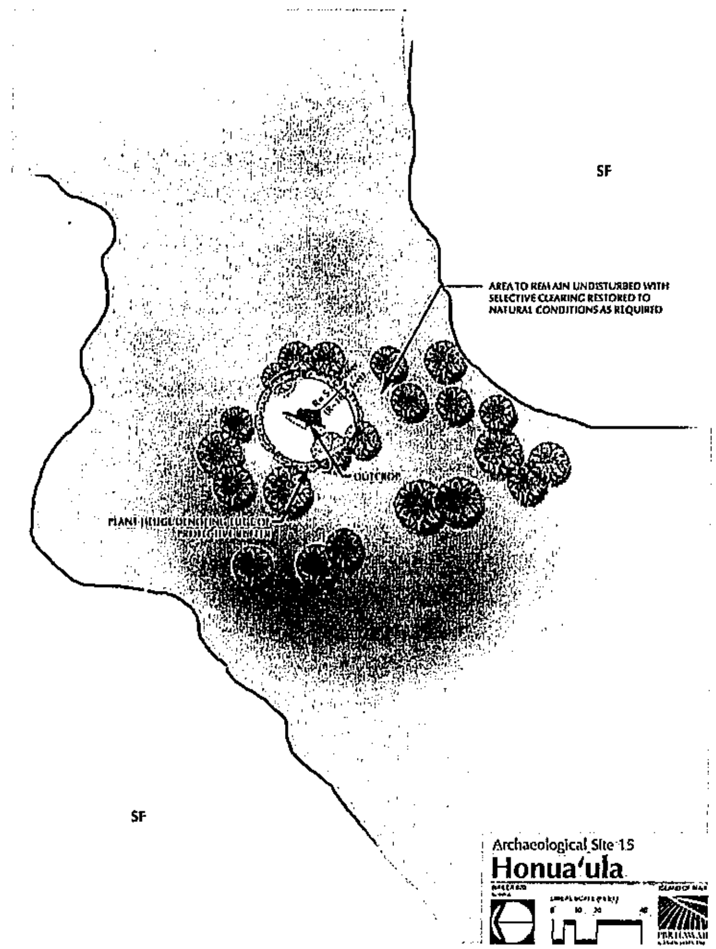

Figure 21. Conceptual Buffer for Long-term Preservation for Site 15

Site 20: Multiple Feature Ridge-top Complex

This complex of 6 features is located along a ridge crest on the southern edge of a shallow gulch in the northeastern quadrant of the southern third of the project area (Fig. 22). This complex encompasses roughly 3000 square meters and measures 100 m (northeast/southwest) by 20-50 m (northwest/southeast). This multiple-feature complex occurs at the northeastern tip of the main Native Plant Preservation Area surrounded by an area designated Multi-family Residential.

Feature A is a complex of modified outcrops on the base of an outcrop ridge located to the east of the main complex. These features consist of marginal fill areas, single stone alignments, and crude mounds representing probable agricultural features.

Feature B is a C-shaped enclosure measuring 5.0 m by 2.8 m with dilapidated walls ranging in height from 0.20 to 0.45 m. The enclosure opens to the west and the interior floor is soil. The southern portion of this structure incorporates a large outcrop into the wall.

Feature C is an open earthen clearing, adjacent to the outcrop ridge. It measures about 15 m east-west and 6 m north-south. Several clearing mounds of rocks and cobbles occur in the area between this feature and Feature C.

Feature D is a small platform built up against the southern base of the ridge just 4 m southwest of Feature C. It measures 2.4 m square and 1.0 m high at its southern facing. Its northern side is incorporated onto a bedrock ledge.

Feature E consists of a rectangular enclosure with two adjoining walled areas and several small activity areas that level and descend down the top of a narrow outcrop ridge towards the southwest (Fig. 23). The enclosure measures roughly 5.5 m square, with walls ranging in width from .80-1.0 m and 0.70-1.4 m high. A free-standing wall adjoins the southern corner of the enclosure and follows the edge of the ridge down-slope for 14.5 m. An L-shaped wall adjoins the enclosure on the northwest side to create a three-sided enclosed area. This wall follows the northern edge of the ridge for about 8.0 m. The interior floor areas are fairly clear of rocks and flat. A branch coral manuport was located outside the southwest wall of the enclosure. Below these structures are at least three, stepped, modified terrace areas each measuring around 6.0 by 3.0 m. Each terrace is about .35-.40 m lower. Modifications of rock and rubble fill areas and some boulder alignments define these terrace areas.

Feature F is a rectangular fire-pit located on the last or lowest, defined terrace area of Feature E (Fig. 24). It is located nearly centrally within a level floor area measuring 6.1 by 2.6 m. It is composed of four elongate, thin slabs of basalt set on end to form a rectangular enclosure measuring 0.73 by 0.56 m. and standing about 0.16 m above ground surface. Each of the slabs was buried about 12-14cm into the ground.

Buffer Zone

A no encroachment zone five (5.0) meters from the exterior of the outer-most features shall be continuously delineated to define a perimeter around the complex, except at the eastern portion of

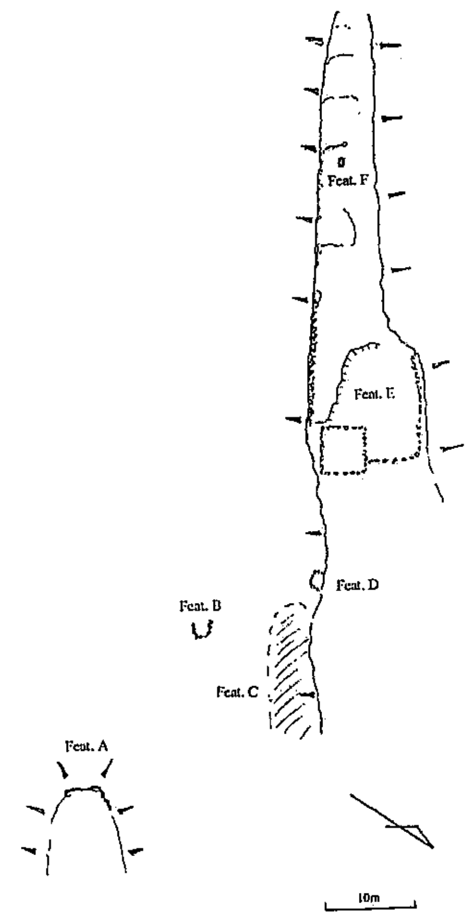

Figure 22. Plan View of Site 20* (4957) Ridgetop Complex

Figure 23. Site 20* Feature E Rectangular Enclosure and Attached Wall to Northwest

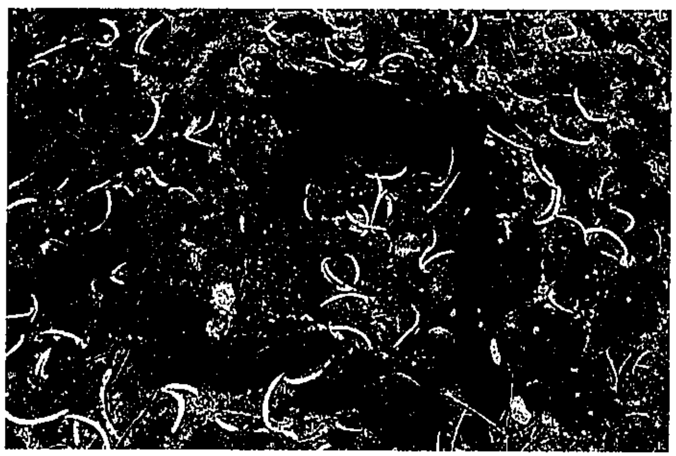

Figure 24. Site 20* Feature F Slab-lined Firepit

the complex, where a fifteen (15.0) meter buffer is recommended (Fig. 25). The western portions, perched atop the bedrock ridge are better protected by topographic barriers. The avoidance of accidental encroachment during construction-related, earth-moving activities is imperative to maintaining the environmental integrity of this preservation precinct.

Short Term Protection Measures

Orange plastic temporary fencing should be placed around the perimeter of this whole site and may also include the neighboring Site 5112, which may be an associated feature. A buffer zone of 15 meters should be maintained, especially at the eastern portion of the complex.

Permanent Preservation

This site complex represents the largest of the preservation precincts and perhaps one of the more significant remains from the intermediate inland zone. Although conclusive age determination is needed to determine its origins and function, this multiple feature complex may represent an intermediate inland residential compound, associated with prehistoric or traditional semi-permanent habitation and marginal agricultural activities. The presence of some unique individual features, such as the rectangular, slab-lined firepit, lends public interpretational value to this site. A variable buffer with a maximum of 15 meters should be permanently established using a combination of planted and natural topographic barriers. This site is suitable for multiple categories of *in situ* preservation including public interpretation, data banking, and Native Hawaiian stewardship activities such as landscaping using vegetation native to the area.

Site 26: Modified Outcrop Platform

This small modified outcrop, terrace platform, constructed against a small outcrop ridge within the southeast quadrant of the southern third of the project area, is located immediately west of a bulldozer cut. The platform measures 5.0 m long, 2.0 m wide, and varies in height from 0.30 m on the south side to 1.2 m on the west side (Fig. 26). The outcrop ridge occupies the eastern side and the northern side is tumbled. Five to six courses of aa boulders and rocks form a facing around the exterior of this roughly rectangular structure. The upper surface and interior are clinker-filled and leveled. This platform site is also located at the northeastern tip of the main Native Plant Preservation Area immediately southeast of Site 20.

Buffer Zone

A no encroachment zone five (5.0) meters from each side shall delineate a protective perimeter around the site (Fig. 27). The buffer zone will roughly encompass a 180-square meter area.

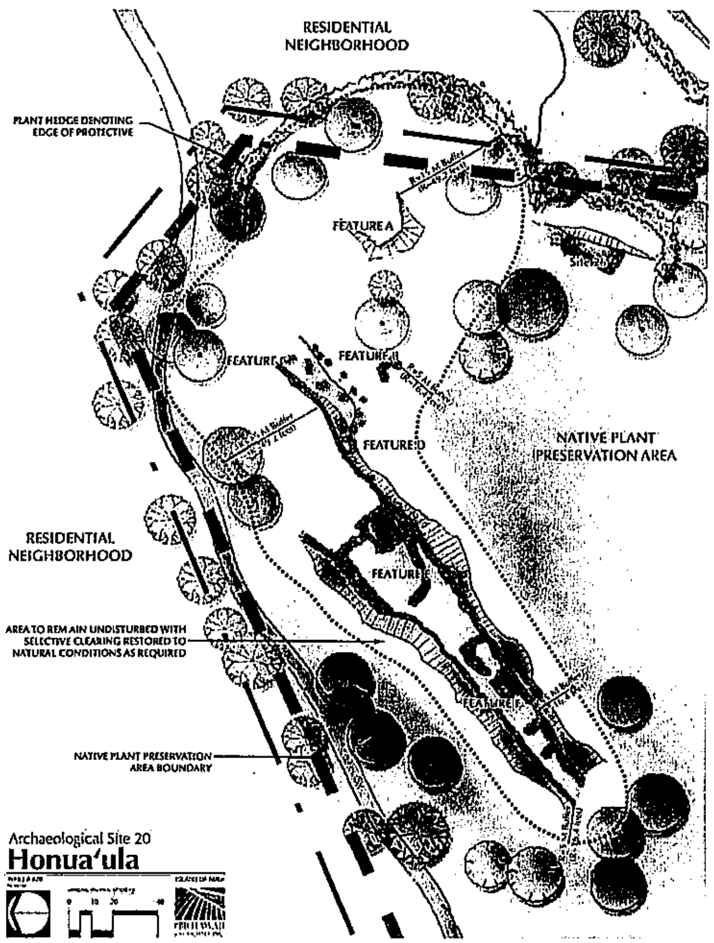

Figure 25. Conceptual Buffer for Long-term Preservation for Site 20

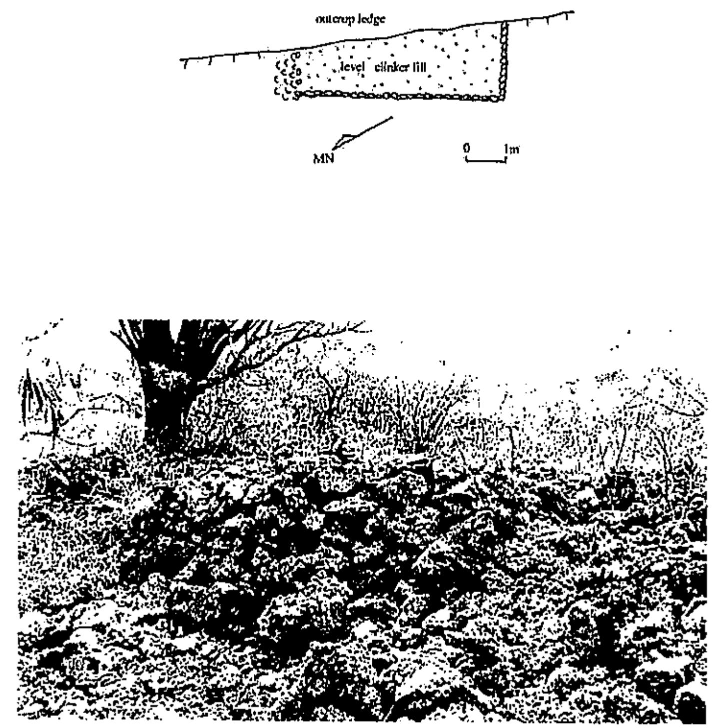

Figure 26. Plan View and Photo of Site 26* (5111) Platform to Northeast

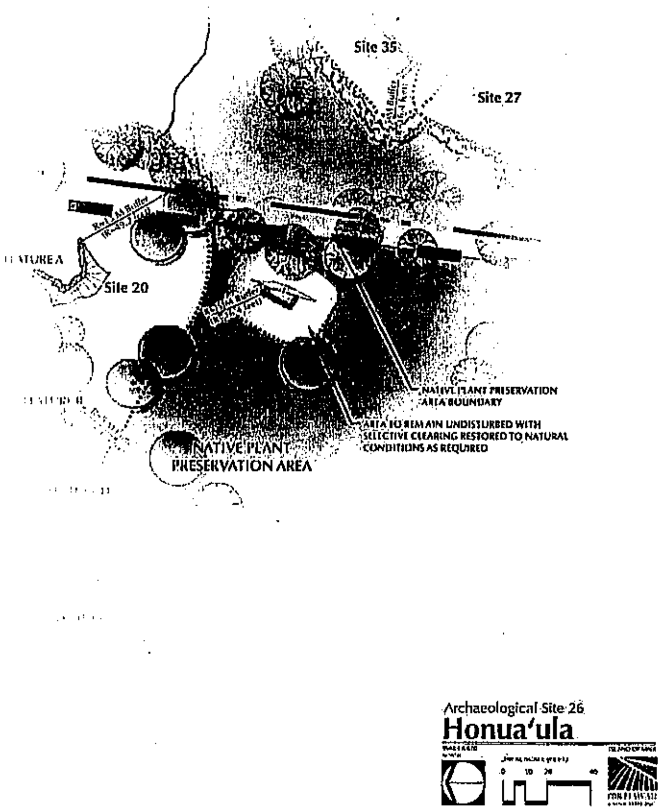

Figure 27. Conceptual Buffer for Long-term Preservation for Site 26

Short-term or Interim Protection Plan

The perimeter of this site shall be clearly marked on the ground with orange plastic fencing over the duration of construction activities. The fencing shall be periodically monitored to ensure that it is intact and clearly demarking the buffer zone.

Long-term or Permanent Preservation Plan

Site 26, representing a probable prehistoric or traditional habitation site, is suitable for permanent *in situ* preservation. Signage and possible inclusion in a self-guided, walking-tour trail network may be appropriate. Based on the proposed disposition of the immediate surroundings, either a vegetation or constructed barrier shall define the perimeter of the buffer zone for this site.

Site 27: Modified Outcrop Platform

This platform, although about twice as long, is similar in construction and form to Site 26 and comprises another terrace platform incorporating an outcrop ridge. This site is located about 50 meters south of the east terminus (Feature A) of the Site 20 complex. The platform is constructed against the northwest side of an outcrop ridge and measures 12.0 m in length, 2.5 m in width, and averages 1.3 m in height (Fig. 28). The roughly rectangular structure has three sides faced with 3 to 4 courses of aa rocks and boulders with the interior and upper surface clinker filled. This platform site is located within the Native Plant Conservation Area near the northeastern tip of the Native Plant Preservation Area southeast of Sites 20 and 26.

Buffer Zone

A no encroachment zone five (5.0) meters from each side shall delineate a protective perimeter around the site (Fig. 29). The buffer zone will roughly encompass a 275-square meter area.

Short-term or Interim Protection Plan

The perimeter of this site shall be clearly marked on the ground with orange plastic fencing over the duration of construction activities. The fencing shall be periodically monitored to ensure that it is intact and clearly demarking the buffer zone.

Long-term or Permanent Preservation Plan

Site 27, like Site 26 probably represents a prehistoric or traditional habitation site. This site is suitable for permanent *in situ* preservation. Signage and possible inclusion in a self-guided, walking-tour trail network may be appropriate. Based on the proposed disposition of the immediate surroundings, either a vegetation or constructed barrier shall define the perimeter of

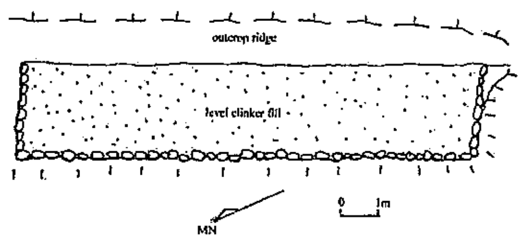

Figure 28. Plan View and Photo of Site 27* (5112), Modified Outcrop Platform to North

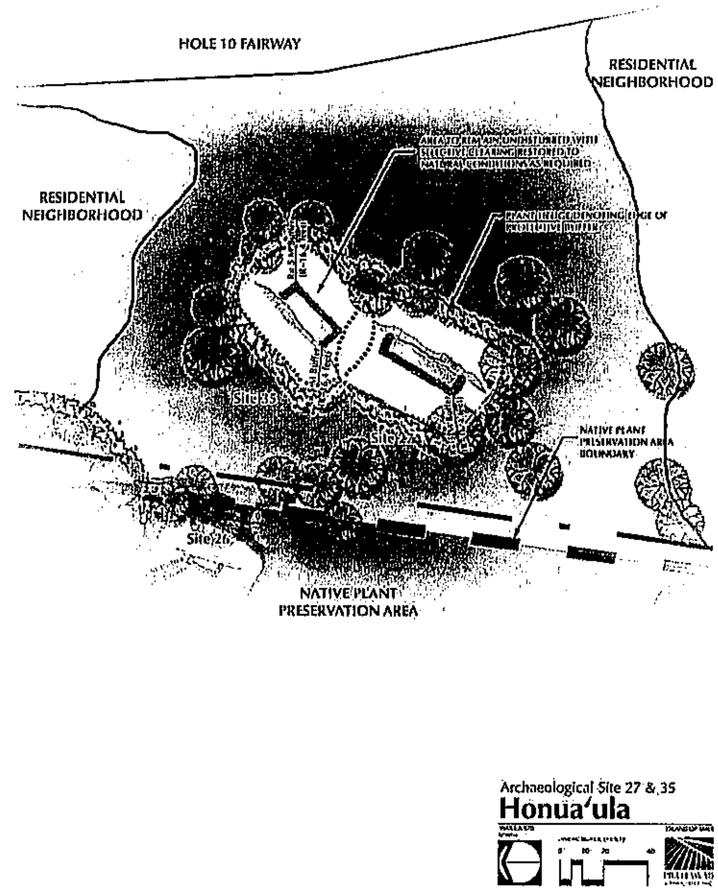

Figure 29. Conceptual Buffer for Long-term Preservation for Site 27 & 35

the buffer zone for this site. There is also the possibility that both Sites 26 and 27 could be incorporated into the secondary Native Vegetation Management and Enhancement Area.

Site 29: Overhang Shelter

This site comprises the only archaeological site recorded within the northern section of the Honua'ula Development area. It consists of an overhang shelter situated around the 500 ft. elevation on a small shelf on the northern edge of a dry gulch, the second of such gulches south of the project area north boundary. The site is located in the Natural Gulch area within a Multi-family residential area. The overhang, situated 4-5 meters above the gulch bed on a small ledge or shelf, measures 6.0 m wide and ranges in depth from 0.50 to 1.5m from the drip-line. The ceiling heights vary from 0.50 to 0.70m at the drip-line and decrease toward the back wall of the shelter, where the ceiling meets the floor. A small, natural, earthen terrace area, measuring 1.5 m from the shelter opening and 4.0 m wide, fronts the shelter opening to the south (Fig. 30).

Buffer Zone

A no encroachment zone, five (5.0) meters from each side of the shelter, shall delineate a protective perimeter around the site (Fig. 31). The gulch affords natural protection for the southern side of the site.

Short-term or Interim Protection Plan

The perimeter of this site shall be clearly marked on the ground with orange plastic fencing over the duration of construction activities. The fencing shall be periodically monitored to ensure that it is intact and clearly demarking the buffer zone. The northern and western sides of the site shall especially be closely monitored during construction activities since a proposed roadway crosses the gulch to the south of this site.

Long-term or Permanent Preservation Plan

Site 29 probably represents a traditional, temporary habitation site. This site, located in an existing gulch slated as open space, represents the only extant archaeological feature in the northern section of the project area and thus warrants permanent *in situ* preservation. Signage and possible inclusion in a self-guided, tour may be appropriate. Since the immediate surroundings are slated for multi-family, residential development, either a vegetation or constructed barrier shall primarily define the northern perimeter of the buffer zone for this site. The eastern, southern, and western perimeters are protected by the natural topography of the gulch.

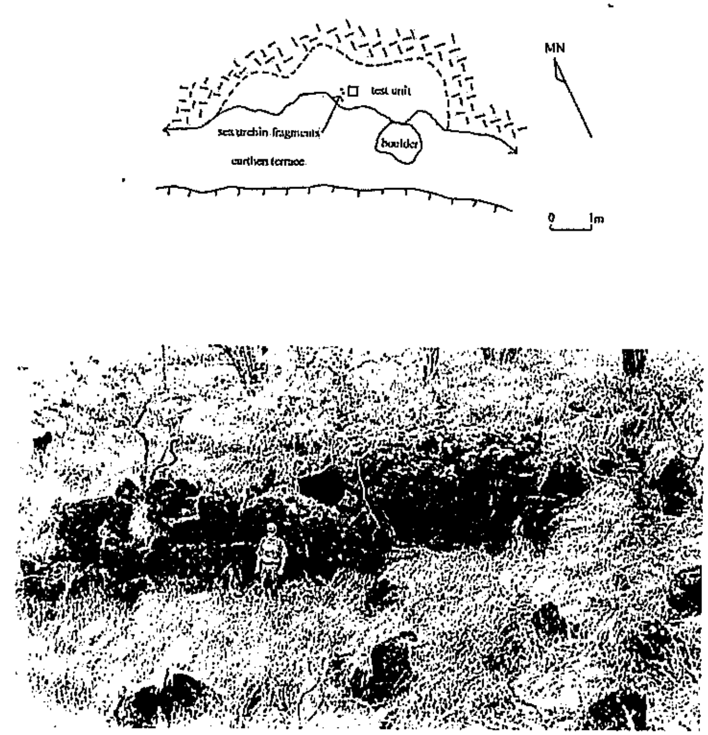

Figure 30. Plan and View of Site 29 to North

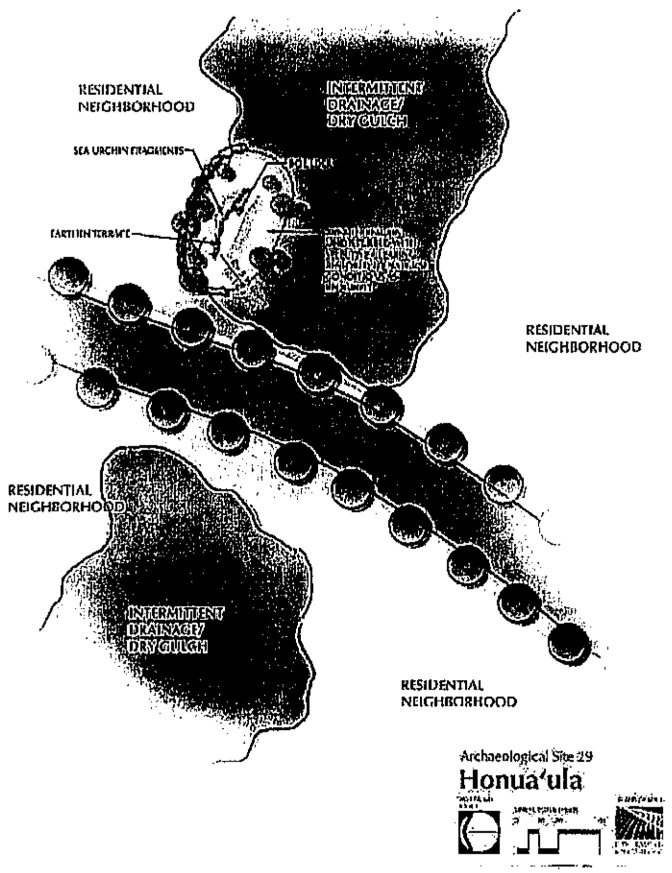

Figure 31. Conceptual Buffer for Long-term Preservation for Site 29

Site 33: Cluster of Two C-shaped Enclosures

This site is a feature cluster comprised of two C-shaped enclosures situated 2 meters apart in a low-lying area, roughly 100 meters due south of the Site 20 complex. The larger structure, Feature A, measures 3.5 m by 4.5m with 0.80 m thick walls that range in height from 1.0 to 1.2 meters (Fig. 32). The opening is oriented 151° of magnetic north. Feature B, the smaller structure, located roughly 2.0 meters to the south-southwest, measures 3.6 m in diameter with 0.60 m wide walls that range in height from 0.20 to 0.40 m. The opening of the smaller C-shape is oriented 126° of magnetic north. This two-feature cluster is located at the eastern edge of the Native Plant Preservation Area south of Sites 20 and 26. Feature A is located within the area designated for Single Family residential development.

Buffer Zone

A no encroachment zone five (5.0) meters from each side shall delineate a protective perimeter around the site (Fig. 34). The buffer zone will roughly encompass a 272-square meter area.

Short-term or Interim Protection Plan

The perimeter of this site shall be clearly marked on the ground with orange plastic fencing over the duration of construction activities. The fencing shall be periodically monitored to ensure that it is intact and clearly demarking the buffer zone.

Long-term or Permanent Preservation Plan

Site 33 probably represents a prehistoric or traditional habitation site. This site is suitable for permanent *in situ* preservation. Signage and possible inclusion in a self-guided, walking-tour trail network may be appropriate. Based on the proposed disposition of the immediate surroundings, either a vegetation or constructed barrier shall define the perimeter of the buffer zone for this site. There is also the possibility that Site 33 could be incorporated into the secondary Native Vegetation Management and Enhancement Area.

Site 35: Modified Outcrop Platform

This rectangular platform measuring 9.0 m long, 2.5 m wide, and 1.2 m in height, is built along the edge of an outcrop ridge with its long axis oriented at 210° of magnetic north (Fig. 33). This

Figure 32. Site 33* Feature A, C-shaped Enclosure

Figure 33. Site 35 Large Terrace Platform on Edge of Outcrop Ridge

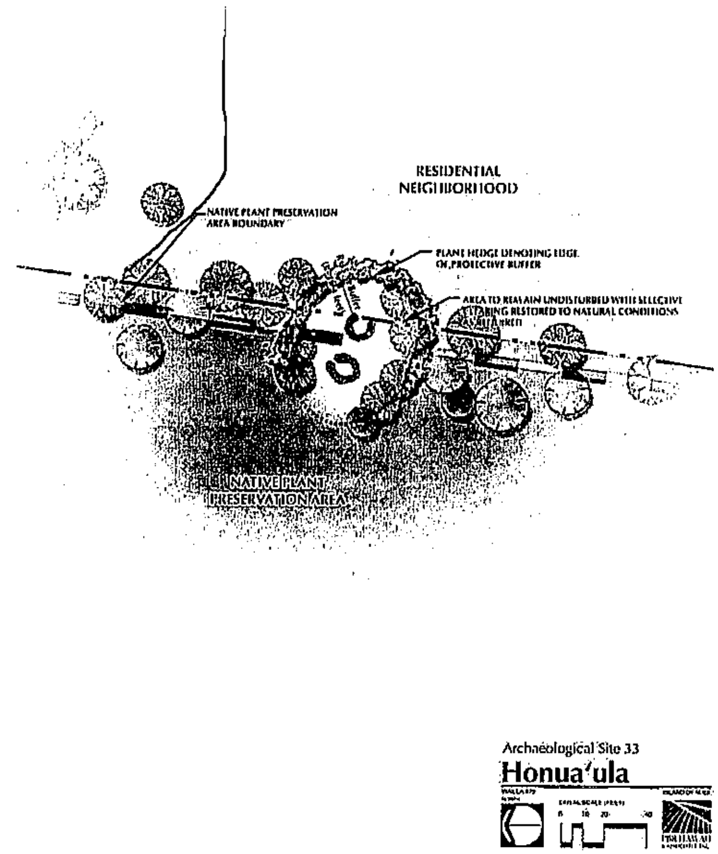

Figure 34. Conceptual Buffer for Long-term Preservation for Site 33

site is located about 50 meters south of the eastern terminus of the Site 20 complex and northeast of Site 27 in the Native Plant Conservation Area..

Buffer Zone

A no encroachment zone five (5.0) meters from each side shall delineate a protective perimeter around the site (see Fig. 29). The buffer zone will roughly encompass a 240-square meter area.

Short-term or Interim Protection Plan

The perimeter of this site shall be clearly marked on the ground with orange plastic fencing over the duration of construction activities. The fencing shall be periodically monitored to ensure that it is intact and clearly demarking the buffer zone.

Long-term or Permanent Preservation Plan

Site 35, similar in construction and form to Sites 26 and 27, probably also represents a prehistoric or traditional habitation site. This site is suitable for permanent *in situ* preservation. Signage and possible inclusion in a self-guided, walking-tour trail network may be appropriate. Based on the proposed disposition of the immediate surroundings, either a vegetation or constructed barrier could be used to define the perimeter of the buffer zone for this site. There is also the possibility that Site 35 could be incorporated into the secondary Native Vegetation Management and Enhancement Area.

Site 36: Lava Tube

This site is a lava tube with the opening facing east and measuring 1.2 m east/west, 0.80 m north/south, and 0.80 m in height (Fig. 35). The interior opens up to a chamber measuring 3.0 m wide and 3.5 m deep with ceiling heights ranging from 0.8 to 1.3 m. The opening is situated at the eastern edge of a bedrock ledge approximately 1.0 m high. This site is located within the Single Family residential area near the southeast corner of the southern section of the project area.

Buffer Zone

A no encroachment zone with a radius of ten (10.0) meters around the opening delineating a protective perimeter around the site will be established (Fig. 36). The buffer zone will roughly encompass a 360-square meter circular area.

Short-term or Interim Protection Plan

The perimeter of this site shall be clearly marked on the ground with orange plastic fencing over the duration of construction activities. The fencing shall be periodically monitored to ensure that it remains intact and clearly demarking the buffer zone.

Long-term or Permanent Preservation Plan

Site 36 is an uncommon site type in the area, representing prehistoric or traditional temporary habitation site. This site is suitable for permanent *in situ* preservation. Signage and possible inclusion in a self-guided, walking-tour trail network may be appropriate. Based on the proposed disposition of the immediate surroundings, either a vegetation or constructed barrier could be used to define the perimeter of the buffer zone for this site. There is also the possibility that Site 35 could be incorporated into the secondary Native Vegetation Management and Enhancement Area.

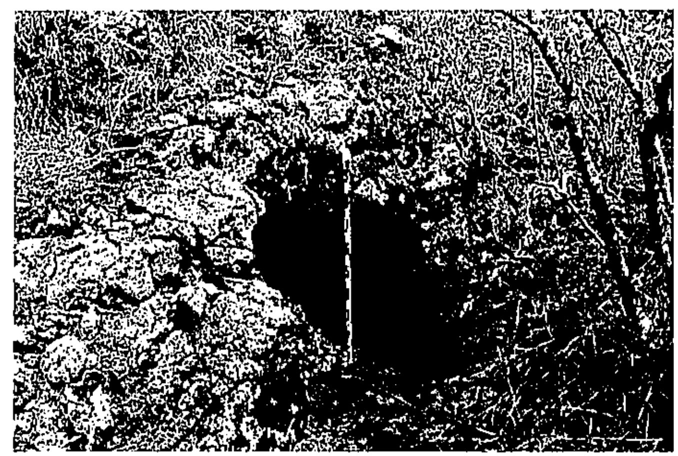

Figure 35. Site 36 Lava Tube Entrance

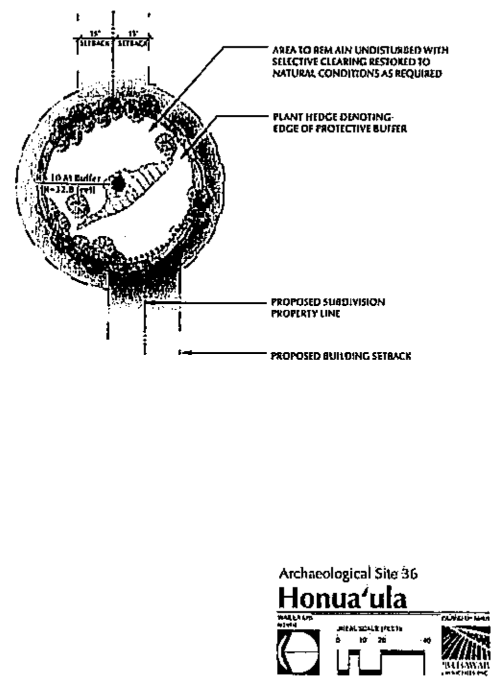

Figure 36. Conceptual Buffer for Long-term Preservation for Site 36

PRESERVATION PLAN SUMMARY

A total of fifteen (15) sites are recommended for permanent *in situ* preservation. Of this total, twelve (12) sites in the southern section are anticipated to be incorporated within either the ca 22-acre primary Native Plant Preservation Area or the additional ca 23-acre Native Plant Conservation Area (Fig. 37). Two sites, Sites 2 and 36, will be preserved as isolates in historic preservation easements within development areas. Site 29 in the northern section will be preserved within an existing gulch which is slated to remain as an Gulch Area. The nature of specific preservation locales will not be finalized until the final golf course layout and grading plans have been established. In addition, the layout of the various residential lots and infrastructure will also be finalized.

A total of 18 sites have been recommended for further data recovery and 7 sites warrant no further work. Due to the establishment of more than 73 acres of plant preservation, open space, and landscape buffer areas, in addition to golf course roughs not requiring grading, ample opportunities to retain those sites which normally may undergo removal have been exercised.

In addition, more than 23% (45+ acres) of the land area of the southern third of the project area shall remain unchanged, enhancing the natural setting in which cultural preservation is implemented.

DISCUSSION

Three large landholdings in the vicinity of the current project area have been archaeologically investigated and preservation recommendations have been partially implemented at all three development areas (Fig. 38). The differing nature of the management of each area provides important comparative examples for future historic preservation initiatives.

The Wailea Development area immediately adjoins the proposed Honua'ula Development area to the west. The multiple golf courses contain several preservation areas. Additionally, portions of the original holdings have been subdivided and leased or sold to a number of unrelated entities and individuals. Preservation has been most successful within the golf course areas. Data recovery procedures have been conducted in many of the smaller subdivided parcels. The management and administration of long-term preservation initiatives pose difficulties when a number of owners or other responsible parties are involved. Thus, the golf course being under one management entity facilitates implementation of the recommended mitigation measures. To

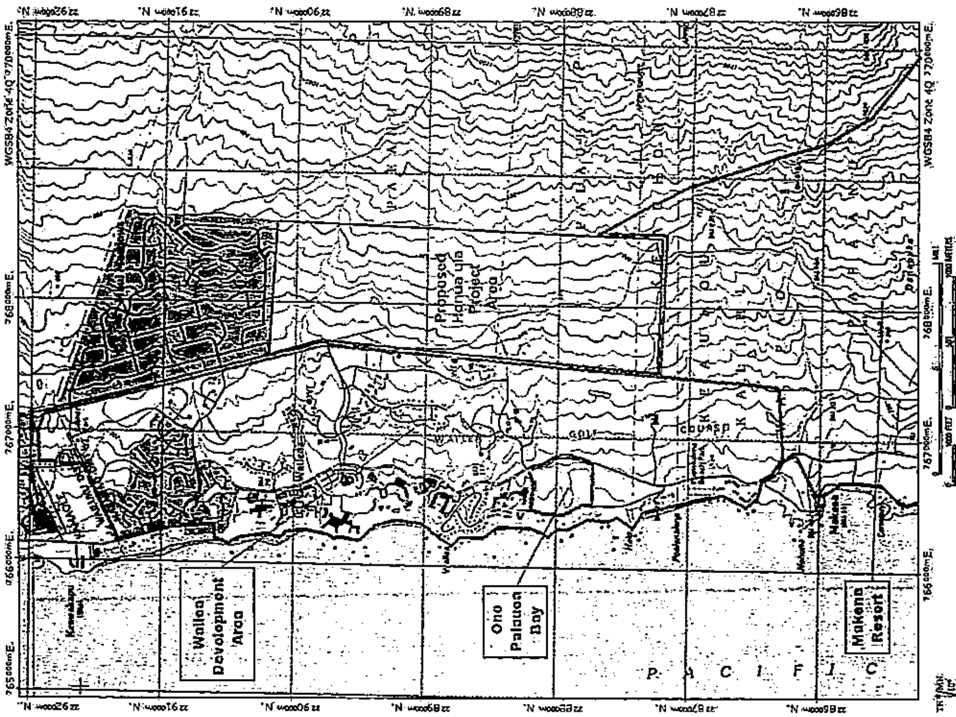

Figure 38. Locations of Neighboring Development Areas on USGS Makena Quadrangle

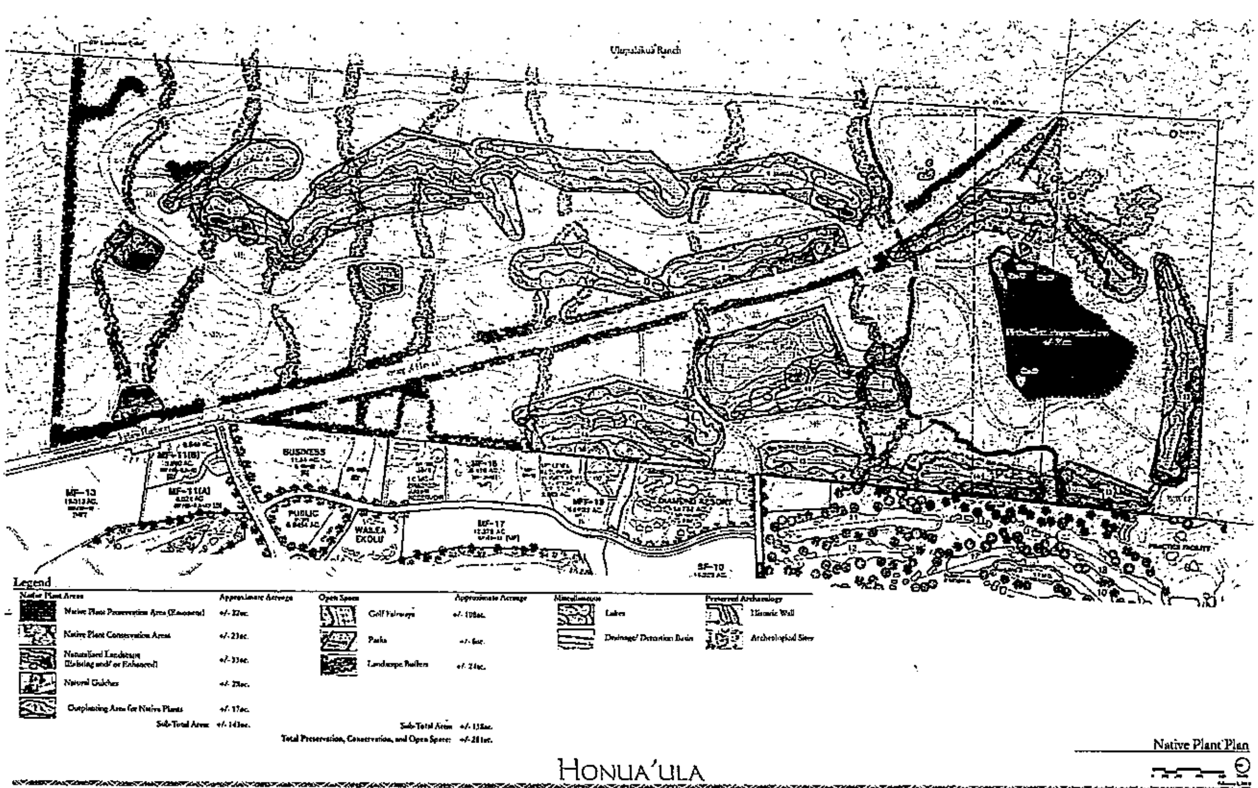

Figure 37 Native Plant Areas, Open Space, and Preserved Archaeology

date, *in situ* preservation and avoidance (data banking) have been implemented, but no further active preservation procedures have been undertaken. In the 188-acre, Wailea "Southern Acreage and Lot 15" study, of the total 40 sites, comprised of nearly 300 component features, 10 are slated for permanent preservation, 4 sites are provisionally preserved, and portions of two other sites are partially preserved. Twenty-one (21) sites have been totally mitigated and one site has been partially mitigated. The preservation objective is to protect a representative set of site clusters that represent relatively early prehistoric permanent occupation of the area. Sites in the lower elevations of the intermediate zone in three *ahupua`a*; Palauea, Keauhou, and Papa`anui; ranging from 40 to 400 feet amsl are represented in the preservation assemblage. These include permanent habitation compounds or *kauhale*, agricultural components, and recurrent seasonal occupation, as well as temporary sites. The age of sites ranges from A.D. 1280 to 1900.

Located seaward of the Wailea Golf Course is the One Palauea Bay Development that spans the coastal flat between the Makena-Keone`o`io Road and the Wailea/Makena Alanui. Here the elevation ranges from 15 to 120 ft. amsl. The significance of this area to the Honua`ula Development study area is the fact that the One Palauea Bay Development area occupies the coastal portion of Palauea *ahupua`a*. A roughly twenty acre area within the central portion of the development has been set aside and donated to the University of Hawai`i as a preservation precinct feasible for use as a field school. This area, in the early 1970s, was part of the vast consolidated Wailea holdings, but it was subdivided and sold to another entity that undertook development in late 2000. The area had undergone several episodes of investigation starting in 1969 by Kirch and an inventory survey by Cleghorn in 1992. An addendum survey was undertaken in 2000 by Aki Sinoto Consulting for the new owners. A total of 16 sites consisting of 255 component features were located in the 44.4 acre project area. A total of twelve (12) of the sites, with 247 features (97% of all features), were incorporated into the 20-acre preservation precinct. The four sites, consisting of 8 features underwent intensive data recovery and were cleared. The preservation area sites represent a coastal, permanent settlement loci, with a religious compound consisting of a moderate-sized *heiau* with five associated structural components. In addition, 188 pit and mound features, the majority interpreted as agricultural in function, were recorded in the adjoining aa flow, inland of the *heiau*. An indigenous residential compound, or *kulana kauhale* occupied by an *ohana* or descent group, with fourteen component features occurs along a ridge on the northern side of the project area and three of the inland components of this complex were still found to be extant in the periphery of the Wailea Golf Course *mauka* of Wailea/Makena Alanui. This site is significant due to its embodiment of the

characteristics of a typical *kauhale* or residential compound and the fact that it was initially recorded and described in the late 1960s makes it a type site. Another important aspect is the occurrence of an aa lava flow within the preservation precinct and the presence of steppingstone trail segments similar to those in the *mauka* Honua`ula project area. The aa flow and trail most likely connected this coastal settlement to the *mauka* areas in the past. The age of sites ranges from A.D. 1200's to the mid-1700s, with some limited possibilities of a few sites being occupied as early as A.D. 600-700. Here too, *in situ* preservation and interim protection measures during construction have been implemented, but following the transfer to the University, no additional mitigation or interpretive procedures have been undertaken. A cultural resource management plan to be prepared by the University has yet to be completed.

The third is the Makena Resort development area which immediately adjoins the Honua`ula project area to the south. Keauhou *ahupua`a* is arbitrarily truncated by modern land ownership boundaries. The northern portion of the expansive Makena Resort holdings, exceeding 1,830-acres, contains the continuation of some of the sites located in the southern portion of the Honua`ula project area. The terrain and environment consist of undulating aa flows interspersed with older pahoehoe ridges. Small overhang shelters connected with steppingstone trails occur in this portion of Keauhou *ahupua`a*. The Makena Resort holdings represent the largest development property within the coastal areas owned by a single owner. It spans portions of ten (10) *ahupua`a* and ranges in elevation from sea level up to about 1,200 feet. Only about a third of its holdings have been developed to date. During the past 3.5 decades, a large number of archaeological procedures have identified, recorded, and mitigated hundreds of features within the development areas. An in-house management plan undertaken in 2005 by Aki Sinoto Consulting compiled a total of 15 sites consisting of 303 constituent features included in the *in situ* preservation category. In addition, 46 sites consisting of 169 features have been recommended for further investigation including detailed mapping, testing, and data recovery. The assemblage of sites on this vast property represents a whole array of functional attributes, settlement strategies, and age. A Makena variant of the *kauhale* have been identified as walled compounds of various sizes and several have been slated for preservation. One such exceptional and large example of the Makena *kauhale* variant encompasses more than 8-acres in area and a total of 227 component features. Radiocarbon dating suggested a 500-year duration of occupation for this site. Settlement activities include permanent habitation, recurrent seasonal habitation, temporary habitation together with a florescence of agricultural activities that took place in a favorable micro-climate in the arid leeward coastal environment during both the prehistoric and historic periods. The Makena region became a hub of historic period commercial activity involving sweet potato and Irish potato cultivation followed by cattle ranching. Numerous Grants and L.C.A. were recorded during the Mahele, especially within the southern coastal areas. The age of sites inferred through the investigations range from A.D. 1300 – 1900 in the northern portions closer to the Honua'ula project area and A.D. 1100 – 1900 in the southern portions. No sites above 500 feet in elevation have been dated in the Makena project area. Owing to its duration as a development area, several preservation initiatives have been implemented in the past. However, as in the other two areas discussed, no unified attempt at public interpretation of the preservation sites or precincts have been undertaken to date. Unfortunately, the recent economic downturn has caused circumstances that may threaten a unified approach towards a historic preservation initiative for the total acreage of this vast area. Hopefully, future initiatives shall institute at least some of the recommendations that have been most recently formulated and evaluate the significance of sites based on *ahupua'a* and regional contexts.

The extant sites within the current project area represent occupation of an intermediate zone between the coastal and upland zones. As the archaeological knowledge base has progressively grown, much of the traditionally held perceptions that the subject region was marginal and sparsely occupied until the latter phases of the prehistoric period have been changing. Similarly, the interpretation that the "intermediate" zone between the coastal areas and the forested upland zones was barren, used only during transit between the two loci, and lacked any consequential occupation, has also recently come into question. Recent studies of the intermediate zone (Grosser et at. 1993 & 1997, Sinoto 2008) highlight: 1) the importance of the intermediate zone in specific areas of the region; and 2) a range of site types representing various activities in the intermediate zone.

The foregoing discussion has shown that, between about the 700-foot elevation and sea-level, there exist ample preservation sites and precincts that could be integrated into a unified interpretive program for the Honua'ula region. Although, realization of such a goal may be too idealistic and currently unrealistic, future preservation initiatives in the region should minimally apply the basic principles and guidelines espoused and demonstrated in this Cultural Resources Preservation Plan for the proposed Honua'ula development.

One such example is the excellent opportunity that exists to synthesize the archaeological and cultural data regarding a contiguous, 2 km, portion of Palauea *ahupua'a* from sea level to the 700-foot elevation. In addition, every opportunity must be exploited to gather data regarding the *mauka* areas for which very little archaeological data has heretofore been documented.

E Kia'i
Traditional; translated by Mary Kawena Pukui

E kia'i	To guard,
E alaka'i	to guide,
E ho'ona'auao	to educate,
E ho'olanakila	to be victorious
A pae ka wa'a i ke kula	land the canoe on the plains
Me ka lanakila	with victory
Āmama ua noa	It is lifted, it is free

Napo'o Ana O Ka Lā
by Keli'i Tau'ā

It is exciting to chant praises to a natural, warm energy source that awakens each morning on the top of Haleakalā and moves across the clouds touching 'Īao in central Maui and eventually setting on the opposite side of Maui viewed by residents of South and West Maui. This simple *mele* requested provides us with paying homage to the sun and leaving with a warm aloha *"a hui hou 'āpopo"*—which means, "see you tomorrow."

Aloha ka napo'o ana o ka lā *Me ka waiho'olu'u o ke ānuenue*	I love the sunset With the various colors of the rainbow
'Ula'ula melemele 'ōma'oma'o *Ākala 'alani 'āhinahina*	Adorned in red, yellow & green Bordered by hues of pink, orange & gray
Ala i ka lā i Haleakalā *Napo'o ana i komohana*	The warmth of the sun rises at Haleakalā Setting radiantly in the Western skies
E walea ana napo'o o ka lā *A hui hou e ka lā 'āpopo*	Enjoy the warmth of the setting sun into Pō Anxiously a wait to see you tomorrow

Oli Mahalo
by Keli'i Tau'ā

This is a simple group chant praising God, ancestral Gods, grandparents, parents, teachers, and leaders of a growing student or child. The chant is used after students/children receive instruction or at any time one feels prompted to express gratitude. Three claps to the thighs precede each line and as you say the "Mahalo" raise hands above head.

Mahalo Akua *Mahalo Akua*	Thank you God (group) Thank you God
Mahalo nā 'Aumakua *Mahalo nā 'Aumakua*	Thank you family gods (group) Thank you family gods
Mahalo nā Kupuna *Mahalo nā Kupuna*	Thank you elders (group) Thank you elders
Mahalo nā Makua *Mahalo nā Makua*	Thank you parents (group) Thank you parents
Mahalo nā Sponsors *Mahalo nā* Sponsors	Thank you Sponsors (group) Thank you Sponsors
Mahalo Maui Hawaiian Chamber *Mahalo* Maui Hawaiian Chamber	Thank you Maui Hawaiian Chamber (group) Maui Hawaiian Chamber
Mahalo Ia'u *Mahalo Ia'u*	Thank you self (group) Thank you self (hands to chest)
Aloha	Aloha
Pa'i Pa'i (4x)	Clap hands 3 times... repeat 4x
Hele aku	Let's go!

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APPENDICES A- D

Appendix A

Copies of Published Notices for
Public Comment and Input

Appendix B

The List of Consulted Parties:
Government Agencies
Community Groups
Individuals
and
Copies of the Questionnaire

Appendix C

List of Responses Received and
Copies of Letters and Completed Questionnaires

Appendix D

Response to Pertinent Comments and Input Received.

APPENDIX A

AFFIDAVIT OF PUBLICATION

STATE OF HAWAII, }
County of Maui. } ss.

Kamery A. Lee III being duly sworn deposes and says, that he is in Advertising Sales of the Maui Publishing Co., Ltd., publishers of THE MAUI NEWS, a newspaper published in Wailuku, County of Maui, State of Hawaii; that the ordered publication as to

NOTICE IS HEREBY GIVEN

of which the annexed is a true and correct printed notice, was published 1 times in THE MAUI NEWS, aforesaid, commencing on the 23rd day of January, 2009, and ending on the 23rd day of January, 2009, (both days inclusive), to-wit: on

January 23, 2009

and that affiant is not a party to or in any way interested in the above entitled matter.

This 1 page NOTICE IS HEREBY GIVEN, dated January 23, 2009, was subscribed and sworn to before me this 5th day of February, 2009, in the Second Circuit of the State of Hawaii, by Kamery A. Lee III

Notary Public, Second Judicial Circuit, State of Hawaii

LEILA ANN L. LEONG
My commission expires 11-23-11

LEILA ANN L. LEONG NOTARY PUBLIC No. 03-691 STATE OF HAWAII

NOTICE IS HEREBY GIVEN that Honua'ula Partners LLC, in accordance with Condition 13 of Maui County Zoning Ordinance No. 3554, shall be preparing a Cultural Resources Preservation Plan; for their 670-acre proposed development area (TMK: (2)2-1-008:056 and 071) located in portions of Paeahu, Palauea, and Keauhou *ahupua'a*, Makawao District, Maui Island; in consultation with pertinent public agencies, community groups, and individuals. Native Hawaiian groups, individuals and all other interested parties intending to provide input during the formulation of this plan are requested to transmit, in writing, their names and mailing addresses by February 22, 2009, to:

Honua'ula Partners, LLC
c/o Mr. Charles Jencks
Owner Representative
Pacific Rim Land, Inc.
1300 N. Holopono Street, Suite 201
P.O. Box 220, Kihei, Hawaii 96753
(MN: Jan. 23, 2009)

IN THE MATTER OF

PUBLIC NOTICE

PUBLIC NOTICE

NOTICE IS HEREBY GIVEN that Honua'ula Partners LLC, in accordance with Condition 13 of Maui County Zoning Ordinance No. 3554, shall be preparing a Cultural Resources Preservation Plan; for their 670-acre proposed development area (TMK: (2)2-1-008:056 and 071) located in portions of Paeahu, Palauea, and Keauhou ahupua'a, Makawao District, Maui Island; in consultation with pertinent public agencies, community groups, and individuals. Native Hawaiian groups, individuals and all other interested parties intending to provide input during the formulation of this plan are requested to transmit, in writing, their names and mailing addresses by February 22, 2009, to:

Honua'ula Partners, LLC
c/o Mr. Charles Jencks
Owner Representative
Pacific Rim Land, Inc.
1300 N. Holopono Street, Suite 201
P.O. Box 220
Kihei, Hawaii 96753
(Hon. Adv.: Jan. 23, 2009) (A-627290)

STATE OF HAWAII
City and County of Honolulu | AFFIDAVIT OF PUBLICATION
ss.

Jane Kawasaki being duly sworn deposes and says that she is a clerk, duly authorized to execute this affidavit of THE HONOLULU ADVERTISER, a division of GANNETT PACIFIC CORPORATION, that said newspaper is a newspaper of general circulation in the State of Hawaii, and that the attached notice is a true notice as was published in the aforereferenced newspaper as follows

01/23/2009 The Honolulu Advertiser

and that affiant is not a party to or in any way interested in the above entitled matter.

Subscribed and sworn to before me this 23rd day of January A.D. 2009

ELSIE A. MARUYAMA NOTARY 88-127 PUBLIC STATE OF HAWAII

Notary Public of the First Judicial Circuit
State of Hawaii My commission expires: 3/7/2012

NOTARY PUBLIC CERTIFICATION

Elsie A. Maruyama First Judicial Circuit
Document Description: Affidavit of Publication
No. of Pages: 1 Date of Doc. 1/23/2009
Notary Signature 1/29/2009 Date

627290

ELSIE A. MARUYAMA NOTARY 88-127 PUBLIC STATE OF HAWAII

IN THE MATTER OF

PUBLIC NOTICE

PUBLIC NOTICE

NOTICE IS HEREBY GIVEN that Honua'ula Partners LLC, in accordance with Condition 13 of Maui County Zoning Ordinance No. 3554, shall be preparing a Cultural Resources Preservation Plan; for their 670-acre proposed development area (TMK: (2)2-1-008:056 and 071) located in portions of Paeahu, Palauea, and Keauhou ahupua'a, Makawao District, Maui Island; in consultation with pertinent public agencies, community groups, and individuals. Native Hawaiian groups, individuals and all other interested parties intending to provide input during the formulation of this plan are requested to transmit, in writing, their names and mailing addresses by March 12, 2009, to:

Honua'ula Partners, LLC
c/o Mr. Charles Jencks
Owner Representative
Pacific Rim Land, Inc.
1300 N. Holopono Street, Suite 201
P.O. Box 220
Kihei, Hawaii 96753

(Hon. Adv.: Feb. 10, 2009) (A-634854)

STATE OF HAWAII
City and County of Honolulu } ss.

AFFIDAVIT OF PUBLICATION

Jane Kawasaki being duly sworn deposes and says that she is a clerk, duly authorized to execute this affidavit of THE HONOLULU ADVERTISER, a division of GANNETT PACIFIC CORPORATION, that said newspaper is a newspaper of general circulation in the State of Hawaii, and that the attached notice is a true notice as was published in the aforereferenced newspaper as follows

02/10/2009 The Honolulu Advertiser

and that affiant is not a party to or in any way interested in the above entitled matter.

[signature]

Subscribed and sworn to before me this 10th day of February A.D. 2009

ELSIE A. MARUYAMA NOTARY 88-127 PUBLIC STATE OF HAWAII

Elsie A. Maruyama
Notary Public of the First Judicial Circuit
State of Hawaii My commission expires: 3/7/2012

NOTARY PUBLIC CERTIFICATION

Elsie A. Maruyama First Judicial Circuit

Document Description: Affidavit of Publication

No. of Pages: 1 Date of Doc. 2/10/2009

Elsie A. Maruyama 2/12/2009
Notary Signature Date

ELSIE A. MARUYAMA NOTARY 88-127 PUBLIC STATE OF HAWAII

634854

FEB 1 2 2009

AFFIDAVIT OF PUBLICATION

STATE OF HAWAII,
County of Maui. } ss.

Rhonda M. Kurohara being duly sworn deposes and says, that she is in Advertising Sales of the Maui Publishing Co., Ltd., publishers of THE MAUI NEWS, a newspaper published in Wailuku, County of Maui, State of Hawaii; that the ordered publication as to NOTICE IS HEREBY GIVEN that Honua'ula Partners LLC of which the annexed is a true and correct printed notice, was published 1 times in THE MAUI NEWS, aforesaid, commencing on the 10th day of February, 2009, and ending on the 10th day of February, 2009, (both days inclusive), to-wit: on February 10, 2009

and that affiant is not a party to or in any way interested in the above entitled matter.

[signature]

This 1 page To All Parties In Interest, dated February 10, 2009, was subscribed and sworn to before me this 10th day of February, 2009, in the Second Circuit of the State of Hawaii, by Rhonda M. Kurohara

[signature]

Notary Public, Second Judicial Circuit, State of Hawaii
LEILA ANN L. LEONG
My commission expires 11-23-11

NOTICE IS HEREBY GIVEN that Honua'ula Partners LLC, in accordance with Condition 13 of Maui County Zoning Ordinance No. 3554, shall be preparing a Cultural Resources Preservation Plan; for their 670-acre proposed development area (TMK: (2)2-1-008:056 and 071) located in portions of Paeahu, Palauea, and Keauhou ahupua'a, Makawao District, Maui Island; in consultation with pertinent public agencies, community groups, and individuals. Native Hawaiian groups, individuals and all other interested parties intending to provide input during the formulation of this plan are requested to transmit, in writing, their names and mailing addresses by March 12, 2009, to:

Honua'ula Partners, LLC
c/o Mr. Charles Jencks
Owner Representative
Pacific Rim Land, Inc.
1300 N. Holopono Street, Suite 201
P.O. Box 220, Kihei, Hawaii 96753

(MN: Feb. 10, 2009)

Subject: Re: public notice for Honua'ula
Date: 1/21/2009 11:34:48 A.M. Hawaiian Standard Time
From: lisaa@oha.org
To: AKIHIKOSINOTO@aol.com

Sent from the Internet (Details)

Aloha,

I received your notice and we'll be running it free of charge as a public notice in the February issue of Ka Wai Ola.

Please call me should you have any questions.

Mahalo,
Lisa

Lisa Asato
Ka Wai Ola, Editor
Public Information Specialist
Office of Hawaiian Affairs

Subject: Re: public notice for Honua'ula
Date: 3/13/2009 10:01:15 A.M. Hawaiian Standard Time
From: lisaa@oha.org
To: AKIHIKOSINOTO@aol.com

Sent from the Internet (Details)

Aloha,

The notice ran in the February issue of Ka Wai Ola, first day of issue is Feb. 1, 2009

The notice was posted online Feb. 19.

Mahalo,
Lisa

Lisa Asato
Ka Wai Ola, Editor
Public Information Specialist
Office of Hawaiian Affairs

OFFICE of HAWAIIAN AFFAIRS
KA WAI OLA NEWSPAPER
711 Kapi'olani Blvd., Ste. 500 · Honolulu, Hawai'i 96813-5249
Pepeluali 2009 · Vol. 26, No. 2
www.oha.org/kwo/2009/02

KA WAI OLA
THE LIVING WATER of OHA

Pepeluali 2009:

HO'OLAHA LEHULEHU · PUBLIC NOTICE

Cultural Resources Preservation Plan for Honua'ula / Wailea 670

NOTICE IS HEREBY GIVEN that Honua'ula Partners LLC, in accordance with Condition 13 of Maui County Zoning Ordinance No. 3554, shall be preparing a Cultural Resources Preservation Plan for their 670-acre proposed development area (TMK: (2)2-1-008:056 and 071) located in portions of Paeahu, Palauea, and Keauhou ahupua'a, Makawao District, Maui Island, in consultation with pertinent public agencies, community groups, and individuals.

Native Hawaiian groups, individuals and all other interested parties intending to provide input during the formulation of this plan are requested to transmit, in writing, their names and mailing addresses within 30 calendar days from the publication date of this notice to:

Honua'ula Partners, LLC
c/o Mr. Charles Jencks
Owner Representative
Pacific Rim Land, Inc.
1300 N. Holopono Street, Suite 201
P.O. Box 220
Kihei, Hawai'i 96753

APPENDIX B

LIST OF AGENCIES/ORGANIZATIONS CONSULTED DURING PREPARATION OF THE CULTURAL RESOURCES PRESERVATION PLAN

PUBLIC AGENCIES AND ELECTED OFFICIALS

2. DvsuB. DpusfmTbufxjef rsphsbn Nbobhfs
   Ejwjtjpo pg psftusz boe jmemjgf
   Ob Bth I fmf Usbjmboe Bddftt rsphsbn
   Department of Land and Natural Resources
   2262 vodi cpx mTusffu-Sppn 436
   Lbtboja pl v Cvjmejoh
   I popmmv-I bxbjaj :7924

3. Mbvsb I Uijfmfo-Di bjs fstpo
   Tbuf pgI bxbjaj
   Department of Land and Natural Resources
   P. Cpy 732
   I popmmv-I bxbjaj :791:

4. Es vbbthpl bboj Bjv-Ben jojtusbups
   Tbuf pgI bxbjaj
   Department of Land and Natural Resources
   State Historic Preservation Division
   712 Lbn pl jtb Cmwe.-Sppn 666
   Lb pmfj-I bxbjaj :7818

5. N bvj0Mbobj Jtmboet CvsjbmDpvodjm
   Tbuf pgI bxbjaj
   Department of Land and Natural Resources
   State Historic Preservation Division
   712 Lbn pl jtb Cmwe.-Sppn 666
   Lb pmfj-I bxbjaj :7818

6. **Maui/Lanai Islands Burial Council**
   241 N bi bmboj Tusffu
   bjmml v-I bxbjaj :78:4

7. Dmef Oãn vap-Ben jojtusbups
   Office of Hawaiian Affairs
   822 Lb jpmboj Cpvmfwbse-Tvjuf 611
   I popmmv-I bxbjaj :7924

8. Tbonfz Tpmhn jmp
   Maui County Cultural Resources Commission
   361 Tpvui I jhi Tusffu
   bjmml v-I bxbjaj :78:4

9. I popsbcmf Eboo Nbfp-DpvodjmDi bjs
   Maui County Council
   311 Tpvui I jhi Tusffu
   bjmml v-I bxbjaj :78:4

: I popsbcmf TpmL bi ppi bmhi bmb
   Maui County Council
   311 Tpvui I jhi Tusffu
   bjmml v-I bxbjaj :78:4

21. I popsbcmf bzof Ojtiijl j
   Maui County Council
   311 Tpvui I jhi Tusffu
   bjmml v-I bxbjaj :78:4

22. I popsbcmf Hmbezt Cbjtb
   Maui County Council
   311 Tpvui I jhi Tusffu
   bjmml v-I bxbjaj :78:4

23. I popsbcmf p Boof pi otpo
   Maui County Council
   311 Tpvui I jhi Tusffu
   bjmml v-I bxbjaj :78:4

24. I popsbcmf CjmmN fefjspt
   Maui County Council
   311 Tpvui I jhi Tusffu
   bjmml v-I bxbjaj :78:4

25. N jdi bfm . N pmob-DpvodjmWjdf.Di bjs
   Maui County Council
   311 Tpvui I jhi Tusffu
   bjmml v-I bxbjaj :78:4

rEBUB D UDpoejjpot 24&DS bbfodmjun shx e

26. I popsbcmi ptf, i , potbojmb
Maui County Council
311 Tpvui I jhi Tusffu
w bjmlv-I bx bjaj :78:4

27. I popsbcmi Njl f Wjdupsjop
Maui County Council
311 Tpvui I jhi Tusffu
w bjmlv-I bx bjaj :78:4

COMMUNITY GROUPS AND ORGANIZATIONS

28. , buz Ojtijzbn b
Na Kupuna O Maui
431 Lbfp , mdf
Mbi bjob-I bx bjj :7872

29. Tbwf N bl fob
48 Mbob Tusffu
, bjb-I bx bjj :78:9

2: Mbodf I pmfs-Di bjs, fstpo
Tjfssb Dmc N bvj Hspv,
, P Cpy 8:2291
, bjb-I bx bjj :788:

31. Jsfof Cpx jf-Fyfdvujwf Ejsfdups
N bvj Upn pssp x , pvoebujpo-Jod
, P Cpy 3::
N bl bx bp-I bx bjj :7879

32. Jsfof Cpx jf-Fyfdvujwf Ejsfdups
N bvj Upn pssp x , pvoebujpo-Jod
66 Di vsdi Tusffu Tvjuf B.6
w bjmlv-I bx bjaj :78:4

33. Fmfi Dpdi sbo-, sftjefou
N bvj Vojuf
664 P gjdf Spbe
Mbi bjob-I bx bjj :7872

INDIVIDUALS

34. Mf Bmfocfsh-, i E.
3716 Mpi pmp , mdf
Lji fj-I bx bjj :7864.8229

35. I fsefsuTjmb
, .P. Cpy 316:
Lb, bb-I bx bjj :7857

36. , bofuTjy-BCE , i.E.
, .P Cpy 893
, vvofof-I bx bjj :7895

37. Fsjd Ojfmfo
271 Lfpofl bj Spbe , 2.314
Lji fj-I bx bjj :7864

38. Bmfo Tdi j,, fs
2712 O. Bmbojv , mdf
Lji fj-I bx bjj :7864

39. , bn Ebpvtu
2:1 I bvpmj Tusffu, 416
w bjmlv-I bx bjj :78:4

3: Ebmf ,. Efofx fu
, .P Cpy 2347
w bjmlv-I bx bjj :78:4

41. Lfi bv Mfavx bj
621 Tpvui Ljl bojb , mdf
w bjmlv-I bx bjj :78:4

42. Tzmjb Dmsf f I bn jmpo
, .P Cpy 675
Lji fj-I bx bjj :7864.1675

43. Hfof w fbwfs
, .P. Cpy 912
I bjl v-I bx bjj :7819

44. Mbpo w fbwfs
663 Lvn vmboj Esjwf
Lji fj-I bx bjj :7864

45. Fe Mpetfz
2198.B , ppl fmb Spbe
N bl bx bp-I bx bjj :7879

46. Lbui fsjof Lbn bafn baf Tn jui
611 Lb, bmb Esjwf , 31, 8.9
Mbi bjob-I bx bjj :7872

47. Fmfo Mv
86 Vmuhoj Tusffu
Lvmb-I bx bjj :78:1

48. Di jtb Ej, po
3164 T. Lji fj Spbe-Voju3D
Lji fj-I bx bjj :7864

49. Dpez Ofn jut
52 F. w fbl bi bp
Lji fj-I bx bjj :7864

4: Lbmb Cbebzbo
33 Lfl bj Spbe
Mbi bjob-I bx bjj :7872

HONUA'ULA

SAMPLE

March 30, 2009

Irene Bowie, Executive Director
Maui Tomorrow Foundation, Inc.
55 Church Street, Suite A-5
Wailuku, Hawaii 96793

Dear Ms. Bowie:

Honua'ula Partners LLC, the owner and developer of the proposed Honua'ula Project is providing this consultation request to you as one of the initial stages of the preparation of a Cultural Resources Preservation Plan (CRPP) for the Honua'ula project. Public consultation is being conducted in accordance with Condition No. 13 of Zoning Ordinance No. 3554, recently enacted by the Maui County Council. This consultation request document provides an overview of the Honua'ula project as well as a summary of the procedural requirements, methodology and objectives of the CRPP. This background information is being presented to invite input addressing specific aspects of the plan objectives to assist in the CRPP preparation process.

PROJECT BACKGROUND

The development area for the proposed Honua'ula Project (hereafter referred to as the "project area"), encompassing approximately 670 acres, is located along the southwestern slopes of Haleakala, within the *moku*, or traditional district, of Honua'ula, on Maui Island. The Honua'ula District was subsumed into the modern district of Makawao during the Territorial Period of Hawai'i. Occupying elevations ranging between approximately 300 and 680 feet, the project area incorporates portions of three *ahupua'a*, from Paeahu in the north, Palauea in the middle, to Keauhou in the south. See **Figure 1**.

Proposals for development of the project area, formerly known as Wailea 670, were first formulated in 1988 by the former owners of the property. These plans, articulated in an EIS, contemplated a residential/resort community of more than 2,100 residential units, two 18-hole golf courses, a resort lodge, and six (6) acres of commercial property. To implement this proposal, the former landowner obtained several land use entitlements for the project area, including a community plan amendment, establishment of Chapter 19.90 (referred to as the Kihei-Makena Project District 9 or "Wailea 670"), Conditional Zoning approval, Phase II and Project Master Plan approval, Phase III approval, and State Land Use District Boundary Amendment (DBA). The DBA, the last entitlement approval, was obtained in September 8, 1994.

In the mid-1990s an extensive community-based update of the Kihei-Makena Community Plan was completed, which resulted in the Project District 9 designation for the property being maintained. During this update process, the community reaffirmed that Project District 9 should be a residential

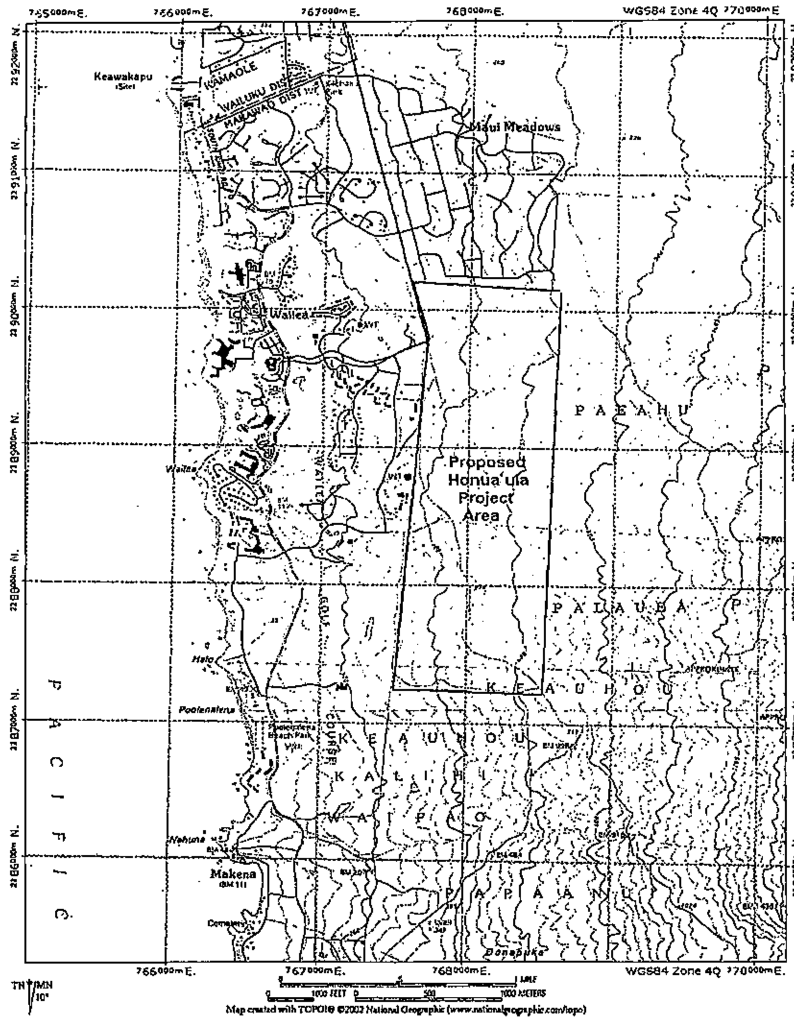

Figure 1. Location of the Proposed Honua'ula Project Area on USGS Makena Quadrangle

community complemented with commercial uses, golf courses, and other recreational amenities.

The current owner, Honua'ula Partners, LLC, (formerly known as WCPT/GW Land Associates, LLC) purchased the project area in December 1999, resulting in the preparation of a revised plan for the property. The revised plan, now known as the Honua'ula Project, envisioned a master-planned community with no more than 1,400 homes, one golf course, open space and recreational trails, and village mixed use areas. While meeting the overall vision for Project District 9 as set forth in the Kihei-Makena Community Plan, the revised plan was considerably smaller in scale than the previous Wailea 670 plan of 1988.

The subsequent Change in Zoning (CIZ) and Project District applications for this revised plan were submitted to Maui County for processing in June 2000. The Change in Zoning and Project District Phase I applications were approved by the Maui County Council in April 2008. As approved by the Council, Project District 9 now includes provisions for 1,400 homes (including affordable workforce housing units in conformance with the County's Residential Workforce Housing Policy), village mixed uses, a single homeowner's golf course, a native plant sanctuary, archaeological/cultural resource preservation areas, and other recreational amenities (Ordinance No. 3553 and No. 3554, approved April 8, 2008).

GUIDING LEGISLATION

Throughout the period of review and deliberation of the entitlement applications for the Honua'ula project by the Maui County Council, there was public testimony focused on the importance of defining an archaeological and cultural preservation program to ensure the long-term protection of significant cultural and archaeological sites within the project area for both present and future generations. In responding to these concerns, the following conditions were attached to the zoning approval:

Condition No. 13:

The Honua'ula Partners, LLC, its successors and permitted assigns, shall prepare a Cultural Resources Preservation Plan ("CRPP"), in consultation with: Na Kupuna O Maui; lineal descendents of the area; other Native Hawaiian groups; the Maui County Cultural Resources Commission; the Maui/Lana'i Islands Burial Council; the Office of Hawaiian Affairs; the State Historic Preservation Division, Department of Land and Natural Resources; the Maui County Council; Na Ala Hele; and all other interested parties. Prior to initiating this consultation process, Honua'ula Partners, LLC, its successors and permitted assigns, shall publish a single public notice in a Maui newspaper and a State-wide newspaper that are published weekly. The CRPP shall consider access to specific sites to be preserved, the manner and method of preservation of sites, the appropriate protocol for visitation to cultural sites, and recognition of public access in accordance with the Constitution of the State of Hawai'i, the Hawai'i Revised Statutes, and other laws, in Kihei-Makena Project District 9.

Upon completion of the CRPP, Honua'ula Partners, LLC, its successors and permitted assigns, shall submit the plan to the State Historic Preservation Division, Department of Land and Natural Resources, and the Office of Hawaiian Affairs for review and recommendations prior to Project District Phase II approval. Upon receipt of the above agencies' comments and recommendations, the CRPP shall be forwarded to the Maui County Cultural Resources Commission for its review and adoption prior to Project District Phase II approval.

Condition No. 26:

That Honua'ula Partners, LLC, its successors and permitted assigns, shall provide a preservation/mitigation plan pursuant to Chapter 6E, Hawai'i Revised Statutes, that has been approved by the State Historic Preservation Division, Department of Land and Natural Resources, and the Office of Hawaiian Affairs prior to Project District Phase II approval.

The CRPP will be prepared in accordance with applicable requirements set forth by Chapter 6E, Hawai'i Revised Statutes (HRS) and Chapter 13-277, Hawai'i Administrative Rules (HAR, Oct. 2002), "Rules Governing Requirements for Archaeological Site Preservation and Development". In order to ensure that all regulatory requirements are satisfied, pursuant to CIZ Conditions No. 13 and 26, the State Historic Preservation Division (SHPD) will be contacted for review and approval of the methodology and recommendations set forth by the CRPP. With the exception of the guidelines set forth by the Office of Environmental Quality Control for conducting Cultural Impact Assessment studies, at the present time, there exists a paucity of rules or regulation specifically defining or governing the preservation of "cultural resources" other than archaeological or historical sites.

PLAN FORMULATION

During the course of CRPP formulation, a review of pertinent archival data and existing literature will be undertaken; interested parties will be consulted; oral informant interview data will be compiled; and the resulting syntheses of archaeological and cultural information will support the determination of parameters and guidelines for the preservation and management of extant cultural resources within the project area. The following summarizes the anticipated development phases for CRPP preparation process:

- **Phase I: Public Notification**

  The CRPP formulation process will draw upon the input of government agencies and established cultural authorities as well as other interested parties. As required under CIZ Condition No. 13, a formal public notice was published in both the Honolulu Advertiser and the Maui News on January 23, 2009 soliciting the names and addresses of Hawaiian groups and other interested parties wishing to participate in the consultation process for the CRPP. To further promote opportunities for community involvement, a second public notice was also published in these newspapers on February 10, 2009. A public notice was also published in the February edition of the Office of Hawaiian Affairs' Newsletter, *Ka Wai Ola*, first date of issue on February 1, 2009 and the notice was also posted on the OHA online newsletter, *Ka Wai Ola Loa*, on February 19, 2009.

- **Phase II: Consultation**

  A consultation list has been defined based on the list of agencies identified in Condition No. 13 and the written requests received during the public notice comment periods. A copy of this consultation request has been distributed to the agencies and individuals for response during the consultation phase of the CRPP preparation process. Where appropriate, written comments received during this consultation phase will be used in the next phase of work and will represent an integral element of the draft CRPP formulation process.

- **Phase III: Draft CRPP Development**

  Following the consultation process and review of comments provided, a draft CRPP document will be developed reflecting input from agencies and interested individuals in preparation for agency review.

- **Phase IV: Agency Review and Recommendations**

  Upon completion of the draft CRPP, the document will be submitted to the Department of Land and Natural Resources (DLNR), SHPD, and the Office of Hawaiian Affairs (OHA) for agency review and issuance of recommendations in accordance with the requirements set forth in CIZ Condition No. 13.

- **Phase V: Final CRPP Development**

  Recommendations issued as a result of this agency review process will be reviewed and a final CRPP prepared in preparation for review and adoption.

- **Phase VI: Cultural Resources Commission Review and Adoption**

  As noted above, the Final CRPP will be submitted to the Department of Planning for final review and adoption by the Cultural Resources Commission.

<u>APPROACH AND METHODOLOGY</u>

As previously outlined, the CRPP will draw upon the input of recognized Native Hawaiian organizations and groups, as well as interested individuals together with data compiled from previous archaeological studies and cultural assessment efforts undertaken for the project area. Additional archaeological research and cultural consultation in accordance with the conditions set forth herein will assist in the development of a comprehensive plan for the preservation and interpretation of cultural resources in the project area.

- <u>Scope of Work</u>

  Data and information guiding the development of the CRPP will be compiled from a review of archival records, historic documents, previous cultural and archaeological studies, and

SAMPLE

input received from the current consultation. The existing data will be supplemented through additional interviews with knowledgeable informants. The results of research and data collection will be synthesized to distinguish key archaeological, cultural, and historic resources of the project area, and to subsequently define programs and parameters for the preservation and management of said resources. Specific objectives driving the development of the CRPP are described below.

- <u>Plan Objectives</u>

In compliance with Condition Nos. 13 and 26 referenced previously in this document, the CRPP project team is asking for input on specific aspects of the CRPP development process. To that end, your understanding and concurrence with the following five (5) objectives will help define some of the key components that will support the formulation of a draft CRPP:

<u>OBJECTIVE I:</u> *<u>To define cultural parameters that will guide the preservation of archaeological resources and the interpretation of archaeological data</u>*

More often than not, cultural resource management planning evaluates the significance of extant resources only within the context of culturally arbitrary land boundaries tied to modern property ownership, commonly referred to as the "project area." The proper approach, however, dictates that the distribution and function of extant resources should be interpreted and understood within the context of traditional land divisions and land use. Thus, a more holistic *ahupua'a*-based approach, looking at the extant remains in neighboring properties or in portions of the *ahupua'a* not incorporated in the project area can provide a more accurate representation of the past use of an area.

<u>OBJECTIVE II:</u> *<u>To document settlement patterns and timelines for the project area</u>*

Living on an island with limited space, each subsequent group of inhabitants, over time, tends to favor occupying the same areas. However, external influences such as the introduction of foreign technologies, different social, economic, and belief systems influence and change the mode of day to day life. Thus, the settlement patterns, the life ways, and the artifacts change over time. The documentation of such changes, as indicated and supported by the study of extant remains of an area, is another important aspect that aids the understanding and accurate interpretation of past life in a specified area as well as in a region.

OBJECTIVE III: *To consult with traditional/cultural practitioners with ties to the Honua'ula region and other interested parties*

The interpretation of traditional practices and other aspects of a region require persons with long-term familiarity and proprietary knowledge of that area. Such individuals with family history and genealogical ties to the land are valuable and scarce since many elders have already passed away.

OBJECTIVE IV: *To identify lineal descendents to the project area and to the moku of Honua'ula*

The opinions and recommendations of persons with family history and genealogical ties to the land should be entitled to special consideration when pertinent input for decision-making is being sought. Persons confirmed as lineal descendents by the Maui and Lana'i Islands Burial Council for burials in the *moku* of Honua'ula are one category of such descendents. Others include those who can document their ties to the land.

OBJECTIVE V: *To ensure long-term consistency and integrity of historic preservatioms in the project area and the Honua'ula region*

The Honua'ula, Wailea, and Makena development areas comprise a large part of the traditional district of Honua'ula under the control of three relatively large private land owners. Proactive coordination and cooperation will be fostered among the large landowners through development of the CRPP. This coordination will also be reflected in how Objective 1 above is applied in the evaluation, implementation, and interpretation stages of the preservation initiatives.

Toward achieving the foregoing objectives, we have prepared the attached consultation questionnaire for your review and completion. See Exhibit "A". Your assistance in providing responses to the questions presented in the questionnaire will prove valuable toward the development of the draft CRPP. Please complete and return the provided questionnaire by April 30, 2009 to the following address:

Mr. Charles Jencks
C/O Munekiyo & Hiraga, Inc. (Attn: Mark Alexander Roy)
305 High Street, Suite 104
Wailuku, HI 96793

When completing the questionnaire, please keep in mind the broad objectives of a plan and the importance of evaluating the various aspects based on a number of viewpoints; project area, *ahupua'a, moku* (district)/regional, and island-wide. Your comments should be kept within the limits of pertinent historic preservation mandates and should also take into consideration the most effective, yet reasonable, means of meeting the various needs of the community including those that

SAMPLE

pertain to; the landowner, neighboring residents, regulatory bodies, Native Hawaiian organizations, and other interested parties.

Following the prescribed period for receipt of comments from you and other consulted parties, the input received will be compiled, evaluated, and incorporated, as warranted, into a draft CRPP document to be reviewed by DLNR, SHPD and OHA prior to final adoption by the Maui Cultural Resources Commission.

I would like to take this opportunity to thank you for taking the time to express your interest in the development of the CRPP for the Honua'ula project. Your input is important to us and the project team looks forward to reviewing your responses. Should you have any questions regarding this consultation request please feel free to contact me in my office at 879-5205.

Sincerely,

Charles Jencks
Owner Representative
Honua'ula Partners, LLC

CJ:lh
Attachments
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EXHIBIT "A"

HONUA`ULA
CULTURAL RESOURCES PRESERVATION PLAN
CONSULTATION QUESTIONNAIRE

Participant Name: ______________________

Address: ______________________

OBJECTIVE I: ***To define cultural parameters that will guide the preservation of archaeological resources and the interpretation of archaeological data.***

1. Do you have specific knowledge of any cultural activities currently taking place within the project area? If yes, please specify.

2. Do you know of or are you aware of any historical cultural practices or traditions that were previously associated with the project area? If yes, please specify.

SAMPLE

OBJECTIVE II: ***To document settlement patterns and timelines for the project area.***

3. Do you have any information that would assist the project team in understanding the settlement patterns of the project area or the surrounding areas? If yes, please explain.

4. Do you have any historical data that would provide time frames for settlement for the project area or general vicinity? This would include the prehistoric period, the historic period with cattle introduction, commercial agriculture, ranching, Irish potato cultivation, the period of the Great Mahele, etc. If yes, please explain.

OBJECTIVE III: ***To consult with traditional/cultural practitioners with ties to the Honua'ula region and other interested parties.***

5. Do you know of any cultural practitioners familiar with past or current cultural practices or activities within the project area or general vicinity? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

____

OBJECTIVE IV: ***To identify lineal descendents to the project area and to the moku of Honua'ula.***

6. Are you a lineal descendent of any current or past landowners from the project area? If so, please provide a description of your ties to the property.

____

7. Do you know of any lineal descendents with ties to the project area or to the *moku* of Honua'ula? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

____

OBJECTIVE V: ***To ensure long-term consistency and integrity of historic preservation efforts in the project area and the Honua'ula region.***

8. Do you have other information or considerations that would assist the project team in developing criteria that would help protect and preserve the resources within the project area and the region? Examples include:

- The nature of access to religious, ceremonial, and confirmed burial sites
- The determination of appropriate traditional protocols and practices
- The size and types of buffer zones and appropriate protective barriers
- The criteria for appropriate stabilization or restoration
- When and whether signage is appropriate and, if so, the type, design, and content of the signage
- The types of native flora to be used for landscaping or barriers
- The establishment of Educational and Stewardship programs

____

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Thank you for your participation in the CRPP formulation process. Copies of all questionnaires received during the consultation period will be included in the CRPP, which will become a public document.

By signing below, I hereby give consent for my questionnaire to be used for this purpose.

Signature: ____________________

Date: ____________________

APPENDIX C

LIST OF AGENCIES/ORGANIZATIONS THAT PROVIDED CONSULTATION FOR THE CULTURAL RESOURCES PRESERVATION PLAN

1. Paul J. Conry, Administrator
   Division of Forestry and Wildlife
   Department of Land and Natural Resources
   1151 Punchbowl Street, Room 325
   Kalanimoku Building
   Honolulu, Hawai'i 96813

2. Elle Cochran, President
   Maui Unite
   553 Office Road
   Lahaina, Hawai'i 96761

3. Irene Bowie, Executive Director
   Maui Tomorrow Foundation, Inc.
   55 N. Church Street, Suite A-5
   Wailuku, Hawai'i 96793

4. Clare Apana
   Maui Cultural Lands
   1087-A Po'okela Road
   Makawao, Hawai'i 96768

5. Katherine Kama'ema'e Smith
   500 Kapalua Drive #20P7-8
   Lahaina, Hawai'i 96761

6. Save Makena
   37 Lana Street
   Paia, Hawai'i 96779

7. Lance Holter, Chairperson
   Sierra Club Maui Group
   PO Box 791180
   Paia, Hawai'i 96779

8. Clyde Nāmu'o, Administrator
   Office of Hawaiian Affairs
   711 Kapiolani Boulevard, Suite 500
   Honolulu, Hawai'i 96813

9. Patty Nishiyama
   Na Kapuna O Maui
   320 Kaeo Place
   Lahaina, Hawai'i 96761

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LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL ST., ROOM 325
HONOLULU, HAWAII 96813
TEL (808) 587-0166 FAX (808) 587-0160

April 2, 2009

Mr. Charles Jencks
C/O Munekiyo & Hiraga, Inc.
Attn: Mark Alexander
305 High Street, Suite 104
Wailuku, Maui, Hawaii 96793

Dear Mr. Jencks:

Subject: Cultural Resources Preservation Plan Questionnaire for Honua'ula TMK: 2-1-008: 056 and 071 containing 670 acres by Honua'ula Partners, LLC applicants.

DLNR, Division of Forestry and Wildlife staff reviewed your March 30, 2009 letter to Curt Cottrell, Na Ala Hele Trail and Access Program Manager, as Mr. Cottrell has recently transferred over to DLNR, State Parks. Of the five objectives of the questionnaire, Division of Forestry and Wildlife has the expertise to answer "Objective V" questions, specifically as they relate to native flora and fauna or biological resources for this region.

Our March 31, 2009 letter to you will provide a comprehensive response to the issues we outlined to help protect and preserve the resources within this project area and region (attachment). Please refer to this letter as our response to this questionnaire. The remaining four objectives are more suited for response by DLNR, Historic Preservation Division.

Should you have questions regarding the March 31, 2009 letter, please call Mr. Fern Duvall, Wildlife Biologist on Maui at (808) 873-3502 or Ms. Betsy Gagne, administration staff in Honolulu at (808) 587-0063. Thank you for allowing us to review your project.

Sincerely yours,

Paul J. Conry
Administrator

C: John Cumming, DOFAW Maui Branch
Fern Duvall, Maui Wildlife
Betsy Gagne, NARS Administration

Attachment

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL ST., ROOM 325
HONOLULU, HAWAII 96813
TEL (808) 587-0166 FAX (808) 587-0160

March 31, 2009

Mr. Charlie Jencks
C/O Goodfellow Brothers, Inc.
P.O. Box 220
Kihei, Maui, Hawaii 96753

Dear Mr. Jencks:

Subject: Honua'ula EISPN Comments, Makawao, Maui TMK: 2-1-008: 056 and 071 containing 670 acres by Honua'ula Partners, LLC applicants.

DLNR, Division of Forestry and Wildlife appreciates the opportunity to comment on your development located at Wailea, Kihei-Makena, Maui, Hawaii. The following are comments submitted by our wildlife staff on Maui and administration in Honolulu.

Maui wildlife staff:

Page 22. Please fence and maintain the entire Native Plants Preserve perimeter with a 7-foot deer and ungulate exclusion fence; remove all ungulates and maintain ungulate free. If the Honua'ula site were fenced along its perimeter, this would be the preferred option, to exclude ungulates from the entire site, then fence the Native Plants Preserve with hog-wire. The short fencing would afford some protection against human ingress (as the entire preserve is surrounded by housing (MF) development, and allow for signage explaining the preserve and its special needs.

Page 25. *Manduca blackburni* (Mb) or Blackburn's Sphinx Moth larvae were detected on visits to Honua'ula. The food plants of the moth's larvae are well dispersed in the approximately 130-acre rocky lava region. Food plants for the adult (the moth stage of life), such as the native Capparis *sandwichiana* or Maiapilo were also documented. The Developers will need to document how mitigation can be assured for:

- direct harm to Mb,
- direct loss of food plants for the Mb,
- attraction of Mb to development's lighting which could cause take,
- reduction in available Mb habitat

It should be determined by the HCP coordinator (DOFAW administration staff) and ESRC, if HCP planning applies to Honua'ula – if so, it should cover Hawaiian Stilt, Hawaiian Coot, and Hawaiian Goose which will be attracted to the developed site, as well as the Hawaiian Bat and Mb which have already been documented and seen at this site.

Page 40. Lighting should meet the most current Outdoor Lighting Standards Committee recommendations. To reduce attraction to nocturnal seabirds, and Mb, all outdoor lights should be shielded from top and all sides, and be of the lowest necessary intensity. Use of motion sensors on all outside lights should be incorporated wherever possible.

Administration Honolulu:

PBR, Hawaii the consultant for Honua'ula wrongly labeled this project as an EISPN instead of notice of preparation of a draft EA. SWCA was contracted to do the biological work when this project was previously called Wailea 670. Therefore, all of the original biological work completed previously is missing in this document including the deer perimeter fence, details on the plant preserves, surveys for pueo, other birds, and *Manduca blackburni* (Mb) or Blackburn's Sphinx Moth larvae. We have expressed concerns about the projects design integrating the homes and other related infrastructures with the rare biological

species present on this property, and how effective mitigation measures will be applied to protect these species from the development.

Should you have questions regarding our review of your proposed development, please call Mr. Fern Duvall, Wildlife Biologist on Maui at (808) 873-3502 or Ms. Betsy Gagne, administration staff in Honolulu at (808) 587-0063. Thank you for allowing us to review your project.

Sincerely yours,

Paul J. Conry
Administrator

C: John Cumming, DOFAW Maui Branch
Fern Duvall, Maui Wildlife
Betsy Gagne, NARS Administration
Paula Hartzell, HCP Coordinator
DLNR, Land Division
Tom Schnell, PBR Hawaii
Jeff Hunt, Maui County Planning Department

HONUA'ULA

July 7, 2009

Paul J. Conry, Administrator
Division of Forestry and Wildlife
Department of Land and Natural
Resources
1151 Punchbowl Street, Room 325
Kalanimoku Building
Honolulu, Hawai'i 96813

Subject: Honua 'ula Cultural Resource Preservation Plan

Dear Mr. Conry:

On behalf of the Honua 'ula project team I am writing to thank you for taking the time to complete the cultural questionnaire sent to you and for your assistance in developing the Cultural Resources Preservation Plan for Honua 'ula. Development of the draft preservation plan is now underway and once completed, will be sent to agencies for review and comment. Once the agency comments and recommendations are received, the plan will be submitted to the Maui County Cultural Resources Commission for review and adoption.

Once again, thank you for participating in this process. Should you have any questions regarding the process or development of the draft preservation plan do not hesitate to contact me in my office at 879-5205 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Honua 'ula Partners, LLC

COUNTY COUNCIL
COUNTY OF MAUI
200 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793
www.mauicounty.gov/council

RECEIVED
APR 17 2009

April 3, 2009

Mr. Charles Jencks
Honua'ula Partners, LLC
PO Box 220
Kihei, HI 96753

Dear Mr. Jencks:

SUBJECT: HONUA'ULA PROJECT
CULTRAL RESOURCES PRESERVATION PLAN &
ANNUAL COMPLIANCE REPORT

I am in receipt of both correspondences mentioned above. I have transmitted both correspondences for the next upcoming Council Meeting to be referred to an appropriate Committee for discussion.

Correspondence received regarding Cultural Resources Preservation Plan includes a consultation questionnaire, which is requested to be submitted back to you by April 30, 2009. Currently, Council Committees meetings are currently suspended, except for the Budget and Finance Committee, who meets daily regarding the Budget Fiscal Year 2010 deliberations. Council Committees should be reconvening meetings in June 2009. Until the matter is referred to a committee, then scheduled by the committee, we will not be able to abide by your deadline of April 30, 2009.

If any concerns, questions, please feel free to contact me at (808)270-7678.

Sincerely,

DANNY A. MATEO
Council Chair

cht
doc090403b

April 8, 2009

RECEIVED
APR 10 2009
PACIFIC RIM LAND, INC
MAUI - MAIN

MEMO TO: Members of the Council

F R O M: Danny A. Mateo
Council Chair

SUBJECT: HONUA'ULA PROJECT
CULTURAL RESOURCES PRESERVATION PLAN

Attached is a copy of a letter dated March 30, 2009, from Charles Jencks, Honua'ula Project's cultural resources preservation plan. A zoning condition requires the developer to consult with various parties, including the Council, and requested comments by April 30, 2009. I have the matter on the agenda for our next Council meeting. I am providing you with a copy so that you can submit your comments before April 30, if you want.

Cht
doc090408

cc: Charles Jencks (w/o attachments)

EXHIBIT "A"

HONUA'ULA
CULTURAL RESOURCES PRESERVATION PLAN
CONSULTATION QUESTIONNAIRE

Participant Name: Maui Unite! (Elle Cochran)

Address: 553 Office Rd
Lahaina, HI. 96761

OBJECTIVE I: ***To define cultural parameters that will guide the preservation of archaeological resources and the interpretation of archaeological data.***

1. Do you have specific knowledge of any cultural activities currently taking place within the project area? If yes, please specify.

No, because access has been denied.

2. Do you know of or are you aware of any historical cultural practices or traditions that were previously associated with the project area? If yes, please specify.

We believe native testimonies need to be carefully analyzed for past cultural use.

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OBJECTIVE II: ***To document settlement patterns and timelines for the project area.***

3. Do you have any information that would assist the project team in understanding the settlement patterns of the project area or the surrounding areas? If yes, please explain.

Need more time to contact families from area who can pass on this knowledge.

Our Hawaiian culture is a living treasure. It is important that the area in question stay unspoiled as they have been remembered by current practitioners & local peoples.

4. Do you have any historical data that would provide time frames for settlement for the project area or general vicinity? This would include the prehistoric period, the historic period with cattle introduction, commercial agriculture, ranching, Irish potato cultivation, the period of the Great Mahele, etc. If yes, please explain.

Extensive sites were dated just Makai in Wailea Golf Course, the earliest sites in South Maui in Coastal Palauea c. 600 AD

More site surveys need to be done!

OBJECTIVE III: ***To consult with traditional/cultural practitioners with ties to the Honua`ula region and other interested parties.***

5. Do you know of any cultural practitioners familiar with past or current cultural practices or activities within the project area or general vicinity? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

Need to ask practitioners if they want to participate. Concerns are, what is the intent to use the information?

OBJECTIVE IV: ***To identify lineal descendents to the project area and to the moku of Honua`ula.***

6. Are you a lineal descendent of any current or past landowners from the project area? If so, please provide a description of your ties to the property.

Some Supporters of Maui Unite! are.

Can give names upon their approval.

7. Do you know of any lineal descendents with ties to the project area or to the *moku* of Honua`ula? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

Need more time for research. Question if this process is ethical

OBJECTIVE V: ***To ensure long-term consistency and integrity of historic preservation efforts in the project area and the Honua'ula region.***

8. Do you have other information or considerations that would assist the project team in developing criteria that would help protect and preserve the resources within the project area and the region? Examples include:

- The nature of access to religious, ceremonial, and confirmed burial sites
- The determination of appropriate traditional protocols and practices
- The size and types of buffer zones and appropriate protective barriers
- The criteria for appropriate stabilization or restoration
- When and whether signage is appropriate and, if so, the type, design, and content of the signage
- The types of native flora to be used for landscaping or barriers
- The establishment of Educational and Stewardship programs

We believe that not all has been discovered.

Access needs to be managed by a broad community discussion. Need a process to identify sites so public knows they are cared for.

Would like to use sites as an educational "Living classroom."

Thank you for your participation in the CRPP formulation process. Copies of all questionnaires received during the consultation period will be included in the CRPP, which will become a public document.

By signing below, I hereby give consent for my questionnaire to be used for this purpose.

Signature: Elle Cochran president, Maui United

Date: 4/29/09

HONUA'ULA

July 7, 2009

Ms. Elle Cochran, President
Maui Unite
553 Office Road
Lahaina, Hawaii 96761

Subject: Honua 'ula Cultural Resource Preservation Plan

Dear Ms. Cochran:

On behalf of the Honua 'ula project team I am writing to thank you for taking the time to complete the cultural questionnaire sent to you and for your assistance in developing the Cultural Resources Preservation Plan for Honua 'ula. Development of the draft preservation plan is now underway and once completed, will be sent to agencies for review and comment. Once the agency comments and recommendations are received, the plan will be submitted to the Maui County Cultural Resources Commission for review and adoption.

Once again, thank you for participating in this process. Should you have any questions regarding the process or development of the draft preservation plan do not hesitate to contact me in my office at 879-5205 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Honua 'ula Partners, LLC

1300 N. Holopono Street, Suite 201 • P.O. Box 220 • Kihei, Hawai'i 96753 • p: 808-879-5205 • f: 808-879-2557

MAY 0 1 2009

HONUA'ULA CULTURAL RESOURCES PRESERVATION PLAN
CONSULTATION QUESTIONNAIRE

PARTICPANT NAME: Maui Tomorrow Foundation, Inc.
Address: 55 N. Church Street, Suite A-5, Wailuku, Hawaii 96793

Objective I: To define cultural parameters that will guide the preservation of archaeological resources and the interpretation of archaeological data.

1. Do you have specific knowledge of any cultural activities currently taking place within the project area? If yes, please specify.

Maui Tomorrow is aware of various cultural activities which take place on the lands of this project. The presence of native plants connects to some of these activities.

We are aware of kanaka maoli who wish to see the traditional and historic roads and trails that once served their ancestors through various eras remain open and un-modified. They continue to use these accesses to practice traditional and customary activities. They visit these lands to learn from the indigenous plants, animals and cultural sites in order to pass their knowledge on to others. The ground waters of the project area are also a subject of concern. These waters make it possible for the native forest plants to survive. If these plants survive and flourish, so does the continued practice of traditional Hawaiian culture.

The lands of the Honua'ula project also connect to the makai lands of Palau'ea, Keauhou and Pae'ahu, portions of which are preserved for cultural use. Those who conduct ceremonies at these locations also are extending their use and intent to the entire ahupua'a, including the project area and this fact should be recognized.

More cultural activities, such as replanting of native plants and food crops and restoration of cultural sites, would be taking place on this land if regular access dates were provided. The night sky views are also significant. The project site's proximity to the various neighborhoods of South Maui and present and future school sites presents an excellent opportunity for a "living classroom" to be established for cultural use and education.

In 2008 Maui Tomorrow requested access to the project site on behalf of Maui Tomorrow board member and kupuna, Ed Lindsey; we were referred to a committee. Mr. Lindsey, who has offered regular weekly access to all residents and visitors interested in cultural education opportunities at Honokowai Valley for the past 9 years, was discouraged and never pursued the matter further. Many cultural educators we consulted feel that the lands of Palau'ea and Keuahou offer many of the same opportunities for cultural education as Honokowai Valley and would be widely used if available.

2. Do you know of or are you aware of any historical cultural practices or traditions that were previously associated with the project area? If yes, please specify.

Maui Tomorrow counts many cultural practitioners as supporters. When asked this question they pointed to the long traditions of the area. The project area is associated with the farming of sweet potatoes and with access to the lower dryland forests to gather useful plants such as pili grass, akoko, naio, wiliwili, maiopilo, anunu and others. The area is associated with access to the upper forests to gather plants and logs for canoe building. It is also associated with nearby coastal lands where fishing and gathering took place.

The presence of stepping stone trails points to use of the project lands during pre-Columbian times. Burials have been found in neighboring portions of these ahupua'a and our informants feel that they may also be present in the project site. It is further believed that Hawaiians lived in the area in earlier eras and utilized the resources of the lands to make tools and create shelters.

Without a site visit being offered to potential consultants of the cultural preservation plan it is difficult to give more specific details. It has been suggested that the ili of these lands be researched and mapped, as those place names give information about cultural activities.

Objective II: To document settlement patterns and timelines for the project area.

3. Do you have any information that would assist the project team in understanding the settlement patterns of the project area or the surrounding areas? If yes, please explain.

Maui Tomorrow informants agreed that the entire Honua'ula district once had a substantial population. The informants feel that archaeologists would need to do more detailed work to truly understand the settlement patterns of the project area.

While Hawaiian traditions speak of families traveling between upper and lower lands during different seasons, our informants feel strongly that the lands of Palau'ea , Pae'ahu and Keauhou, in the project area, were not just places their ancestors walked through, but also dwelt on.

Many believe that these ahupua'a all had underground water sources available in earlier centuries before the destruction of the upper forests. Coastal springs in this region are well known, and higher elevation springs are still present in the Polipoli area. Mid-elevation springs are known in the Honua'ula region and studies of the fossil sap and pollen remains in the project area would reveal much about what conditions once existed there and what type of settlement could have been supported.

4. Do you have any historical data that would provide time frames for settlement for the project area or general vicinity? This would include the prehistoric period, the historic period with cattle introduction, commercial agriculture, ranching Irish potato cultivation, the period of the Great Mahele, etc. If yes, please explain.

Maui Tomorrow informants connect the use of the lands in the project area with a long continuum of use. They point to pre-Columbian dates for sites in the makai lands of Palau'ea and sites higher up the mountain in Ulupalakua and Kanaio.

During the Makee ranching era, cotton was grown in Palau'ea and exported to the Union army. The Palau'ea shoreline was a popular "bathing area" for the mangers of Rose Ranch during the 1870's and families were reported as living in thatched huts near the Palau'ea shore during that time. During WWII our informants tell us that these lands were used for military training exercises and may have unexploded ordinance still present.

Since the majority of Land Commission Award claims in Palau'ea, Keauhou and Pae'ahu remain un-located, more research is needed to discover the true place names, history, and even ownership associated with these lands, even within the last 150 years. Our research indicates that by mahele times, patterns of rainfall and available ground water had changed within the leeward coast of Maui and we must look further back to understand more about settlement of the leeward lands.

Objective III: To consult with traditional/cultural practitioners with ties to the Honua'ula region and other interested parties.

5. Do you know of any cultural practitioners familiar with past or current cultural practices or activities within the project area or general vicinity? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

Yes, we have asked if certain cultural practitioners wished to directly share their knowledge but have not heard back as of this deadline, April 30, 2009. Maui Tomorrow feels that the time frame for this process is unrealistic for responses from varied parties.

Objective IV: To identify lineal descendents to the project area and to the moku of Honua'ula.

6. Are you a lineal descendent of any current or past landowners from the project area? If so, please provide a description of your ties to the property.

Maui Tomorrow has spoken with lineal descendents who may be submitting their own comments. As stated above, the short time frame makes it difficult for many parties to respond before the deadline.

7. Do you know of any lineal descendents with ties to the project area or to the moku of Honua'ula? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

There are many lineal descendents of the Royal Patent holders of these lands and there may be kuleana land owners as well. Maui Tomorrow questions whose responsibility it is to conduct this research.

Objective V: To ensure long-term consistency and integrity of historic preservation efforts in the project area and the Honua'ula region.

8. Do you have other information or considerations that would assist the project team in developing criteria that would help protect and preserve the resources within the project area and the region? Examples include:

- **The nature of access to religious, ceremonial, and confirmed burial sites**
- **The determination of appropriate traditional protocols and practices**

- **The size and types of buffer zones and appropriate protective barriers**
- **The criteria for appropriate stabilization or restoration**
- **When and whether signage is appropriate and, if so, the type, design, and content of the signage**
- **The types of native flora to be used for landscaping or barriers**
- **The establishment of Educational and Stewardship programs**

Our informants support a large, 200-acre area being set aside intact and managed as a native plant habitat and cultural landscape. They also support protection of all existing historic and traditional roads and trails and regular public access for cultural, spiritual, educational and restorative purposes.

We have regularly asked for a second team of archaeological consultants to re-survey both the southern and northern lands of the project area. A complete AIS is the first step to a sound Cultural Resource Protection Plan.

All sites and features should be mapped and, if appropriate, tested, even those regarded as "marginal." Marginal sites often prove to be worthwhile depositories of historical data, or even burial sites. Any interested lineal or cultural descendent of this land, along with interested community groups, should be allowed to give input on these surveys and on site significant criteria.

We do not recommend or support any plan which fragments native plant habitat into islands between golf course holes or assigns cultural sites a role as landscape décor.

Any preservation plan should be designed to include both indigenous flora and fauna and cultural sites; adequate space should also be allowed for expansion of native plant habitat.

The natural gulches on the land, especially those with cultural sites, should not be turned into drainage sumps for future urbanized sections of the land as happened in neighboring Wailea.

All access should be respectful and appropriate to the type of site; signage should emphasize the living, ongoing kanaka maoli culture and cultural practices connected to the land as well as its history. Research into the various cultural historic sites should be ongoing and new displays or signs should reflect updated findings where appropriate.

Thank you for your participation in the CRPP formulation process. Copies of all questionnaires received during the consultation period will be included in the CRPP, which will become a public document.
By signing below, I hereby give consent for my questionnaire to be used for this purpose.

Signature: Irene Bowie, Exec. Director

Date: Apr. 30, 2009

HONUA'ULA

July 7, 2009

Ms. Irene Bowie, Executive Director
Maui Tomorrow Foundation, Inc.
55 N. Church Street, Suite A-5
Wailuku, Hawai'i 96793

Subject: Honua 'ula Cultural Resource Preservation Plan

Dear Ms. Bowie:

On behalf of the Honua 'ula project team I am writing to thank you for taking the time to complete the cultural questionnaire sent to you and for your assistance in developing the Cultural Resources Preservation Plan for Honua 'ula. Development of the draft preservation plan is now underway and once completed, will be sent to agencies for review and comment. Once the agency comments and recommendations are received, the plan will be submitted to the Maui County Cultural Resources Commission for review and adoption.

Once again, thank you for participating in this process. Should you have any questions regarding the process or development of the draft preservation plan do not hesitate to contact me in my office at 879-5205 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Honua 'ula Partners, LLC

1300 N. Holopono Street, Suite 201 • P.O. Box 220 • Kihei, Hawai'i 96753 • p: 808-879-5205 • f: 808-879-2557

To: CharlieJefks 879 2557
Jeff Hunt 270 - 7634
PBR HI 523-1402

From: Clare Apana
MCL
ph 242-4189

Pages 6

4-30-09

HONUA'ULA CULTURAL RESOURCES PRESERVATION PLAN
CONSULTATION QUESTIONNAIRE

PARTICIPANT NAME: Maui Cultural Lands
Address: 1087-A Po'okela Rd Makawao, HI 96768

The lands of Pae'ahu. Palau'ea and Keauhou are culturally important to all of Maui's people. They contain the remains of a way of life far more ancient than the Ming dynasty of China, the age of European discovery and the Aztec civilizations, and they deserve the same respect. The cultural features of these lands are both seen and unseen. They include native plants, animals, insects, geological formations, underground water sources, cultural sites, trails & roads and views of Wahi Pana such as Haleakala, Pu'u I'o, Molokini, Pu'u Ola'i and Kaho'olawe. These lands are deeply connected to all of the surrounding lands and islands and any Cultural Preservation Plan should recognize and maintain this connection and the need to have a living Hawaiian culture here. Land and people are interconnected. Hawaiian people belong on this land as well as the Hawaiian plants and animals.

Question I. Current Cultural Activities:

1. Ceremonial use- chants & prayers: a specific oli has been created for these lands.
2. Use of Wiliwili and other plants for cultural activities
3. Cultural access-under PASH, utilizing historic and traditional roads and trails
4. Access to connect with family 'aumakua such as the Pueo
5. Access to honor the planetary cycles, observing the sun, moon and stars and their relationship to the land.
6. Educational access- passing knowledge of landforms, plants and natural features on to others by observing in their natural state, the places traditional Hawaiians lived.
7. Traditional use of land to learn from the places left behind by our kupuna
8. Connecting these lands and their cultural legacy to the other lands within the ahupua'a of Pae'ahu, Palau'ea and Keauhou and their historic and ancient sites, natural lifeforms and features
9. Access to gather medicinal plants
10. access to offer respect to the numerous cultural sites and features such as ahu, terraces and enclosures, platforms, shelters and prominent pohaku that may have been used for birthing or other ceremonial purposes
11. A hula hulau created a specific chant and dance that celebrated this area and its relationship to Kaho'olawe.
12. Cultural activities on these lands include enjoyment of the current views from the coast to the mountains that include the unspoiled vistas now founding the project area.
13. Other native Hawaiian activities

Cultural activities that would be taking place on these lands if access was offered more freely;

Cultivation of traditional crops such as 'uala
Makahiki celebration
Use of traditional ala (stepping stone trails)
Stabilization of cultural sites
Traditional gatherings with singing and prayers
Access for kilo hoku
Traditional access and regular care of the land
Visits by Hawaiian immersion classes and other school children

Question 2 . Historical Cultural activities

1. Numerous terraced areas with good soil for sweet potato cultivation and Native testimony discussing 'uala cultivation in these ahupua'a
2. Historic road (Kanaio-Kalama Pk rd) used prior to WWII for mauka-makai access
3. Pili grass- still found abundantly in some areas of project area, was gathered and used in the coastal settlements up until WWII.
4. places on the land were used to gather for ceremonies and as observation areas for activities and events taking place on the ocean and the lands below.
5. Gulches had springs and more water flow and plant life was predominantly native and water was used by the people
6. Canoe builders lived in Keauhou and traveled through these lands
7. Stone and coral tools were made here.
8. Habitation and worship

More would be known about past cultural activities when a more complete AIS is completed and paleobotanical studies were done.

Question 3 Information about settlement patterns in area

1. Hundreds of identified cultural features in lower lands of Pae'ahu, Palau'ea and Keauhou should be linked with the features found in the project area. Examples: ag complexes, heiau and ko'a, wells and springs, burials in lava tubes, traditional ala trails, traditional boundary walls. Some of these are or were located a few hundred feet away in the Wailea golf course, Others are nearer the ocean.- then a true settlement pattern can be determined. These ahupua'a should be viewed as a whole, not separate parts.

2. A cave surrounded by basalt outcrops with petroglyphs was recently visited by MCL researchers in a Pae'ahu gulch, this same gulch naturally continued mauka into the project area. This gulch is a likely mauka-makai route and needs to be carefully surveyed for more evidence of cultural use in the project area.

Petroglyphs are part of a larger story and the research needs to be done on the project site so the rest of the story can be told.

3. Native claims indicate farming in this general area. An extensive review of native testimonies from the Mahele records needs to be done to locate the claims which may connect to this land.

4. Several enclosures in the project area have fragments of coral in walls or floors

5. Wall 200-A shows up on photographs taken before golf course construction (c.1960) as connected to a mauka-makai wall that goes across current golf course lands and all the way to the cultural preserve at One Palau'ea bay. The section in the preserve still remains. They should be considered as one site.

6. Hawaiian culture is a living culture and it is important that these places which hold a history far older than the voyages of Columbus or the Vikings stay intact and are passed forward to the next generation as they are known to the current inhabitants.

Question 4. Historical data to provide time frames for settlement

1. When Europe and the Middle East were fighting the crusades, the lands of the Honua'ula district on Maui were described in ancient Hawaiian chants.

2. Earliest dated sites in South Maui in Palau'ea ahupua'a.

3. Honua'ula had 4th largest population on Maui during first missionary census in 1831.

4. Many stepping stone marked trails show use before the days of horses

5. Long walls like site 200 that continue for many miles, mauka-makai could have been used and modified over hundreds of years? Is it an ahupua'a boundary wall?

6. numerous structures on project site are constructed in similar manner as structures makai dated between 1400-1700 AD.

7. Palau'ea noted for growing native Hawaiian cotton during Civil war- Makee ranch had a cotton gin to process it.

Question 5. Do you know of cultural practitioners familiar with past or current practices in project area or vicinity?

Yes. We will ask if these individuals want to be involved in the process. Who will have access to the information and how will it be used?

Question 6 Lineal descendent of current or past landowners?

Some MCL supporters may be. Would need more research.

Question 7. Do you know of lineal descendents?

MCL is aware of a number of lineal descendents. Can not give names without checking with them. Need a non-invasive process where names remain confidential and there are protocols for exactly how any information would be used.

Question 8. Information to assist in developing criteria for preservation plan.

1. Need a complete, in depth AIS, and a separate team of cultural specialists deeply connected with Hawaiian culture who are reviewed and accepted by all the consulted parties, not same ones who have already worked on the site.

2. Sites need to be treated as a cultural landscape- and any building placed outside that area. Just using buffers around sites turns them into landscape features and compromises their integrity.

3. All respectful access to lands, plants and sites should be encouraged and made simple

4. Native Plants and cultural sites need to be preserved and cared for together. They are not separate. Hawaiian culture is based on "sticks and stones" (plants and the natural rocks and materials used to create shelter and tools)

5. Keep all historic and traditional roads and trails unaltered and open for traditional and customary access such as gathering and ceremonial occasions. Do not "realign" or replace with new "subdivision" trails.

7. Restore mauka-makai access through the ahupua'a of Pae'ahu, palau'ea and Keauhou. Minimal use of gates.

8. Restore native Plants and stabilize cultural sites

9. Reserve native Hawaiian rights to use the lands and have Hawaiian families living on site to care for the lands.

10. Locate and preserve ahupua'a boundary markers such as walls, ahu's etc

11. Map extensive terrace systems, enclosures, ahus, pits, trails and platforms and preserve as part of cultural landscape

12. no destruction of areas where wiliwili, maiapilo or other native plants now grow. Minimal disruption of any native plant and/or animal, bird or insect habitat area.

13. We need to preserve the current history of our people in Maui and keep a real sense of place.. Can we learn from the mistakes of the past which have resulted in the intrusive condos across from the shops of Wailea that blot out the view of the mountains?.

14. Can we contain the impact of future homes, and have a requirement to build non-invasively? As an example, go walk Kewekapu beach and see which houses blend and which ones cry for a California beach. How do we keep a sense of the place without club houses or big mansions perverting the landscape?

We give our authorization to use as part of a public document.
Clare H. Apana
on behalf of MCL
and Daniel Kanahele
and Colin McCormick

HONUA'ULA

July 7, 2009

Ms. Clare Apana
Maui Cultural Lands
1087-A Po`okela Road
Makawao, Hawai`i 96768

Subject: Honua `ula Cultural Resource Preservation Plan

Dear Ms. Apana:

On behalf of the Honua `ula project team I am writing to thank you for taking the time to complete the cultural questionnaire sent to you and for your assistance in developing the Cultural Resources Preservation Plan for Honua `ula. Development of the draft preservation plan is now underway and once completed, will be sent to agencies for review and comment. Once the agency comments and recommendations are received, the plan will be submitted to the Maui County Cultural Resources Commission for review and adoption.

Once again, thank you for participating in this process. Should you have any questions regarding the process or development of the draft preservation plan do not hesitate to contact me in my office at 879-5205 or via email at charliej@pacificrimland.com..

Sincerely,

Charles Jencks
Honua `ula Partners, LLC

MAY 0 4 2009

Thank you for this opportunity to serve.

EXHIBIT "

HONUA`ULA
CULTURAL RESOURCES PRESERVATION PLAN
CONSULTATION QUESTIONNAIRE

Participant Name: Katherine Kamaemae Smith

Address: 500 Kapalua Drive Apt 20P 7-8
Lahaina, HI 96761

OBJECTIVE I: ***To define cultural parameters that will guide the preservation of archaeological resources and the interpretation of archaeological data.***

1. Do you have specific knowledge of any cultural activities currently taking place within the project area? If yes, please specify.

no

2. Do you know of or are you aware of any historical cultural practices or traditions that were previously associated with the project area? If yes, please specify.

In studying this area for the accurate historical setting of my next book, I found reference to fishing, farming, trading, canoe-building, paddle manufacture, adze and weapon manufacture. It appears that this section of Maui was a center of industry.

As part of this industrial complex, Palauea sites cannot be separated from the whole. Important to integrate treated their significance with the whole of Honua'ula moku and Maui nui.

Page 1

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OBJECTIVE II: ***To document settlement patterns and timelines for the project area.***

3. Do you have any information that would assist the project team in understanding the settlement patterns of the project area or the surrounding areas? If yes, please explain.

All should be considered within the current models of Kirch and Boidner for leeward expansion (1300 - 1600)

4. Do you have any historical data that would provide time frames for settlement for the project area or general vicinity? This would include the prehistoric period, the historic period with cattle introduction, commercial agriculture, ranching, Irish potato cultivation, the period of the Great Mahele, etc. If yes, please explain.

My historical focus is the Pi'ilani kingdom of prehistory at the height of expansion in leeward Maui. I am an author of historical fiction. My method is to capture an accurate historical setting and create a fictionalized story within that setting to make the history come alive. Working title for current work is "Honua'ula: Blood and Stone"

OBJECTIVE III: ***To consult with traditional/cultural practitioners with ties to the Honua`ula region and other interested parties.***

5. Do you know of any cultural practitioners familiar with past or current cultural practices or activities within the project area or general vicinity? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

Kimokeo Kapahulehua
Keli'i Taua
Ka Pono'Ai Molitau

OBJECTIVE IV: ***To identify lineal descendents to the project area and to the moku of Honua`ula.***

6. Are you a lineal descendent of any current or past landowners from the project area? If so, please provide a description of your ties to the property.

No

7. Do you know of any lineal descendents with ties to the project area or to the *moku* of Honua`ula? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

Descendants of Mahoe, Poepoe and Haehae Kukahiko
Communication sent to them.

OBJECTIVE V: *To ensure long-term consistency and integrity of historic preservation efforts in the project area and the Honua'ula region.*

8. Do you have other information or considerations that would assist the project team in developing criteria that would help protect and preserve the resources within the project area and the region? Examples include:

- The nature of access to religious, ceremonial, and confirmed burial sites
- The determination of appropriate traditional protocols and practices
- The size and types of buffer zones and appropriate protective barriers
- The criteria for appropriate stabilization or restoration
- When and whether signage is appropriate and, if so, the type, design, and content of the signage
- The types of native flora to be used for landscaping or barriers
- The establishment of Educational and Stewardship programs

I hope to bring broad-scope input to team so that prehistory and recent history may both considered in Honua'ula 670 preservation plan. I believe that places and artifacts are best preserved by cordoning with landscape planting, and signage to point out significance and garner respect. Lasting preservation and conservation must be accomplished by education. (I worked as an adult trainer for 10 years.) I also believe that a system of grants to sustain long-range stewardship is key to preserving the history of Palauea and Makena

Special attention to preservation of as many place names, wind cloud and rain names, family names, and mythical-mystical names is key to attaching stories of the past to the land sites that inspired the names.

Thank you for your participation in the CRPP formulation process. Copies of all questionnaires received during the consultation period will be included in the CRPP, which will become a public document.

By signing below, I hereby give consent for my questionnaire to be used for this purpose.

Signature: Katherine Kama'ema'e Smith

Date: 4/30/09

HONUA'ULA

July 7, 2009

Ms. Katherine Kama'ema'e Smith
500 Kapalua Drive #20P7-8
Lahaina, Hawaii 96761

Subject: Honua 'ula Cultural Resource Preservation Plan

Dear Ms. Smith:

On behalf of the Honua 'ula project team I am writing to thank you for taking the time to complete the cultural questionnaire sent to you and for your assistance in developing the Cultural Resources Preservation Plan for Honua 'ula. Development of the draft preservation plan is now underway and once completed, will be sent to agencies for review and comment. Once the agency comments and recommendations are received, the plan will be submitted to the Maui County Cultural Resources Commission for review and adoption.

Once again, thank you for participating in this process. Should you have any questions regarding the process or development of the draft preservation plan do not hesitate to contact me in my office at 879-5205 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Honua 'ula Partners, LLC

EXHIBIT "A"

HONUA'ULA
CULTURAL RESOURCES PRESERVATION PLAN
CONSULTATION QUESTIONNAIRE

Participant Name: Save Makena

Address: 37 LANA ST.
PAIA, HI 96779

OBJECTIVE I: ***To define cultural parameters that will guide the preservation of archaeological resources and the interpretation of archaeological data.***

1. Do you have specific knowledge of any cultural activities currently taking place within the project area? If yes, please specify.

We know a few cultural Practitioners who have access the land to visit cultural sites and practice their heritage. We believe many more cultural Activities would take place if access was encouraged and allowed. We have heard reports of many significant sites in the area.

2. Do you know of or are you aware of any historical cultural practices or traditions that were previously associated with the project area? If yes, please specify.

A variety of cultural sites there tell the story of the Past history & cultural practices in the area like Shelters, trails, Dwelling sites, planting sites, connections to coastal lands. These are living treasures - Needs to have access preserved for opio & kanaka so they can learn the cultural Practices & traditions.

OBJECTIVE II: ***To document settlement patterns and timelines for the project area.***

3. Do you have any information that would assist the project team in understanding the settlement patterns of the project area or the surrounding areas? If yes, please explain.

The Lineal Descendants of Mahele land claiments have stores of people living & Farming in these lands.
The archeological sites tell the stories of the settlement patterns of the area.
The sites all together form a landscape. This cultural landscape left intact can tell the the story.
Destroyed, it can't tell us anything.
The archeological landscape is part of the culture. We cannot let it be destroyed. It is so important.

4. Do you have any historical data that would provide time frames for settlement for the project area or general vicinity? This would include the prehistoric period, the historic period with cattle introduction, commercial agriculture, ranching, Irish potato cultivation, the period of the Great Mahele, etc. If yes, please explain.

Independant archeological visits determined precontact sites connected to Palauea Makai complex.

A completed A.I.S. Done by a New archeological team is Needed

OBJECTIVE III: ***To consult with traditional/cultural practitioners with ties to the Honua`ula region and other interested parties:***

5. Do you know of any cultural practitioners familiar with past or current cultural practices or activities within the project area or general vicinity? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

Yes. Will pass information onto them and they will decide to participate or not.

OBJECTIVE IV: ***To identify lineal descendents to the project area and to the moku of Honua`ula.***

6. Are you a lineal descendent of any current or past landowners from the project area? If so, please provide a description of your ties to the property.

Several people have ongoing research into their 'Geneology.

7. Do you know of any lineal descendents with ties to the project area or to the *moku* of Honua`ula? If so, please write the name and contact information in the space below or, alternatively, please ask that person to submit their contact information to the address noted in the attached letter.

We need more time to gather lineal descendants properly.
Have ?'s about improving Process
Need to protect traditional knowledge.

OBJECTIVE V: ***To ensure long-term consistency and integrity of historic preservation efforts in the project area and the Honua'ula region.***

8. Do you have other information or considerations that would assist the project team in developing criteria that would help protect and preserve the resources within the project area and the region? Examples include:

   - The nature of access to religious, ceremonial, and confirmed burial sites
   - The determination of appropriate traditional protocols and practices
   - The size and types of buffer zones and appropriate protective barriers
   - The criteria for appropriate stabilization or restoration
   - When and whether signage is appropriate and, if so, the type, design, and content of the signage
   - The types of native flora to be used for landscaping or barriers
   - The establishment of Educational and Stewardship programs

Anyone From Ahupuaa Needs to be able to travel out on the LAND.
There are many Native plants that should be used as landscaping
Education and Stewardship programs should be community based to get input & info that represents the community

Thank you for your participation in the CRPP formulation process. Copies of all questionnaires received during the consultation period will be included in the CRPP, which will become a public document.

By signing below, I hereby give consent for my questionnaire to be used for this purpose.

Signature: [signature]

Date: 4/30/04

HONUA'ULA

July 7, 2009

Save Makena
37 Lana Street
Paia, Hawaii 96779

Subject: Honua 'ula Cultural Resource Preservation Plan

Gentlemen:

On behalf of the Honua 'ula project team I am writing to thank you for taking the time to complete the cultural questionnaire sent to you and for your assistance in developing the Cultural Resources Preservation Plan for Honua 'ula. Development of the draft preservation plan is now underway and once completed, will be sent to agencies for review and comment. Once the agency comments and recommendations are received, the plan will be submitted to the Maui County Cultural Resources Commission for review and adoption.

Once again, thank you for participating in this process. Should you have any questions regarding the process or development of the draft preservation plan do not hesitate to contact me in my office at 879-5205 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Honua 'ula Partners, LLC

HONUA'ULA CULTURAL RESOURCES PRESERVATION PLAN
CONSULTATION QUESTIONNAIRE

PARTICIPANT: SIERRA CLUB MAUI GROUP
Address: PO Box 791180, Paia, HI 96708

Question 1. Describe current Cultural activities on project site:

The Palua'ea ahupua'a is famed as a significant place. When archaeologist Hal Hammett was asked by the Hawaii Planning Commission what qualifications he had to offer his expertise on extremely sensitive Hawaiian cultural sites ("high profile sites) he brought up his work on Kaho'olawe, Honaunau national historic Park and Palau'ea. Cultural practitioners recognize the connection of the upper and lower portions of the Palau'ea ahupua'a and ceremonies have been held on both upper and lower lands to offer blessings for the many resources there.

People regularly hunt on the site and have for many years under various ownerships. Traditional access to visit the forests also takes place on these lands. Access should continue and existing trails and roads should be preserved. The views available across these lands are also a significant cultural feature, currently enjoyed by many. Presentations have been made about the many native plants on the site and these plants have cultural significance, just by the fact that they are surviving to pass on their heritage to future generations. With 95% of Maui's native dryland forests destroyed, these important remaining native plant habitats found on the project site are part of a living Hawaiian culture, linking the past with the future.

It may not be fair to judge the amount of interest in cultural use of the project area based on current conditions of limited access. Sierra club has participated in the Honokowai restoration project since it was begun 9 years ago. Before that regular access was offered, only limited cultural use of the Honokowai valley was taking place, even though the resources there were substantial. Now, thousands of individuals have come to learn about Hawaiian culture, plants and places, simply because access was offered and managed. There is a lesson here.

Question 2. Describe historical cultural activities on the project site and nearby lands.

Sierra Club members whose families come from this area remember the ranching days and the horseback trails that passed through the upper lands of Honua'ula, including the project site. There was also the gathering of Pili grass which was abundant 60 or 70 years ago. Their kupuna felt that people had lived in all these areas in ancient times when there were more forests, more rain and more water. They felt that people were also buried in areas with rough lava flows and many caves and crevices, like the project area. The upper lands were also good places to watch for invading fleets coming in from the Big Island and other events. All the lands in Honua'ula had some connection to Kaho'olawe in ancient times.

DHHL did fossil plant studies in Kahikinui and discovered that the flora and fauna of 500 years ago was very different in that area than it is today. These studies need to be done in the project area and other Makena lands to really understand the cultural uses of pre-contact times.

Question 3. Describe any settlement patterns in project area and surrounding area.

Archaeological reports for the project area and the Wailea golf course and hotel sites show a clear pattern of settlement in this region for a long span- 1000 AD to the present. These surveys also demonstrate how successive layers of historic occupation are very common. Rough WWII gun shelters found along the Wailea beach lands later proved to have cultural deposits spanning hundreds of years as well as burials.

Nearly 50 sites in the Wailea golf course, immediately makai of the project area, had extensive sub-surface archaeological work done over a period of several decades and many artifacts, subsurface features like hearths and house posts and even burials were discovered.

It is clear from the cultural remains that people lived, raised families, farmed, fished, made tools, traveled and worshipped among these lands, including the project site. There are at least a half dozen recorded ceremonial sites (heiau or ko'a) in the Palau'ea/ Keauhou ahupua'a, which indicates a rich cultural tradition in the area.

Question 4. Describe any historical data to provide time frames for settlement of project area and surrounding lands.

The Palau'ea cultural preserve has over 200 recorded features to date. These have been dated in the range of 1300-1700 AD. Other cultural sites found in nearby Kerauhou ahupua'a and on the sandy shoreline of Palau'ea date from 800 AD to the 1800's Many surface sites fall in the range of 1400 to 1700, while the earlier dates come from subsurface deposits.

Sites found in Pae'ahu during construction of resorts and golf course include use dating as early as 1200AD up to the 1800's. Some sites, such as the complex of enclosures and terraces that was relocated from Wailea Pt. have continuous use from 1300 up to the late 1800's. Lands in the project area are very likely to have use dating over the span of at least 500 years, and quite possibly longer.

Question 5. Do you know of cultural practitioners familiar with past or current practices in project area or vicinity?

Kevin Mahealani Kalaokamalie lead Sierra club volunteers on native plant restoration efforts in Kahikinui over the years. His family is from this area and he had a lot of knowledge about the plants and history. He was interviewed for the project's Cultural Impact Assessment, but it doesn't appear that his views were taken to heart.

Question 6 Do you know lineal descendent of current or past landowners?

Not sure. Many lineal descendents of Royal Patent holders, like Mr. Elden Liu have offered their comments at public meetings. Are they being consulted??

Question 7. Same as above.

Question 8. Criteria for preservation plan.

The first step to preservation is to resolve land titles. This was promised during public hearings and there needs to be follow through with families who have Royal Patent claims.

The Preservation Plan should include a large contiguous area of 150 acres or more to preserve a cultural landscape. The interconnectedness of the various sites is what gives them cultural integrity. Isolated sites with buffers around them are not respectful to the history and importance of these lands. All trails and historic roads need to be left as is. They are part of the area's history and they are protected in the Kihei-Makena Community Plan. Mauka-makai access through these lands has gone on for centuries and must continue. The roads and trails link the planting and dwelling sites and are part of the cultural landscape.

The project area should have native Hawaiian families living among the cultural areas to help manage them and educate others who visit about appropriate protocol. These lands shouldn't be like a museum, but rather a living experience of Hawaiian culture and how Hawaiians adapted these lands to their life.

Combine care of the native plants with care of the cultural sites. All wiliwili trees need to have habitat area protected. Wiliwili's in the golf course of Wailea and Makena are having a harder time surviving. Native plants need natural conditions, not irrigated and sprayed golf greens.

Much more archaeological and ethnographic research is needed. Study the fossil remains of sap and pollen to know about the plants. Do subsurface work to learn more about the cultural sites. Survey and map larger areas of the northern part of the parcel. Map the areas in between larger features to reveal potential complexes of sites. Bring in more of the community to help with the research- students from MCC, Kamehameha Schools, etc.

The many long walls on this site are important historic features and should not just be preserved, but their longer history and significance researched. Over three-dozen unlocated LCA are noted in the ahupua'a of Pae'ahu, Palau'ea and Keauhou. Do any of the native testimony descriptions relate to features, such as some of these walls, that may be in the project area? This should be ongoing research and families connected with these LCA should be traced.

There should be a council of appropriately knowledgeable individuals, including representatives of various Royal Patent holding families from the region who can help guide the management of the natural and cultural resources and they should have public meetings where others can contribute.

Thank you for your participation in the CRPP formulation process. Copies of all questionnaires received during the consultation period will be included in the CRPP, which will become a public document.

By signing below, I hereby give consent for my questionnaire to be used for this purpose.

Signature: Karen Chun, Secretary for Sierra Club, Maui Group

Date: 4-30-09

HONUA'ULA

July 7, 2009

Lance Holter, Chairperson
Sierra Club Maui Group
PO Box 791180
Paia, Hawaii 96779

Subject: Honua 'ula Cultural Resource Preservation Plan

Dear Mr. Holter:

On behalf of the Honua 'ula project team I am writing to thank you for taking the time to complete the cultural questionnaire sent to you and for your assistance in developing the Cultural Resources Preservation Plan for Honua 'ula. Development of the draft preservation plan is now underway and once completed, will be sent to agencies for review and comment. Once the agency comments and recommendations are received, the plan will be submitted to the Maui County Cultural Resources Commission for review and adoption.

Once again, thank you for participating in this process. Should you have any questions regarding the process or development of the draft preservation plan do not hesitate to contact me in my office at 879-5205 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Honua 'ula Partners, LLC

PHONE (808) 594-1888

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

FAX (808) 594-1865

RECEIVED
MAY 29 2009
PACIFIC RIM LAND, INC.
MAUI - MAIN

HRD09/3208F

May 27, 2009

Charles Jencks, Owner Representative
Honua'ula Partners, LLC
P.O. Box 220
Kihei, Hawai'i 96753

**RE: Cultural Resources Preservation Plan
Honua'ula Project**

Aloha e Mr. Jencks,

The Office of Hawaiian Affairs (OHA) is in receipt of your March 30, 2009 letter detailing Honua'ula Partners LLC's intent to develop a Cultural Resources Preservation Plan (CRPP) pursuant in accordance with Condition No.13 of Zoning Ordinance No. 3554, which was enacted by the Maui County Council.

The methodology and objectives outlined within your letter which will be used to develop the CRPP certainly have the potential to produce a document which will identify the resources, practices and traditions important to the 'ohana of Honua'ula and provide the necessary guidance to protect and preserve them for future generations.

OHA looks forward to the opportunity to review and provide comments on the CRPP. Thank you for providing this information at this early stage. Should you have any questions, please contact Keola Lindsey, Lead Advocate-Culture at (808) 594-1904 or keolal@oha.org.

'O wau iho nō me ka 'oia'i'o,

Clyde W. Nāmu'o
Administrator

C: OHA Maui CRC Office

HONUA'ULA

July 7, 2009

Mr. Clyde Namu'o, Administrator
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawai'i 96813

Subject: Honua 'ula Cultural Resource Preservation Plan

Dear Mr. Namu'o:

On behalf of the Honua 'ula project team I am writing to thank you for taking the time to complete the cultural questionnaire sent to you and for your assistance in developing the Cultural Resources Preservation Plan for Honua 'ula. Development of the draft preservation plan is now underway and once completed, will be sent to agencies for review and comment. Once the agency comments and recommendations are received, the plan will be submitted to the Maui County Cultural Resources Commission for review and adoption.

Once again, thank you for participating in this process. Should you have any questions regarding the process or development of the draft preservation plan do not hesitate to contact me in my office at 879-5205 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Honua'ula Partners, LLC

Patty Nishiyama
Lahaina, HI 96761
Phone: 281-1567

August 3, 2009

Mr. Charles Jencks
c/o Munekiyo & Hiranaga, Inc.
(Attn: Mark Alexander Roy)
305 High Street, Suite 104
Wailuku, HI 96793

RE: Cultural Resources Preservation Plan for Honua'ula Project Condition Number 13 of Zoning Ordinance Number 3554

RE: Honua'ula Cultural Resources Preservation Plan Consultation Questionnaire

Dear Mr. Jencks:

Objective 1, Question 1. None -- Project area does not have anyone living on property or any cultural activities currently.

Objective 1, Question 2. None – Archeological research has been done in depth. Cultural sites have been found more on the south area of the project and a few on the north area. There is evidence of temporary and permanent residence, platforms, fire place, agricultural features, and others. Historically, cultural practices were farming in project area, i.e., taro and uala. Fishing was done at the ocean side below the project area.

Project Area Usage:

1. Project area was a transitional area for ancestral people from mauka to makai or vice versa.

2. Mauka of project area was a forest to harvest koa, kolea, aalii, kauwila trees to make canoes, tools, posts. On the project area, wiliwili trees were found to be used as floaters, seeds for leis. Pili grass was found on the project area to make thatched roofs for hales. Project area did have plants for food usage and medicinal use. Project area did have agricultural plants such as taro and uala.

3. Makai of the project near the shoreline, there was a great fishing village. Shoreline fishing, harvesting included manini, moi, holehole, awa, oio, uhu, papio, opihi, limu, lehu, hee, wana, lole, kupee, aama. In the deep sea, opelu, akule, mahimahi, aku, ahi were harvested.

4. The main cultural practice on the project area was farming. It is evident that fishing was done below the project area.

Objective 2, Question 3. Yes.

First, you must understand mokupuni means the island of Maui. Second, you must understand the moku which is Honua'ula. Third, you must understand the ahapuaa within the moku. If you were to take these three into consideration, you will understand the spiritual and physical presence of our kupuna. This idea will help you to understand the settlement patterns of the project area.

Objective 2, Question 4. Yes. We have been working together with archeological and flora and fauna staff of Honua'ula project. We support all data, including historic, cattle, commercial, agricultural, ranching, and the great mahele period.

Objective 3, Question 5. We have kupuna within the moku of Honua'lua. They are Jimmy Gomes, Les Kululio, Eddie Chang, Kimo Wong, Glen Kukahiko, and Randy Piltz.

Objective 4, Question 6. No.

Objective 4, Question 7. No.

Objective 5, Question 8. Access to allow various groups.

1. All groups must call security for appointment.
2. Religious and Hawaiian groups must identify purpose and time.
3. Visitation time limited from 9:00 a.m. to 4:00 p.m.
4. Limitation of groups up to 24 people. If more than 24, special time must be scheduled.
5. Protocol is a must to enter and exit project area.
6. Buffer zones are determined by each case.
7. If cultural site is 4 feet or more, no buffer zone is needed.
8. The cultural sites need a buffer zone recommended 2 feet high and 18 inches wide and 10 feet away from site.

Stabilization for Restoration.

All restoration is to be done manually (by hand) for cultural and burial sites. A cultural monitor is to be used at all times. Stabilization for restoration should be determined by cultural and project manager, not by an association group. Na Kapuna O Maui should make recommendations on a case by case basis. All restorations must follow protocol.

All materials used must be from project area. If not, only from moku of Honua'ula. All restorations should include someone of Hawaiian ancestry.

Signage.

All signs must be the same size, low to the ground for all cultural and burial sites for protection by law. Identification number will be assigned by State of Hawaii Commission Historical Department.

Native floral, plants and trees.

Use as many native floral plants and trees whenever possible for landscaping on project. They must be shown on landscaping development plan. It is referred to use floral, plants and trees on project area or moku of Honua'ula. If non-native plants are used, they should be used as minimally as possible. Na Kapuna O Maui recommends that 100% native floral, plants and trees be used on project.

Educational

Have Hawaiian culturists on site to assist all education groups. Create a Hawaiian center for artifacts found on project site. Establish history of the area for the public. Educational groups are limited to 24 people. If more than 24 people, special arrangements must be made. Educational visitations recommended times are 10:00 a.m. to 2:00 p.m., Monday through Friday. Special arrangements for Saturday visitation must be made. There is no visitation on Sunday.

Stewardship

Establish a non-profit volunteer group. Stewardship is only within specific area, i.e., conservation area and open space area. Protocol should be established with all volunteers. Safety and equipment program must be in place for all volunteers.

Mahalo,
NA KAPUNA O MAUI

Patty Nishiyama

cc: Mark Roy (mark@mhplanning.com)
Kimokeo Kapahulehua (honokohau@gmail.com

HONUA'ULA

August 6, 2009

Ms. Patty Nishiyama
320 Kaeo Place
Lahaina, HI 96761

Dear Ms. Nishiyama:

On behalf of the Honua 'ula project team I am writing to thank you for taking the time to complete the cultural questionnaire sent to you and for your assistance in developing the Cultural Resources Preservation Plan for Honua 'ula. Development of the draft preservation plan is now underway and once completed, will be sent to agencies for review and comment. Once the agency comments and recommendations are received, the plan will be submitted to the Maui County Cultural Resources Commission for review and adoption.

Once again, thank you for participating in this process. Should you have any questions regarding the process or development of the draft preservation plan do not hesitate to contact me in my office at 879-5205 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Owner Representative
Honua 'ula Partners, LLC

NA ALA HELE
Hawai'i Trail & Access System

RECEIVED
AUG 3 2009
PACIFIC RIM LAND, INC.
MAUI - MAIN

July 31, 2009

Mr. Charles Jencks
Honua'ula Partners, LLC
1300 N. Holopono Street
Suite 201
Post Office Box 220
Kihei, Hawaii 96753

Re: County of Maui Zoning Ordinance, Proposed Honua'ula Development, Maui Island, Tax Map Key: 2-1-08-56 and 71

Research has been completed in response to your request regarding the disposition of the Kanalo-Kalama Road and a section of stepping-stone trail found in the vicinity of the subject development.

Based on title searches conducted, it is our view that the Kanalo-Kalama Road did not exist nor become a public highway upon the passage of the Highways Act of 1892. This search found that the original title and survey documents did not disclose the existence of this road when the royal patent grants that comprise the subject property were awarded in 1850. This search revealed no evidence that showed the existence of this road in 1892. If the road was not in existence in 1892, it did not become a public highway when the Highways Act of 1892 was adopted.

Map data and other records fail to disclose the alignment of the stepping-stone trail in the vicinity of the subject development. It is our understanding that development plans call for preserving this feature in place as part of a cultural preservation program. The proposed development of walking trails and the preservation of the stepping-stone trail will provide recreational opportunities that can highlight the historical and cultural values of the area.

Thank you for the opportunity to comment on the proposed development.

Sincerely,

Doris Moana Rowland
Doris Moana Rowland
Na Ala Hele Abstractor
Interim Program Manager

c: Torrie Nohara- NAH Maui

APPENDIX D

Discussion Addressing the Incoming Comments and Input Regarding the Cultural Resources

Entities included in initial consultation and those that responded to the public notices consisted of 6 public agencies, 6 community organizations, and 17 individuals as documented in Appendix B. As compiled in Appendix C, 4 responses from public agencies, 6 responses from community organizations, and 1 response from an individual were received following the mail out of the questionnaire packet to entities that responded to the publications (the Maui News, Honolulu Advertiser, and Ka Wai Ola) and internet posting (OHA electronic Newsletter) of the public notices.

Since the agency consultation is mandated, their responses are generally focused on routine specific concerns within their purview, thus these will not be discussed here other than when they pertain to concerns or questions raised by the other respondents.

Although, the participation ratio of the individual respondents to the initial notices versus those that completed and returned questionnaires appears extremely low, it became clear that the majority of the individual respondents were members of one or more of the community organizations that responded and thus incorporated their voices into one composite response.

Of the community groups; one concurred with most of the findings and recommendations made to date and provided additional recommendations for items related to preservation and interpretation within their purview; four provided recommendations and suggestions, most of which are covered by the current CRPP, but did not provide any new information or cited the lack of time for not being able to provide specific information that was being sought. There were claims made that could not be incorporated into the CRPP without documentation or some other form of substantiation; and one questionnaire response was quite thorough and covered the majority of the questions and comments raised by the others. Thus, the comments and input provided by Maui Cultural Lands shall be discussed and addressed in this appendix.

The solitary individual respondent provided some insightful comments and recommendations regarding the use and preservation of native flora, the need for the preservation of traditional place names, and the importance of education for the long-range stewardship of preservation areas. All of these points have been addressed, included in the current CRPP, and slated to be finalized and implemented in the near future in conjunction with appropriate phases of the development process.

First, however, some general clarification may be warranted, regarding comments and recommendations that were commonly brought up in most of the responses. These are:

1. **Concerns regarding native fauna and flora** – A biological consultant has completed field procedures and a report regarding the terrestrial biology of the project area. A separate consultant regularly monitors the marine biota of the ocean areas that front the Wailea Development area.

2. **The preservation of native plants** – Native Plant Areas totaling 143 acres including the 22-acre Native Plant Preservation Area easement, an additional 23-acre Native Plant Conservation Ares, along with other gulch areas, naturalized landscape areas, and outplanting areas distributed throughout the project area provide opportunities for protection and preservation as well as the propagation of native plants.

3. **Concerns regarding the archaeological surveys** – The fact that two previous surveys completed by other firms had completely missed or just simply dismissed the previously recorded sites while the more current surveys relocated and re-recorded them should indicate the degree and resolution of the walk-through survey employed. In addition, the southern area has been repeatedly scrutinized over an extended period of time at optimal climatic conditions for minimal cover vegetation. The northern area has also undergone multiple coverage. An "independent" archaeologist would have much difficulty duplicating the level of effort expended by the current consultant nor have the familiarity with the project area or the extant sites. Also, as demonstrated in the background section of the current CRPP, extant sites must be interpreted and their significance evaluated within the context of familiarity and understanding of the surrounding areas as well.

4. **Regarding trails and *mauka/makai* access** - The extant steppingstone trail segments represent discontiguous remnants of traditional trails. Currently, they are truncated, not only by prior local disturbances or destruction, but also by private land holdings and existing developments that straddle portions of traditional land divisions. Within the Honua'ula Development area, all remnant segments of steppingstone trails are slated to be preserved *in situ*. Those segments beyond the boundaries of the project, are beyond the jurisdiction of Honua'ula Partners LLC. In terms of the Kamaole-Kanaio roadway, only a small modified segment is still extant with major segments of the original alignment altered by an existing jeep road. The letter (dated July 31, 2009) by Na Ala Hele of the State Division of Forestry and Wildlife indicates that no documentation of this roadway could be found in the grant patents and no record exists of the road being in existence prior to 1892 when the U.S. Highways Act was passed. Thus, the subject roadway is not considered to be a public road. A concurrence is also given for the recommended preservation of the steppingstone trail segments within the subject project area. Thus, no provision is given for free public access through either the Kamaole-Kanaio alignment nor the remnant steppingstone trail segments.

5. **Access into project area** – Given that the subject area is private property, permission must be requested and granted for access into the area for a specified activity or purpose. Protocols for access is currently being formulated with help from Na Kupuna O Maui.

6. **Restoration of Sites and Agricultural Practices** - The current CRPP addresses the steps toward possible eventual restoration and interpretation of the extant sites. However, the existing Historic Preservation Review Process must be followed in order to implement any measures that would utilize or somehow modify an existing historic property.

<u>Maui Cultural Lands Questionnaire</u>

The reader is referred to the completed questionnaire presented in its entirety in the preceding Appendix C, to which the following comments pertain.

The opening paragraph citing the significance of the cultural remains is applicable generally to the whole Hawaiian archipelago and not only to Maui. The concerns stated in the latter half of the opening paragraph regarding cultural connection coincides with the main objective of the current CRPP.

<u>Question 1:</u>

1. The texts and translations of several *mele* and *oli*, both traditional and contemporary have been compiled for the CRPP and audio tracks can be heard on the enclosed compact disc.
2. This can be done by requesting permission from the owner, most likely prior to and during construction. However, once the Native Plant Preservation Area and the ancillary Native Plant Conservation Area have been established, preservation and propagation would be emphasized more than harvesting.
3. The trails and roads on the property are discontiguous segments, with both the beginning and end in differing ownerships and/or destroyed. Also see #4 above on page 2.
4. This would have to be substantiated with lineal descendents since the *pueo* occurs elsewhere as well.
5. same as above and also are there traditions that cite those practices specifically in the subject area?
6. Education is one of the objectives of preservation as recommended in the CRPP.
7. same as above
8. same
9. This is something that needs to be considered for the Native Plant Preservation and Conservation Areas once they have been well established.
10. The number of cultural sites would not be characterized as "numerous," the types of sites listed would conventionally not form the basis for access. If prominent *pohaku* with associated traditions are known then pertinent information and their locations should be shared with the developer or SHPD. Otherwise, any large boulder or rock formation can be said to be one of these by anyone.
11. If it is not one of those included in the CRPP can a copy of the text be provided?
12. True for other areas along same elevations which are still undeveloped.
13. What are the "other native Hawaiian activities"?

Information or documentation is needed regarding "traditional cultural practices" that can be associated with known oral traditions or long-term practice. Most of the points listed are included in the CRPP. Reasonable access provisions at night could be added for "*kilo hoku*" or astronomical observations. Active use of steppingstone trails is not feasible, but they can be visited and viewed in the preservation areas. The trails are discontiguous segments and the surrounding aa lands are slated to be selectively preserved for both a natural and cultural preserve.

Question 2:

1. Again, this is generic to the region and not specific to the subject area.
2. Na Ala Hele (DoFaW) considers this to be a private restricted road and not for public access (never was). The original alignment is not followed by the current jeep road which also destroyed the roadway. Accordingly, the Federal guidelines used by Na Ala Hele preclude the preservation of any historic trail or path modified for current vehicular access. Also, the integrity of the original path and alignment has been lost outside of the subject area both at the Kalama and Kanaio segments, which are also under multiple ownerships.
3. The botanical survey did find remnant stands of *pili* grass.
4. What is the reference or source for this information?
5. Geologically, as in the current period, seasonal flows are indicated in the gulches.
6. Oral traditions about voyaging and canoe building are included in the CRPP.
7. References? Such artifacts have been found, but no manufacturing or source areas, quarries and workshops occur within the subject area.
8. This is true for almost every area, not unique to subject area.

Question 3:

1. Again the numbers are exaggerated, but the assessment of significance based on *ahupua`a* in total is the intent of the CRPP. It always has been, but perhaps not readily apparent for lay readers of archaeological reports, ie. the settlement pattern section discusses the distribution of sites and site types from the whole *ahupua`a* and regional perspectives. The arbitrary modern ownership boundaries make investigation of whole *ahupua`a* or in the context of other traditional land divisions difficult.
2. The authors are familiar with the petroglyphs in the gulch in lower Paeahu. Petroglyphs and shelters were the types of sites that were anticipated in the northern portion of the subject project area. Granted gulches and stream beds were used for travel, but if no substantial remains of human activities are present, then they are considered natural features with no special cultural significance.
3. Again this is general. No native testimony is known from the subject project area.
4. The frequency of branch coral or coral heads in structural features may indicate ceremonial function, while the sporadic occurrence of *Porites* coral may represent a raw material manuport for the manufacture of certain artifacts such as files and abraders.
5. This is discussed in the description of the wall that it continues beyond both the east and west boundaries of the project area. Since the documentation is done by separate researchers under the auspices of different owners/developers, the continuity is described, but the actual determination of all of the segments as one site would be under the perview of SHPD.
6. This is the intent of the CRPP or a specific component of it, such as the educational and/or stewardship initiatives.

Question 4:

Pertinent points are already addressed or included in the CRPP.

Questions 5-7:

1. The information is important since it may be used to formulate specific sections of the CRPP. After its approval by various agencies, the CRPP shall become a public document.

Question 8

1. AIS standards are set by the Administrative Rules and public and peer review guidelines are also in place. See also #3 above on page 2.
1. The preservation strategy applied in the current plan involves preservation precincts that include multiple sites rather than a number of isolated sites surrounded by buffer zones. The 22-acre Native Plant Preservation Area and the additional 23-acre Native Plant Conservation Area have been situated incorporating as many of the preservation sites as possible.
2. Access protocols are addressed in the CRPP and shall be finalized in conjunction with subsequent phases of development planning.
3. In the current reality, sometimes they don't always occur together any more, thus the need for multiple preservation areas.
4. This would be the owner's decision. Na Ala Hele's letter confirmed that the so-called Kamaole-Kanaio Road was never a public road. See also #4 on page 2 and Question 2, No. 2 on pages 3 and 4 above.
5. (missing)
6. With the areas beyond both *mauka* and *makai* boundaries restricted and only remnant segments extant within the project area, such access would be unfeasible. The proposed development is not a gated one. See also #5 above.
7. This is one of the objectives of the CRPP as well as the natural resources preservation plan.
8. Need firm basis for the "rights," such as known oral traditions, etc. Selected uses are covered by CRPP. Stewardship program to care for the sites is discussed in CRPP. It would be more beneficial for groups to care for the sites.
9. If there are any within project area. Normally the principal *ahu(pua`a)* is located on the coast. The extant walls do not appear to follow closely with any land boundaries.
11. No extensive terrace systems occur within the project area. The other sites are represented in the preservation sites.
12. This is covered in the natural resources preservation plan prepared by SWCA.
13. We appreciate and share the concern regarding intrusive architecture, blocked view scapes, etc. The plans do not call for any construction that would obstruct the *mauka* views.
14. General comment. Certainly, the revised golf course plan which reduces the acreage to be graded for fairways by 50% and the Native Plant Preservation and Conservation areas enhance maintaining a "sense of place."

As indicated in the discussion above and from the body of the CRPP, much of the concerns raised by Maui Cultural Lands, as well as the other respondents have been addressed by the current review draft of the Cultural Resources Preservation Plan. There were a few areas in the questionnaire that evoked some hesitancy or reluctance on the part of the respondents to answer and to rightfully question how the responses were going to be used. Hopefully, this Cultural Resources Preservation Plan can aid in eliminating those fears and demonstrate how effectively different sectors of the community can come together for an important common objective. The respondents are encouraged to share any new or additional information that can add to the data base and contribute towards preservation of the cultural heritage of the Honua'ula region.

Appendix K

Cultural Impact Assessment

CULTURAL IMPACT ASSESSMENT
FOR THE
PROPOSED HONUA'ULA DEVELOPMENT

(TMK) 2-1-08:56 and 71 encompassing 670 acres. The land area falls between Makena of the South, Kula in the East, Wailuku of the North and the sacred islands of Molokini and Kaho'olawe of the West.

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<u>Honua'ula kua la'ola'o.</u> *Callous-backed Honua'ula.* Said of the people of Honua'ula, Maui, who were hard workers. The loads they carried often caused calluses on their backs.

Management Summary

Report	Cultural Impact Assessment for the Proposed Honua`ula Development; Paeahu, Palauea and Keauhou *ahupua`a*; Makawao District, Maui Island
Date	October 2006; revised January 2008 to comply with OEQC guidelines.
Project Location	TMK: (2) 2-1-08: 56 & 71 in portions of Paeahu, Palauea and Keauhou *ahupua`a*; Makawao District; Maui Island
Acreage	670 Acres
Ownership	WCPT/GW Land Associates LLC; Honua`ula LLC
Project Description	Proposed Phased Development of 1400 Residential Unites, One 18-hole Private Golf Course, Park Area, Greenways, Walking Trails and Bikeways; and Commercial Use Areas.
Region of Influence	Direct Effect within the 670-acres and Indirect Effect within existing Wailea Resort Region and Maui Meadows subdivision, both in the immediately adjoining areas.
Agencies Involved	SHPC/DLNT, Maui County Council, Maui Couny Planning Department, etc.
Environmental Regulatory Context	The Undertaking is Subject to both State and County Zoning Regulations, the Cleanwater Act, and Other Environmental Regulations, etc.
Results of Consultation	Mauka-Makai Trails, Native Plants, Archaeological Sites, No Apparent Current Gathering Practices or Access Concerns.
Recommendations	Preservation Precincts for Native Flora and Archaeological Sites, Stewardships, etc…

HONUA'ULA

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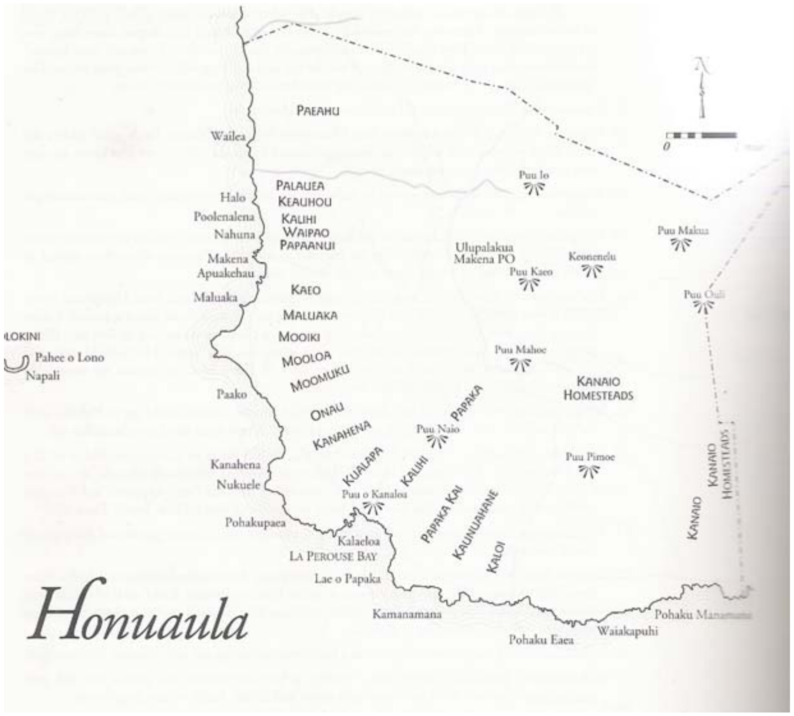

Figure 1 Sterling, 214

Scope

The scope of this report will be to compile various historical, cultural and topographical accounts and facts of Honua'ula and its adjacent ahupua'a (land divisions), (TMK) 2-1-08:56 and 71 encompassing 670 acres. Honua'ula, once referred to as Wailea 670, is the name being used for this present cultural assessment. The land area falls between Makena of the South, Kula of the East, Wailuku of the North and the sacred islands of Molokini and Kaho'olawe of the West.

Honua'ula is close to the tail end of the funnel of northeast trade wind that blows from Kahului all the way through Makena from the early afternoon into the wake of the sunset hour at South Maui.

Honua'ula, e pāluku 'ia ana nā kihi po'ohiwi e na 'ale o ka Moa'e. *Honua'ula whose shoulders are pummeled by the Moa'e wind,* (Pukui, 113). A poetical expression for a person being buffeted by the wind. Honua'ula, Maui, is a windy place.

Honua'ula (red earth) connotes sacred earth as to the sacred color red. Our kupuna (elders) recognized Kaho'olawe with red lepo (dirt) and deemed it sacred. The creation chant also recognizes neighboring Lāna'i to be laden with lepo 'ula'ula (red dirt).

In the short version of the Kumulipo (Hawaiian Creation Chant), the chant describes the chronological order of the birthing of the Hawaiian Islands with a focus on Wakea (Sky father) and Papa (Earth Mother). Lāna'i, Kaho'olawe and Honua'ula form a small pūnana (nest) of red in close proximity but on separate islands. When looking west at the beautiful sunset from the higher part of Honua'ula, the glow of red burns bright red as the daily ritual of the lā (sun) fades into the komohana (west).

In the "Hawaiian Antiquities" by David Malo (p. 360) we find the short version of the Kumulipo.

O Wakea noho iā Papahānau moku	Wakea (Sky Father) lived with Papa (Earth Mother)
Hānau o Hawai'i he moku	Born was Hawai'i an island
Hānau o Maui he moku	Born was Maui an island
Ho'i hou o Wakea noho 'ia Ho'ohōkūkalani	Wakea returned to live with Ho'ohōkūkalani
Hānau o Moloka'i he moku	Born was Moloka'i an island
Hānau o Lāna'i ka ula he moku	Born was Lāna'i the red island
Lili-opu-punalua o Papa iā Ho'ohōkūkalani	Jealous anger flowed with Papa
Ho'i hou o Papa noho iā Wakea	Papa returned to live with Wakea
Hānau o O'ahu he moku	Born was O'ahu an island
Hānau o Kaua'i he moku	Born was Kaua'i an island
Hānau o Ni'ihau he moku	Born was Ni'ihau an island
He ula a o Kaho'olawe	Lastly born a red island was Kaho'olawe

We delight in bringing you, the reader, a glimpse of ancient life in the realm of Honua'ula, the red sacred earth with a dash of pa'akai 'ula'ula or 'alae (red salt) to flavor the mo'olelo (story).

Introduction

Hana Pono, under contract to WCPT/GW Land Associates LLC, has conducted a Cultural Impact Assessment (CIA) for the lands of Honua'ula that will occupy (TMK) 2-1-08:56 and 71 encompassing 670 acres.

The CIA was conducted accordingly with the State of Hawai'i Office of Environmental Quality Control (OEQC) Guidelines for Assessing Cultural Impacts {1997} and includes oral interviews with knowledgeable consultants of Honua'ula and its surrounding areas as well as archival research.

In this report, I (Keli'i Tau'ā) am taking the liberty to express my personal experiences since I grew up in the area. As a native Hawaiian, a place tells me who I am and who my hānai (extended) family is. Honua'ula gives me my history, the history of my clan, and the history of my people. When thinking of Honua'ula (red earth), I can see my father with the red dirt in his hands building the pu'u (mound) around the uala (sweet potato) plant so that the support of the soft dirt would provide the corm with rich soil and minerals for it to grow to its fullest potential. Honua'ula ties me in to the human events of the past that affect me and my love ones. Honua'ula gives me a feeling of stability and belonging to my family, those living and those who have passed away. Honua'ula gives me a sense of well-being and of acceptance of all who have experienced this ahupua'a or who will be experiencing this sacred 'aina as residents. Reviewing the traditional proverbs, chants, and legends of South Maui will allow the reader to understand the overall cultural significance of Honua'ula. This simple chant expresses where the ancient knowledge and wisdom are stored:

E Hō Mai

E hō mai ka 'ike mai luna mai e
O nā mea huna no'eau o nā mele e
E hō mai, e hō mai, e hō mai e

Bring forth the knowledge and wisdom from above
All those great works found in the chants
Bring them forth . . . .

I am approaching this report utilizing five periods of time with a general overview of each period to give the reader some background to get a bigger picture and background information of the settlement of Honua'ula. Hopefully, the result of this approach will help you the reader to make a personal decision of Hana Pono's findings.

Ho'omakaukau – let's begin

Mythical Creation

After the Kumulipo (Creation) birth of the Hawaiian Islands similar to Darwin's creation of the world, several other mythical creation stories evolved starting with the Fire Goddess, Pele. There are many stories of Pele's travels from Tahiti to the islands of Hawai'i but we share just the stories that covered the island of Maui and the ahupua'a of Honua'ula.

Pele lived a very long time at Pu'u Keka'a on Maui but the people living on the island saw her only as fire. The whisper of the natives who lived at Honua'ula spoke of Pele as their woman chief who was greater than all of them.

In Sterling's, "Sites of Maui" she accounts a mo'olelo (story) about Pele's position in the community leading a man named Paea who lived at Wahane, Honua'ula to dedicate his new home to Pele saying that it should not be occupied until she had entered it. Sadly, he did not keep his word and ate all the ho'okupu (ceremonial food) which he had left for her. His unfaithfulness caused Pele to chase Paea to the ocean and her curse changed him into Pohaku Paea (Rock of Paea); which is located north of La Perouse Bay standing tall at the ocean front as a symbol of her prowess of yesterday, today and forevermore. (p 228)

The latest and last physical appearance of Pele occurred as late as mid 1800 when the Fire Goddess flowed from the top of the southern slopes of Haleakalā down through Honua'ula and landing at the surf of Makena and Wailea.

In the Hawaiian Annual published by Thomas Thrum and James Dana's "Characteristics of Volcanoes", they report Father Bailey's statements of his oral interviews explaining that the last flow had occurred in 1750 (Sterling, 228).

Many of the lava flows in the summit depression and in the Ulupalakua to Nu'u area were dark black and bare 'a'a (rough, jagged type of lava landscape). The two freshest lava flows run near La Perouse Bay. The upper flow broke out of a fissure near Pu'u Mahoe and the lower flow broke out at Kalua o Lapa cone. Both flows contain large balls or wrapped masses of typical 'a'a found throughout Hawai'i. The earliest published record seem to indicate that the Lapa flow might be the historic flow and the Mahoe flow earlier, but the similarity of petrology and degree of weathering suggest simultaneous eruption in the district of Honua'ula.

About two centuries ago, Tutu Pele completed her Lalanipu'u (row of foot hills) in Honua'ula such as Pu'u Naio, Pu'u Kalu, Pu'u 'Ola'i, Pu'u Lua Palani and Pu'u Pimoe. In 1736, Pele was still at Pimoe as she welcomed the birth of Kamehameha the Great. Although Haleakalā remains dormant, there is still a lot of seismic activity from Pu'u Pimoe and over to Pu'u Ola'i (Earthquake hill) at Ku-Makena.

At Pu'u Ola'i, Pele was jealous of the mo'o maiden of Kaho'olawe, Inaina, whose parents were Hele and Kali. Pele accused Inaina of trying to steal her lover Lohi'au from her. In a fit of anger, Pele transformed the three into hills named after them. Her older brother Kamohoali'i scolded her and pronounced the Kanawai Inaina there, meaning, "you must not say or do unkind things to others." From that time the people of Honua'ula observed that law. They named the area Ku-Makena meaning "stand courageously, accepting the joys and sorrows of life bravely, even while mourning or rejoicing."

While Pele was carving her niche on the islands from below the earth's surface, her counterpart demi-god Māui-akamai had taken an ocean approach to presenting the islands. He paddled out into the sea of Po'o from Kipahulu and in line with the hill Ka-iwi-o-Pele near Hana with his brothers Māui-mua, Māui-waena and Māui-iki-iki to fish up the islands from beneath the deep ocean with the magical fishhook Manaiakalani. It is only because his brothers looked back which prevented the islands from all rising to the top. Today, we can be reminded of Māui-akamai's works by enjoying his fishhook, Manaiakalani, which is the constellation Scorpio stretched out in the Southern sky from Honua'ula.

Eras 1 & 2: Pre-contact Migration – 0 to 1100AD

After the mythical creation of the islands was completed, pre-contact migratory periods in five distinct eras started in the year 0 to 600 A.D. Migrations from Polynesia, particularly the Marquesas, continued through the second era. Between 600 and 1100 A.D. the population in the Hawaiian islands primarily expanded from natural internal growth on all of the islands. Through the course of this period the inhabitants of the Hawaiian islands grew to share common ancestors and a common heritage. More significantly, they had developed a Hawaiian culture and language uniquely adapted to the islands of Hawai'i which was distinct from that of other Polynesian peoples (Fornander, 222).

During these periods, the social system was communal and organized around subsistence production to sustain 'ohana (large extended families). Hawaiian spiritual beliefs and customs focused on maintaining harmonious and nurturing relationships to the various life forces, elements and beings of nature. Ancestral spirits were honored as deities. Land and natural resources were not privately owned; rather, the Hawaiian people maintained a communal stewardship over the land, ocean and other natural resources of the islands. The kupuna (elders) provided leadership and guidance to the mauka (adults) who performed most of the daily productive work of fishing, cultivation, and gathering. Between the islands of Hawai'i there was some variation of language dialect and names for plants, animals, rains and winds. There were also variations in physical structures, subsistence techniques and art forms. Origin myths varied according to the particular migration and genealogical line from which families descended. The prominence of akua (gods) and kupuna (elders) also varied by island. For example, as discussed above, the volcanic deity Pele was more prominent in Puna and Ka'u. Qualitatively, the language, culture, social system and spiritual beliefs and customs were common among all the inhabitants of the islands. Oral traditions indicate frequent transmigration and even intermarriage among families from different islands.

Mālie Maui ke Waiho Mai la from the Bishop Museum Library

Mālie o Maui	Maui is peaceful
Ke waiho mai la Kaihuakala	Situated next to rough seas
'O Kaihuakala Mokuhano kai uka	Kaihalulu is inland
Kaihalulu i ke alo Kauiki	And Kaihalulu on the face of Kauiki
Hii Kauiki ia Mokuhano	Kauiki guards over Mokuhano
Hii Mokuhano ia Keanini	Mokuhano attends to Keanini
Hii Waikoloa i ka ili'ili	Waikoloa cares for the pebbled beach
Hone ana ia Kapueokahi	Which softly embraces Kapueokahi
O **Honua'ula** mauka	**Honua'ula** is inland
O Kauliuli makai	Kauliuli is seaward
Pau Pe'ape'a i Keahi	Pe'ape'a is destroyed by fire (The border ends at keahi)
No ka hee-palaha	Because it's slipping away
Moku i ka ohe la ea la e	Severed by the sacred knife

The above chant describes the gentle calmness of the early settlers to these islands especially Maui. The title of the chant, "Mālie o Maui" means "the peacefulness of Maui." I can recall growing up in the top edge of Honua'ula where we could look down to Kahului as well as Kihei, Kaho'olawe and Makena. As I woke up daily with my dad at sunrise, he would look makai (towards the ocean) and if it was so, he would automatically say, "Mālie i ke kai (The sea is calm)."

Era 3: Early Tahitian Migration – 1100 to 1400AD

This third period, between 1100 and 1400 A.D., marks the era of the long voyages between Hawai'i and Tahiti and the introduction of major changes in the social system of the Hawaiian people's nation. The chants, myths and legends record the voyages of great Polynesian chiefs and priests, such as the high priest Pa'ao, the ali'inui (Head Chief) Mo'ikeha and his sons Kiha and La'amaikahiki, and high chief Hawai'iloa. Traditional chants and myths describe how these new Polynesian chiefs and their sons and daughters gradually appropriated the rule over the land from the original inhabitants through intermarriage, battles and ritual sacrifices. The high priest Pa'ao introduced a new religious system that used human sacrifices, feathered images, and enclosed heiau to facilitate their sacred religious practices among the priests. The migration coincided also with a period of rapid internal population growth. Remnant structures and artifacts dating to this time suggest that previously uninhabited leeward areas were settled during this period.

Honua'ula is an ancient name that was introduced to Hawai'i by Chief Mō'ikeha of Tahiti. The reason Chief Mō'ikeha decides to depart from Tahiti was to separate himself from his lover Lu'ukia who originally came from Hawai'i with her husband Olopana. Lu'ukia had created turmoil in Mō'ikeha's life and therefore the Chief felt that his separation from her would heal his wounds. (Sterling, 214)

Chief Mō'ikeha's departure was not simply moving to another section of his island and beloved home of Lanikeha. Instead, he ordered Mo'okini, his kahuna nui (influential priest) to prepare their large wa'a kaulua (double-hull canoe) to set sail to the distant land of Hawai'i. On this voyage, he would take his foster son Kamahualele to help him on this voyage. Mō'ikeha also took his sisters Makapu'u and Makaaoa, and his two younger brothers, Kumukahi and Ha'eha'e. At this time, Kamahualele was inspired to provide a definition of the character of a kanaka maoli (indigenous Hawaiian) in the following chant.

From David Malo's "Hawaiian Antiquities" (p. 222) we can see that Hawaiians of ancient times were equally connected to their genealogical lines and the islands they called home.

Eia Hawai'i	Here is Hawai'i
He moku	An island
He kanaka	A man
He kanaka Hawai'i e	A Hawaiian man
He kanaka Hawai'i	A man of Hawai'i
He kama na Kahiki	A child of Kahiki
He pua ali'i mai Kapa'ahu	A favorite chief from Kapa'ahu
Mai Moa'ulanui'ākea Kanaloa	From Moa'ulanui'ākea Kanaloa
He mo'opuna nā Kahiko lāua o Kapulanakehau e	A grandchild for Kahiko and Kapulanakehau

The translation of this chant describes a Hawaiian person as Hawai'i, an island, a man, a Hawaiian man, a man of Hawai'i and a child of Kahiki. This information is important in as much as Polynesians of ancient times identified themselves with their protocol genealogical chant in their first meeting.

On his inaugural sail, Chief Mō'ikeha stops at the first landfall at South Point, Hawai'i. There, the Kalae family on Mō'ikeha's first migratory journey asks the Chief if they could reside there. He grants them permission and today, one of South Point's community names is the town of Kalae.

After Kalae, the remaining families on the wa'a kaulua (double-hull vessel) followed in line by requesting to get off as they came to a place in the Hawaiian Islands that attracted them. The Chief sailed north to drop the Hilo family at the town of Hilo. He took kahuna nui (powerful priest) Mo'okini up along the North-western part of the island to Kawaihae where the famous Mo'okini Heiau was eventually built after his popular priest.

From north Kohala, Hawai'i, Chief Mō'ikeha could clearly see the beauty of Haleakalā which enticed him to set sail and island hop from Kawaihae onto the deep rough channel of 'Alenuihāhā to Hana, Maui. There, the Hana family asked and were granted permission to reside at Hana. After, he sailed around the Kaupo coastline until he arrived at Honua'ula.

The Honua'ula family was granted permission to take up residence there. Still to this day Maui is the home for Honua'ula's descendants. The rest of the voyagers along with the Chief sailed on to Lahaina, then Moloka'i, O'ahu and eventually Kaua'i where he decided to take up permanent residency.

Era 4: 'Ohana – 1400 to 1600AD

The fourth period dates from 1400 through 1600. Voyaging between Hawai'i and Tahiti ended. The external influences of the migrating Polynesian chiefs along with internal developments within the culture resulted in sophisticated innovations in cultivation, irrigation, aquaculture, and fishing. These innovations were applied in the construction of major fishponds, irrigation systems, and field cultivation systems. Such advances resulted in the production of a food surplus which sustained the developing stratification of Hawaiian society into three basic classes, ali'i (the chiefs), kahuna (the priests), and maka'ainana (the commoners). Oral traditions relate stories of warring chiefs, battles, and conquest resulting in the emergence of the great ruling chiefs who controlled entire islands, rather than portions of islands. These ruling chiefs organized great public works projects which are still evident today. For example, 'Umi-A-Liloa constructed taro terraces, irrigation systems, and heiau throughout Hawai'i island, including the Pu'uhonua at Kealakekua. King Pi'ilani on the other hand was the only island king inspired to construct the King's Highway that passed through Honua'ula as it encircled the entire island of Maui.

Another popular mo'olelo (story) that touches Honua'ula through chant in this era has to do with a father/son connection whose names are Paka'a and Kua Paka'a. Kua Paka'a received the gift of learning all the wind chants for the archipelago of Hawai'i nei. Below is the wind chant that describes the wind originating from the island of Hawai'i traveling through the southern coastline of Maui until it passes Honua'ula then moves mauka (upward) towards Kula:

Ka Mele Makani a Kua-Paka'a (Upcountry winds of Maui), (Fornander, 97-100).

Aia la, aia la, ke kau mai la ke ao	There! There they are! The wind blown

makani,	clouds are appearing
O ka pali ale ko Hilo makani,	Hilo's wind is Kapali ale
He pakiele o Waiakea,	Waiakea's is Pakiele
He makani ko Hana he ai maunu,	Hana's wind is 'Ai-Maunu(bait eating)
He kaomi, he kapae.	Kaomi, Kapae
He ho'olua, he lau'awa'awa,	Ho'olua, Lau'awa'awa
He apiolopaowa, he halemau'u,	Apiolopaowa, Halemau'u
He ku, he kona,	Ku and Kona
He Kohola-pehu ko Kipahulu,	Kipahulu's wind is Kohola-pehu
Kohala-lele iho no ilaila,	Kohola-lele blows there also
Ai loli ko Kaupo,	'Ai-loli wind belongs to Kaupo
He Moa'e ko Kahikinui,	Kahikinui possesses Moa'e
He papa ko **Honua'ula**,	**Honua'ula** proudly hails the low blowing wind, Papa
He nā'ulu a'e i Kanaloa,	Towards Kanaloa blows the showery sea breeze, Nā'ulu
Hina ka hau i ka uka o Kula,	Hau blows steadily in the Kula uplands.
Ko laila makani no ia,	This wind blows there
Ke noke ami la i ke pili,	Persistently whirls the pili grass
Ulalena i Pi'iholo,	Ulalena is at Pi'iholo
Ukiu ko Makawao,	The ukiu wind belongs to Makawao
Ka ua pu'ukoa i Kokomo,	The Pu'ukoa rain is at Kokomo

Although the common people provided food, bark cloth, and household implements to the chiefs, Hawaiian society remained predominantly a subsistence agricultural economy. There is no evidence of a money system or commodity production. A system of barter in essential goods between fishermen, mountain dwellers, and taro cultivators existed within the framework of the extended family unit called 'ohana. In general, this exchange within the 'ohana functioned primarily to facilitate the sharing of what had been produced upon the 'ili (extensive land grant) that the 'ohana held and worked upon in common.

In this chant from the Bishop Museum Library, the author describes the land and its plants again using the travel log approach to cover a larger geographical area including Honua'ula: No A.K. Kamuohou-Nani, Hanohano ke Kuahiwi.

Nani hanohano ke kuahiwi o Ka'uiki	The hill of Ka'uiki is proud and beautiful
Kapu maika'i i ke alo o Hanailanakila	Sacredly guarded in the face of Hanailanakila
Ke nana mai 'oha na maka	The eyes are delightful to look at
Ena'ena i ka la o **Honua'ula**	Intense in the sun of Honua'ula
Malo'elo'e ke kulana i ke one Pueokahi	The position of Pueokahi is firm
Akahi a ike ia ka nani o Keanini	The beauty of Keanini is just seen
Kela nalu kaulana i ke kai	The famous wave of the sea, climbs

Pipi'i he ehukai pae i ke one	The ocean spray splashes on the sand
Auau aku i ka wai o Punahoa	Bathe in the water of Punahoa
He hoa nona Ulumano	A companion of the Ulumano wind
Makani alo pali o Waikoloa	The wind of the cliff at Waikoloa
Pipipili i ke kula o Waika'ahiki	Buffeting the uplands of Waika'ahiki
A hiki mai ia olu Honokalani	Until it reaches pleasant Honokalani
Olu iho la loko wai nanahe wale	Comfortable is the soft sounds of the pool
Hehene iki ka aka i Haneo'o	The shadow of Haneo'o is giggling
Ua like no laua me Alau	They are indeed like Alau
Me he kapa kela i ka wai o Waiohonu	It is like a white covering in the water of Waiohonu
'A'ala i ka peia i ka palai me ka awapuhi	Fragrant is the place with the palai and awapuhi
'A'ala i ka noua e ka Mālie me ka hinano	Fragrance was cast down in the calm with hinano
'A'ala laua'e i kuia me ke kupaoa	Fragrant is the laua'e sewed together with the kupaoa
Punia i ke ala honi ho'omau i ke A'ali'i	All around is the continuous scent of the a'ali'i
I'ini a nana ka pua	The flower which is desired and searched for
Ho'oumu aela i ke alo o Kawaloa	Abundant in the face of Kawaloa
A ola maika'i ka nohona pono ke kino	The body has good existence, when life is good
Pomaika'i ke kini i Mu'olea	The people of Mu'olea are blessed
Ahu ka waiwai pi'i ka loa'a	The wealth gotten expands
Ola na pua i Kaumakani	The flowers live on at Kaumakani
He mau pua hiwahiwa na ka mana'o	Precious flowers for the thoughts
Aia ka'u makemake la o Papauluana	There is my desire of Papauluana
E pili like maila me Kaho'omano	Which very much resembles Kaho'omano
Ilaila ka mana'o me ka ano'i ana	The idea for hope is there
I ka nana maika'i mai o na maka	When the eyes look favorably upon me
Kau mino ole ka lae o Makahiku	Placed upon the creaseless promontory of Makahiku
O a'u kumu lehua i Kuahine	It is I who is the lehua tree at Kuahine
Kohukohu ka noho i kuloa	Symbolizing the lifestyle at Kuloa
Ha'aheo i ke kula o Ka'akau	Haughty is the plains of Ka'akau
Heaha kau hana e Pu'unui	What are you doing Pu'unui
He pali au ke ku kilakila	Sighing loudly like Wailua
Uhunui ka like ana me Wailua	I am a cliff standing majestically
He hiwahiwa kapuna na Lani	The spring which is precious for Lani
He aupuni Kuokoa i ke alo o Puuhaoa	The independent government is in the face of Puuhaoa

He kuahiwi noho mau na ke ala	A mountain area with continuous fragrance
Ilaila ka moani a ke kupukupu	The sweet-smell of the ferns are there
Onaona ka mapuna hanu o Kamakohala	The fragrance of Kamakohala fills the air
Ho'olewa ela la'ahia pu me kanahele,	Carried together in the forest.
Ike ala _______________e	I know the scent.

Within the 'ohana unit there was constant sharing and exchange of foods, utilitarian articles and services. It was not an organized barter system but a voluntary (though decidedly obligatory) giving. 'Ohana living inland raised taro, bananas, wauke (for tapa, or bark cloth making) and olona (for its fiber). The inlanders had need of gourds, coconuts and marine foods; they would take a gift to some 'ohana living near the shore and in return would receive fish or whatever was needed. When the fishermen needed poi or 'awa they took fish, squid or lobster upland to a household known to have taro, and would return with his kalo (taro) or pa'i'ai (hard poi, the steamed and pounded taro corm)…. In other words, it was the 'ohana that constituted the community within which the economic life moved.

Cultivation of taro and fishing were the centerpieces of the material culture. The system of irrigation, fishing and aquaculture was highly developed and produced a surplus that sustained a relatively developed and unified social structure that was embraced throughout the whole archipelago. All the basic necessities came from plants. Even fishing relied on plants; the canoe was made from a hardwood tree; the net was woven out of olona or some other vine; spears were carved out of a hardwood tree; ropes were woven from the coconut husk or a vine; the sails were usually made of lauhala (pandanus leaves). Hawaiians could not have survived without plants, and Hawaiians were expert planters and cultivators.

Sam Po was one of the major native consultants for the book "Sites of Maui" authored by Elspeth P. Sterling. Throughout the "Site of Maui", Kupuna Po shared ideas relating to Hawaiian mauka-makai use of the ahupua'a in Honua'ula and south east Maui. He said that the planting cycle was dependent upon the variations in rainfall according to elevation and seasons. He went on to say that planting in the uplands were done year round since there was rain daily. However, in the lowlands, planting was done when the rains came. Kupuna Po said that he had seen entire families with lauhala baskets carry lepo (dirt) from mauka (upland) to makai (lowland) one month before the rains to put in the lava holes. Hawaiian watermelon, ipu oloolo, ipu nuhou-lani, pumpkin, and Poha or Ipu 'ala matured in about six months and were consumed while the families enjoyed the lowland plantings and fresh fishes from the sea.

Era 5: Chiefly rule of the Ahupua'a – 1600 to 1778

In the fifth period, during the century preceding the opening of Hawai'i to European contact in 1778, the Hawaiian economy expanded to support a population between 400,000 and 800,000 people. The social system consisted of the 'ohana who lived and worked upon communally held portions of land called 'ili within the ahupua'a natural resource system. These families-- the building blocks of the Hawaiian social system--were ruled over by the stewards of the land, the chiefs along with their retainers and priests. The history books are filled with tales of battles among the chiefs from all islands.

The earliest war between the island of Maui and the island of Hawai'i is attributed to Hua'akapuaimanaku, high chief of Maui, probably a descendent of the southerner Hua family from which Paumakaua and Haho came. Hua'akapuaimanaku resided at Hana. He built a heiau at Honua'ula. After his successful war on Hawai'i, he returned and built the Kuawalu heiau.

Kiha-Pi'ilani who reigned in the last half of the 15th century connected the entire island with a network of trails to aide his people in their travels and gave the king quick access to all parts of his kingdom. Even today, the original trails still exists from Keone'oi'o to Nu'u. Branching trails extended from the Pi'ilani trail in the Honua'ula area, Keawakapu to Nu'u, up to Pu'u Ninole and Pu'u Palani, through Kanaio and up through Pu'u Pane. A trail name Kekua-waha'ula derives its meaning from Pele Smiting Red Mouth. She smites people who speak evil from her listening "blow hole" in the waiting hill Pu'uokali in the Keokea 'ili (land division) in Honua'ula. Near the church in Kanaio, the trail entered the area known as Ma'ahi and into the forest of Auwahi where such plants as the 'akalea grew. The old trail is located mauka of the government road of Kahikinui. Two trails crossed from Kanaio to Keone'o'io. The upper, or mauka one, was through Pu'u Pane down towards Luala'ilua hills and across to Kaupo. The makai trail went along the sea connecting the coastal villages.

Honua'ula was the residence of Queen Kalola, a daughter of high chief Kekaulike who ruled Maui till 1736. She was the last ali'i to pronounce the kapu (taboo) of the Burning Sun. Only the Maui chiefs had this Kapu which was Maui in the Pathway of the Sun.

In Honua'ula, high chief Kahekili gave permission to a chief named Ku-Keawe to run pigs in the upland. This chief abused his power and was killed with his body placed propped up facing the sea as an example to others who might consider abusing their powers.

Even during this period of chiefly rule, land in Hawai'i was still not privately owned. The chiefly class which provided stewardship over the land divided and re-divided control over the districts of the islands among themselves through war and succession. A single chief could control a major section of an island, a whole island or several islands depending upon his military power. Up until the time of Kamehameha I, however, no one chief was ever paramount over all the islands.

During the time of Captain Cook's first visit, King Kalaniopu'u and uncle of Kamehameha the Great ruled Hawai'i island and King Kahekili of the Valley Isle controlled Maui as well as Moloka'i, Lāna'i, Kaho'olawe, Kaua'i and Ni'ihau.

The chief divided his landholdings among lesser ranking chiefs who were called konohiki. The konohiki functioned as supervisors on behalf of the chief over the people that lived on the lands and cultivated them. The tenure of a konohiki was dependent upon his benefactor, the chief. Konohiki were often related to the chief and were allocated land in recognition of loyal or outstanding service to him. However, unlike elsewhere in Polynesia, the konohiki were rarely related to the maka'ainana or commoners on the land under his supervision. Thus, the konohiki represented the collective interest of the ali'i class over the maka'ainana as well as the individual interest of his patron chief.

The lands allocated to the konohiki were called ahupua'a. Ahupua'a boundaries coincided with the geographic features of a valley. They usually ran from the mountain to the ocean, were

watered by a stream, and were bounded on both sides by mountain ridges. It afforded the 'ohana who lived in the ahupua'a access to the basic necessities of life-- marine foods from ocean reefs and streams, low lying wetlands for taro, fresh water, timber, and medicinal plants from the forest. The use rights of the konohiki included fishing rights over shoreline fishponds and reefs.

The konohiki supervised all productive communal labor within the ahupua'a month-to-month and season-to-season. He collected the annual tribute and determined if it was sufficient in relation to the productivity of the land. He regulated the use of land and ocean resources, administering the kānāwai (law) applying to the use of irrigated water as well as to fishing rights in the ocean. The konohiki was responsible for organizing communal labor for public works projects such as roads, fishponds, and irrigation systems.

The ahupua'a of the konohiki was further divided into strips of land called 'ili which were allocated to the maka'ainana (commoner Hawaiians). These land grants were given to specific extended family units of maka'ainana called 'ohana. The 'ili either extended continuously from the mountain to the ocean or was comprised of separate plots of land located in each of the distinct resource zones of the ahupua'a. In this way an 'ohana was provided access to all of the resources necessary for survival (Handy, Handy, Handy & Pukui, 49).

In Sterling's "Sites of Maui", he introduces the guardian shark Ka'ala-miki-hau of Honua'ula in this short chant: (p. 10)

'O Hi'u noho i Keanae	Hi'u resided in Keanae
Keli'i hue wa'a noho i Hana	Keli'i hue wa'a lived in Hana
Puhi noho i Kipahulu	Puhi was stationed at Kipahulu
Ka'ala noho i **Honua'ula**	Ka'ala-miki-hau guarded **Honua'ula**
Kamohoali'i ke ali'i nui a puni o Maui	King Kamohoali'i watched over all Maui

Here is the mele inoa (name) chant for Ka'ala-miki-hau who served the people of Honua'ula as their aumakua (ancestral god).

Eia ka 'ai	Here is the food
Eia ka i'a	Here is the fish
Eia ke kapa	Here is the kapa
Nou e Ka'ala-miki-hau	For you Ka'ala-miki-hau
Nana ia'u kau pulapula	Look upon me your devotee
I mahi'ai	That I can cultivate the ground
I lawai'a	That I may fish
Kuku kapa	And beat the kapa
A e ola ia'u, Kanui	Grant life to me, Kanui.

Honua'ula, Kahikinui and Kaupo

Now that a general explanation of the lifestyle of Hawai'i has been provided in the above pages, we now focus upon the specific development of the ahupua'a of Honua'ula. The coastline of this section of Maui, much like Kaho'olawe, is windswept and relatively barren. As indicated above, most mo'olelo (oral traditions) for southeast Maui date back to the era of the great migration from Tahiti and the long voyages between Hawai'i and Tahiti. The mo'olelo of Kaupo, Kahikinui, and Honua'ula are also intertwined with that of the island of Kaho'olawe. Kaho'olawe was originally dedicated to Kanaloa, the great Polynesian god of the ocean and of seafaring. The channel between Honua'ula and Kaho'olawe is known as Kealaikahiki Channel (pathway to Tahiti). Thus, the wahi pana (sacred storied places) of southeast Maui reveal a history of the settlement of the islands of Hawai'i by the high chiefs of Tahiti as they were guided to Hawai'i by their great navigators such as Mō'ikeha, Hawai'iloa, Kiha, La'amaikahiki and Pa'ao.

Up the coastline from Honua'ula is Nu'u which connotes a high place and also the name for the second platform in a temple. A sacred village site, Nu'u Bay was named because it was the landing place of Nu'u, a great kahuna navigator who was an ancestor twelve generations from the beginning of the Hawaiian people in the genealogy of Kumuhonua. Preceding Nu'u is Kaupo meaning "landing by canoe at night." As the name attests, the bay of Nu'u was a noted landing site for the entire south-east Maui.

Kahikinui was named for the beloved homeland, Kahiki of the earliest settlers who came to Maui from the South (Handy, Handy and Pukui, 508). Most of the Hawaiians in the Hana districts trace their ancestry to Hawaiians who lived in Kaupo, Kahikinui and Honua'ula before Captain James Cook's arrival in 1778.

The ocean along the shoreline of southeast Maui had abundant marine life and is a source of sustenance for many people. Fresh water seeps into the ocean at the shore and creates a productive ecosystem for a large array of sea life. The gods Kane and Kanaloa are credited with going about all of the islands providing fresh water. They are attributed with providing springs of fresh water along the southeast coastline of Maui. It is said that they landed at Pu'u-o-Kanaloa (Hill of Kanaloa), a small hill north of Keone'o'io when they first came from Kahiki. They dug a water hole by the beach and found the water Ka-wai-a-ka-la'o. These gods also opened up the Kanaloa fishpond at Luala'ilua-kai providing the brackish water for fish spawning (Beckwith, 64). They went on to Nu'u to dig another spring (Handy, Handy and Pukui, 510).

Kamehameha III was responsible for Ka Mahele in 1848 and the Kuleana Act in 1850 establishing a system of private ownership of all lands in Hawai'i. The Board of Commissioners to Quiet Land Titles, which was set up under a law passed by the Hawaiian Government in December 1845, began hearing testimony on selected claims registered by non-Hawaiians early in 1846. The division of lands between the King and about 250 chiefs took place in 1848 and resulted in what is known as the Mahele Book. In it is recorded the names of the lands belonging to Kamehameha III and the names of the chiefs with the lands that they claimed. At the end of each Mahele (division), a phrase was added that protected the rights of the hoa'aina, who were the farmers living on lands (ahupua'a and 'ili) taken as private property by the king and the chiefs.

When the lands were divided in the Mahele (division) of 1848, there were a number of ahupua'a (sub-district land divisions) designated as "Government Lands" within the moku (districts) of Honua'ula, Kahikinui and Kaupo. These designated "Government Lands" are indicated in the Indices of Awards (Office of the Commissioner of Public Lands, Territory of Hawai'i 1929.

Regardless of the parcel size granted to them, the tenants (Native Hawaiian) of an ahupua'a retained their traditional mauka-makai access and gathering and fishing rights. These rights are

spelled out in the Kuleana Act of 1850 and are sustained in the Revised Laws of Hawai'i. They are as follows:

> *"Where the landlords have obtained, or hereafter obtain, allodial titles to their lands, the people on each of their lands shall not be deprived of the right to take firewood, house-timber, aho cord, thatch, or kï leaf, from the land on which they live, for their own private use, but they shall not have a right to take such articles to sell for profit. The people shall also have the right to drinking water, running water, and the right of way. The springs of water, running water, and roads shall be free to all, on all lands granted in fee simple; provided that this shall not be applicable to wells and watercourses, which individuals have made for their own use" (Haw. Rev. Stat. Section 7-1 (1985).*

Territorial years

Control over the Hawaiian Government Lands and the Crown Lands were taken by the Provisional Government that was established in 1893 when the Hawaiian monarchy was overthrown with the assistance of U.S. military forces. When the Republic of Hawai'i was declared in 1894 these two categories of lands were combined and collectively called "Public Lands." In 1898, "Public Lands" that had not been sold by the Republic of Hawai'i were "ceded" to the United States of America at time of Annexation.

In 1900, under the Organic Act, most of these "Ceded Lands" were turned over to the Territory of Hawai'i to administer; however, some of the "Ceded Lands" were retained by the United States Government, primarily for use of the U.S. military and Coast Guard. In the report of the Governor of the Territory of Hawai'i, 1901, it lists the "Ceded Lands" in the district of Honua'ula and Kahikinui.

District and Ahupua'a	**Acres**
Honua'ula:	
Kanaio	7,600
Papaka	300
Kualapa	400
Kanahena	1,000
Onau	600
Papa'anui	4,500
Kahikinui	25,000

At this time, the Governor's report described the Honua'ula lands as "Rocky Grazing," and the Kahikinui lands as "Grazing Lands." Inez Ashdown, an avid researcher of Hawaiian culture states that at the turn of the century 1900, Honua'ula was rich with pili-grass, tobacco, cotton, ilima, native plants, and trees, such as noni and kukui. However, E.S. Craighill Handy reports the following ecological changes due to cattle ranching:

> *In Honua'ula as in Kahikinui and Kaupo, the forest zone was much lower and rain more abundant before the introduction of cattle. The usual forest zone*

plants were cultivated in the lower uplands above the inhabited area. Despite two recent lava flows, which erupted in about 1750, the eastern and coastal portions of Honua'ula were thickly populated by Hawaiian planters until recent years. A number of families whose men are employed at Ulupalakua Ranch have homes near the ranch house. Close by these native homes are little dry land taro cultivated. (p. 508)

Ranching has been blamed for many of the district's environmental problems. The cattle and goats stripped the land of its native flora while destroying ancient Hawaiian temples and gravesites. Ranching operations took over land previously owned by Hawaiian families. Some Hawaiians left the area and were not aware of it when the ranchers took their lands through the process of "quiet title" or adverse possession.

The 'Ahihi-Kina'u Natural Area Reserve encompasses 2,052 acres in Honua'ula, Makawao. It runs from 'Ahihi Bay to La Perouse Bay and includes all of Cape Kina'u and is intersected by the Makena Keone'o'io Government Road. The Marine Reserve includes pristine shallow water ecosystem with dense and diverse bottom community. Inter-tidal fauna is rich. The Lava Flow Reserve at Cape Kina'u contains native vegetation in kipuka (open areas surrounded by lava) such as Hawaiian caper, Naio, Wiliwili, Nehe, and Pili grass. The Tide pool and Pond Reserve provide irregular porous lava and another class of aquatic ecosystems intermediate between open seashore and freshwater. Biota in these systems varies with the degree of salinity. Near shore ponds are marine-like, showing algae, invertebrates and fishes. Progressing inland, fewer and unusual species are present. Fishes and marine algae disappear and two species of crustaceans, the endemic small red shrimp ('Opae'ula) and an alphaeid shrimp, known from 3 other localities in the Pacific appear. The Cape Kina'u ponds represent the only extensive habitat for this uncommon species on Maui. Water birds such as the Ae'o (Hawaiian Stilt), sanderlings, curlews, plovers, turnstone, and migratory ducks have been observed in the larger open ponds.

Fishing and Ocean Gathering

Fishing and ocean gathering occurred along the coastal areas throughout the region (from Makena to Kaupo). The techniques used to catch fish differed according to the particular locality. For example, fish traps were found in Makena and Kanahena where moi and weke were caught. Akule were found in abundance in La Perouse Bay at Kalihi and Nu'u Bay at Nakula.

One of our consultant families, Butch and Sandy Akina shared this story of catching Akule. They said sometimes they caught so much fish they had to give it away. They recall inviting the locals to come assist in taking the Akule out of the nets. Even the wife of the late Hannibal Tavares came to assist and at the end took home free fish as payment for her assistance. "At times there was so much in the nets we had to give it away," says Butch. He went on to say that he learned from kupuna (elders) that fish have ears. "You have to take care," the kupuna said, "or not you wouldn't be able to catch them again." During the early years of Butch's fishing life, he used to accompany his dad to catch turtles for the U.S. Government to feed the troops during World War II. "Big kind turtles like over three hundred pounds," Butch said. He went on to say that the turtle steak was better eating than a cow. (Akina, 9)

Ahi and ono were caught in the deeper waters near Mamalu Bay at Naholoku. Mullet, ulua, manini, uhu and other shoreline fish were successfully caught along the Honua'ula coastline even up till today. Because the elders taught fish had ears and would run and hide if they overheard a conversation about fishing, reference to go on a fishing excursion was usually made by saying simply, "we going holoholo" which secretly meant that they were going fishing. Earlier, I had made reference to my dad awakening to the saying, "Mālie i ke kai." When he verbalized those words, to my disappointment, I knew we weren't going fishing. On the other hand, if I saw him gathering the fishing gear as I opened my eyes, with much excitement I woke up silently and prepared my fishing gear to be ready to go with him on a fishing excursion. In fact, I can still recall catching my first fish, an ūpapalu in the early dark morning at 'Ahihi Bay with dad standing by my side.

Ocean gathering occurred along the Honua'ula shoreline where 'opihi (limpet), limu (seaweed), and kupe'e (ocean snail) were gathered and 'a'ama (crab) was caught on the rocks. He'e (octopus) was speared when walking the shoreline or diving; ula (lobsters) and crabs were caught while diving; and some species of crab were caught in traps as far as 2 miles from shore.

Another consultant Mahealani Kai'okamalie (Kai'okamalie, 4) and resident of Honua'ula recalled vividly "cutting out" from school to go fishing with his upena kiloi (throw net) on the shores of Honua'ula. He walked on the rugged 'a'a to get to his fishing grounds and along the way, put bottles of water alongside the walking trail. Upon his return trip with his heavy load, he would stop for a drink that he had earlier hid away in the crevices of the many lava tubes.

Disputes over access to fishing grounds have been a constant and deep concern for many consultants. One person described a problem between his family and a ranch over who owned or had jurisdiction over a road that provided access to the shoreline. He said it was difficult to concentrate because you were always aware that the ranch might come down on you when you were using the road.

A recurring theme among local fishermen was to take only what was needed and to only go fishing when the family's fishing supply was down. Many consultants spoke proudly about carrying on this traditional approach to ocean conservation. They believed that if they were not sensitive to the marine ecology, then nature would impose its own sanctions by not providing food. One consultant mentioned that he was taught by his elders to not go fishing during the months of October and December. If he disobeyed this rule, fishing would be unsuccessful during the other months of the year.

Fishing, Fishponds (Loko i'a), and Fishing Grounds

It has been said by the people of old that the measure of an ahupua'a's wealth and power was determined by the amount of functional heiau that existed in their boundaries coupled with existing loko i'a (fishponds). As explained above, the Honua'ula shoreline has abundant marine life that served as a source of sustenance for many people. The fresh water seeping into the ocean at the shoreline produces a large array of sea life. The gods Kane and Kanaloa showered their blessings upon the neighboring Kahikinui ahupua'a by opening the fishpond Kanaloa at Luala'ilua. Loko i'a served as liquid iceboxes or food storage. There, people could fetch a fresh variety of fish especially those cruising along in schools like mullet, moi, weke, aholehole and numerous other varieties. The other food delicacies such as crab, octopus, seaweed and the like were raised in these ponds. Other loko i'a built in the Honua'ula neighborhood were at Pu'u Ola'i; in the shallows of Keawalai Church; Kalepolepo in Kihei; and close by at Ko'ie'ie which is hosted by the Whale Sanctuary Center on South Kihei Road. Wetland areas such as Ma'alaea mud flats served as other natural inlets to house the various marine life that the Hawaiians could use.

Ku-Makena and 'Ahihi bays each had a fish pond. The one at Keone'o'io was very large stocked with 'Ama'ama, Awa, and 'Oi'o. At certain times the spirits of the dead chiefs are heard and sometimes seen. This procession is called as 'oi'o or as huaka'i-po, the Marchers of the Night. The two main ponds are named Halua and Kauhioaiakini and here dwell the mermaids and the benign sharks, such as Kamo'oali'i and Kaneikokala, their spirit mates of the sea. The fishponds at Maonakala village were sacred to Queen La'akapu and her son, Kauholanuimahu.

Many a time, fishponds were inspired by an ali'i who wanted the convenience of having fish readily available for themselves or their guests. Lahaina, the capital of Maui housed the large loko i'a Mokuhinia which fed the ali'i whose residence was at Moku'ula.

I was raised listening to my mother telling us of our father's experiences with wahine hi'u i'a (mermaids) and huaka'i-po. In my dad's younger years, he was raised in Kuau and Huelo so he was accustomed to seeing these spiritual encounters at places such as Twin Falls with the mermaids and other waterways at Ko'olauloa and Ko'olaupoko. It was an experience for me as a young boy to be with him at the shores of Honua'ula and have the huaka'i-po literally lift our truck off the King's trail and set it down in the opposite direction. Today, I realize that the spirits of the huaka'i-po we encountered were not from the same district. We were the mālihini (new comer) in their ahupua'a.

The other measure of an ahupua'a's rich success was the amount of agriculture heiau (temples) that were found in their land districts. Yes, it might impress the mālihini to claim that they have a large heiau on their ahupua'a but after all that have been said about the make-up of the Hawaiian lifestyle and the importance of plants in the Hawaiian society, one could determine that more agriculture heiau rather than one large luakini (sacrificial temple) would show the richness of their ahupua'a community.

In Honua'ula, there are many heiau and little alters of stones where people prayed to Lono and to Hina for rain and ample crops since the area was primarily used for planting, farming and ranching. Other temples include many fishing shrines (ko'a), a hula platform and a place of refuge (pu'uhonua). Appendix A is a summary list of the temples and sacred sites relevant to Honua'ula and its surrounding neighbors.

Summary

In summary, this is our assessment of Honua'ula (Red Earth). As a whole, this ahupua'a from the beginning of its occupancy in early Hawai'i was very rich at its shores with an abundance of marine life. That includes deep and shoreline fishing and all the animals like squid, octopus, crab, and shell fish with an abundance of various seaweeds consumed by the native peoples. Makena Landing became the second busiest port next to Lahaina since the cattle and agricultural products were brought here to load as well as receiving goods for residents throughout Central Maui. During the time of Kamehameha the Great, he required large quantities of sandalwood to be harvested from mauka (Kula, Makawao and Haleakalā) and loaded at Makena. His invasion of Maui occupied all the shores of Honua'ula to defeat the Maui king Kalanikupule. (Sterling, 254).

Afterwards, the king took time to direct his people to rebuild the fishponds of Kalepolepo and Ko'ie'ie. Since Honua'ula did not possess rich waterways from mountain to ocean, sweet potato, sugar cane and ranching were the key activities of the ahupua'a. The maka'ainana (common people) worked the land under the direction of the konohiki and occasionally the ali'i would drop by enroute to Kaupo where most of the activities of the chiefs took place.

By looking at the chart on heiaus, we are able to see that the greatest numbers of heiaus were in the southern part of Maui from Kaupo to Kahikinui. Also, the second largest heiau on Maui was Loa-loa of Kaupo. This area possessed a greater amount of luakini heiau to serve Maui's warriors with the psychological purpose of Hawaiian warfare between the warring soldiers of Hawai'i island. As we move north, fewer luakini heiaus are found in Nu'u, Kahikinui, Kanaio and Makena and hardly any in the heart of Honua'ula. For the most part, the heiau in the Honua'ula District were agriculture, rain and or fishing type of heiau. As of this writing, we are convinced that the villagers and occupants of Honua'ula was a peaceful farming and fishing community with occasionally excitement from visits of Tutu Pele and French discoverer Captain La Perouse. Honua'ula was and still remains the land of the sacred red earth.

Kimokeo Kapahulehua and I (Keli'i Tau'ā) as Hawaiian practitioners send our Mahalo Akua, Nā Aumakua, Nā Kupuna, a me Charlie Jencks (Thank God, Ancestral Gods, Elders, and Mr. Jencks) for inspiring us to provide this sincere and honest cultural report.

The Honua'ula development will open up south Maui from Kihei to Makena with new challenges. We hope the developers will tread with as much care as they have shown during the planning process. It is our sincere wish that the cultural sites that have been found can be retained and infused into the planned site development. Also, we desire that the native plants can be kept in tact as much as possible to retain the ahupua'a's unique identity. Lastly, we desire that the ala i ke kai (pathway to the ocean) and the ala i ke kula (pathway to the uplands) will always be recognized as part of the law decreeing that one should respect Hawai'i's gathering rights (passage to fishing at the ocean and streams or gathering native plants in the mountain). By saying those things, we now can close this report me ke aloha pumehana (our fondest love and support) and the wisdom of our kupuna who said, "E ho'olohe i ka leo o ka 'aina" (Listen to the voice of the land).

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Appendix A: Heiau

Information gathered from Sites of Maui by Elspeth P. Sterling. Please see General Index and Index of Place Names for specific page numbers for each listed Heiau.

Heiau Names	Ahupua'a location	Purpose
Lo'alo'a	Kaupo	Luakini – sacrificial. West Mamawainui Gulch. By menehune. Long temple on Maui. 2nd largest next to Pi'ilanihale heiau of Hana
Kanaloa	Luala'ilua/Kahikinui	Built by gods Kane & Kanaloa for rain
Na-hale-loulu-a-kane	Honua'ula	Built in antiquity dedicated famine/ epidemic
Manonokohala	Kanaio	At Puki east
Manoka'ahia	Kanaio	At Puki west
Pu'u mahoe	Kanaio	Keawanaku
No name	Kanahena	
Kalihi	Keone'o'io	
No name	Kaloi	
Pu'u-la-kua	Kaupo	Luakini. Heiau belonged to chief Kekaulike
Pohakunahaha	Makena	small well preserved structure
Onipa'a/Onepa'a	Ulupalakua	By Pu'u Ola'i gate owned by Seibu Corp.
Oniuli/Oneuli	Makena	On Sam Garcia's land. Used as kahuna school. Hula hālau there. Makahiki games played. Built by Kauholamahu son chief Kahoukapu La'akapu
Papakea	Makena	Pu'u Ola'i. Large shrine to Ku'ula-kai
Kalani	Makena	David Chang's property
Popoki	Makena	Kukahiko Cemetery
Ko'ula	Kanahena	Ho'oulu 'ai-place to ask for plenty food
No name	Ulupalakua	Makee Ranch
Pu'u Naio	Keone'o'io	Papaka land of the ghost of a departed chief
No name	Nahawale	At water spring called Waipe'epoli
Ke'eke'ehia	Honua'ula	Place of refuge Hale Pueo. Place to pray for the souls of the dead. The Pueo-kahi and Pueo-nui-akea are two names for the akua, or God. Pueo is symbolic of Wisdom and the whole universe & light. An aumakua or ancestral guardian spirit.
Nahaleloulua		Dedicated to Kane
Ka'aiea		Multiply to produce food
Pa'alua	Kalihi,	For rain. Maka-kilo-i'a

	Honua'ula Above La Perouse Bay.	
Kaulena	Keone'o'io	A ko'a
Keawanaku	Kaloi, Honua'ula	Probably a Ku'ula
Kahemanini	Honua'ula	Multiplying fish
Kuahuka	Kanaio, Kaunukeaha	2700 feet
Kohola	Kanaio	South of the Kula pipe
Manonokohola	Kanaio East Honua'ula	Congregational Church
Manoka'ahia	Kanaio West	At Puki, West of the Church
Halileo	Kalepa, Kaupo	Luakini
Papanuiokane	Kanaio	Hulapapa
Ki'ipuna, Ninaulunui	Kanaio	Between Wai-a-'ilio and Wahene. Large platform
Popoiwi	Popoiwi, Kaupo	Built by the menehunes
Keakalauae	Kaupo	One of the largest by King Kekaulike 1730. used as a Pu'uhonua or Hill of Refuge
Paukela	Kaupo	Whole hill top used as heiau. Rock tomb w/body
Lanikaula	Kaupo	Located in back of Post Office. Kukui tree in front
Pu'umaka'a	Kaupo	Mauka from school house
Haleokane	Kumunui, Kaupo	Luakini. Chief Nakuli's temple. Kauili succeeded.
Lonoaea	Kohulau, Kaupo	Fifty yards south from Haleokane.
Kekaulike	Kaupo	Heiau also called Ka-lani-ku'i-hono-i-ka-moku. Kekaulike, Maui king also built luakini Loa-loa Kane-malo-hemo, Popo-iwi, & Pu'u-maka'a 18th
No name	Puhilele, Kaupo	Overlooking Waiuha to the West
Hala	Kaupo	Agriculture. Kaiuli the chief, Hala the kahuna
At Halaulani	Kaupo	
Pu'uakua	Kaupo	Below house @ Antone Marciel Sr. to Nu'u Road
Pua'akolo	Kaupo	In pasture of Antone Marciel Sr. upper to Nu'u
Waihi	Kaupo	300 yards south of upper Nu'u trail
At Kou	Kou, Kaupo	Large heiau open to west 250 ft. by 265ft.
At Keanawai	Kaupo	130 ft. by 50 ft above Keanawai looking out to sea
At Opihi	Kaupo	On the flat country above Pu'u Mane'one'o to Nu'u

Laia	Kaupo	Near Catholic Church
Papakea	Nu'u	One burial found there. Multiply food crops.
Fish(Ukulaelae)	Nu'u	Consultant Kenui said heiau to increase fish supply
At Kaili'ili	Nu'u	Large 50 x 124 ft. quarter mile up from shore
Halekou	Nu'u	Large 145 x 90 up from Nu'u Gulch 600 ft.
Oheohenui	Nu'u	Small 43 x 50. Possible heiau for tapa drying
At Anakalehua	Nu'u	Small 44 x 33 open to the sea
Pili-o-Kane	Nu'u	Luakini
Ohela	Nu'u	No information
3 small heiau	Nakula, Nu'u	30 x 40 between Kahalulu and Pukai
At Pahihi	Nakula, Nu'u	38 x 35 ft facing the sea
Hakalauai	Kahikinui	La-pueo is the ahupua'a. Uluao Keakakilohi/chief. Mana was the priest
Kahuahakamoa	Kahikinui	Wall enclosure still standing
At Poloae	Kahikinui	Near milepost 32 @Kula trail. 45 feet
At Kamoamoa	Kahikinui	94 x 80 feet built at Kama'ole Gulch.
At Naka'aha	Kahikinui	Small heiau on hill over-looking village site
At Naka'ohu	Kahikinui	Above Waiapea. Curious shaped heiau.
At Wailapa	Kahikinui	Sixty yards north of Wailapa village
Hale-o-Lono	Kahikinui	Built by Kekaulike; Maui chief; luakini@ Kipapa
At Kepalaoa	Kahikinui	30 x 45 ft open on 3 sides facing sea
Kaooa	Kahikinui	At Alena, a luakini
Momoku	Kahikinui	At Luala'ilua built by the menehune @ Ka-papa-iki
Kaluakakalioa	Kahikinui	Above village Hanamau'uloa 48ft. square.
At Auahi	Kahikinui	Small west of Luala'ilua Hills
At Koholuapapa	Kahikinui	Total length 110 ft. Rough basalt w/ili'ili, pebbles
At Makee	Kahiknui	At Makee village @ shore 60 x 30 ft.
3 Heiau	Keone'o'i'o	Ho'omana for shark, Pa'alua-rain & fish, in Papaka Kaulana koaia, another Papaka uka called Pu'unaio
Mahia	Kula	Small
Kaunuopahu	Kula	Small
Po'onahoahoa	Kula	Small
Mana	Kula	Small
Nininiwai	Kula	At Pulehu, trampled by cows and replaced by pine
Papakea	Keokea, Kula	Below Kula Sanitarium
Keahialoa	Keokea, Kula	On hill in back of Kula Sanitarium
Moloha'i	Keokea ,Kula	Several hundred yards below Papakea heiau
Kaumiumimua	Keokea, Kula	Below Moloha'i in line with Haleakalā Church& Pu'u Kali
Kaumeheiwa	Waiohuli, Kula	Northeast of Kaumiumimua on 'a'a lava

Kaimupe'elua &	Waiohuli,	Small heiau on rocky knoll
Pauhu	Kula	Large 60 x 66 ft. Destroyed when road built
At Rice camp	Kaonoulu	Small L-shaped heiau
At Alae	Kaonoulu	Above main road of Kaonoulu Gulch
Kalaihi &	Kaonoulu	In back of Mormon Church site
Kealalipoa		
At Waiakoa	Kula	Small heiau
At Pu'umaile	Waiakoa	Story told to Kamehameha 1 that 3 haoles were sacrificed @ this heiau
Haleokane	Pulehunui	At Po'onahoahoa small heiau
Mo'omuku	Oma'opi'o, Kula	Large 90 x 108. Drums heard
Mana	Oma'opi'o	Large heiau where many graves included
Mahia	Oma'opi'o	Small heiau
Po'ohinahale	Oma'opi'o	Might be heiau Kaunuopahu called by Thrum
Pu'upane	A'apueo	Kihapi'ilani declared this heiau sacred
Keahuamanono	Haleakalā	Built by Kaoao, younger brother of King Kekaulike

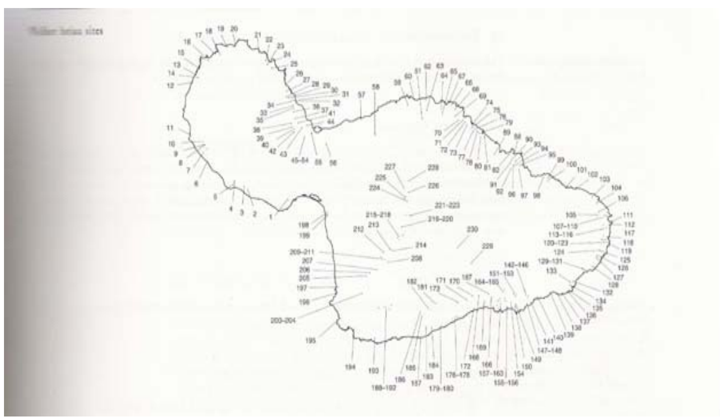

Figure 2 Sterling, 13

Consultant Interviews:

Interview: Douglas Wayne "Butch" Akina

By Keli'i Tau'ā/ Kimokeo Kapahulehua

KT- Keli'i Tau'ä
BA- Butch Akina
W- Wife of consultant (Mrs. Sandy Akina)

KT- So, mahalo for allowing me to come talk story, your full name.
BA- Douglas Wayne Akina.
KT- No more Hawaiian name?
BA- No more, Butch. My nickname Butch, everybody know me like that.
KT-Yeah, and when were you Grand Marshall? What was that? Kamehameha Day Parade?
BA- No, Kihei.
KT- For what event?
BA- For Kihei Community.
KT- Community, wow. So, Butch how old are you now?
BA- Sixty three. Just made sixty three.
KT- And we're feeling the pains yeah of sixty three.
BA- Yeah.
KT- But congratulations I heard you got some wonderful contracts, your business is expanding.
BA- Yeah.
KT- More headaches but of course.
BA- More headaches and the people not like, the workers not like they used to be. Today everybody is..
KT- Not committed.
BA- No, they not committed.
KT- Yeah, money first and even then sometimes they don't show up.
BA- The more money you pay, same thing. Doesn't matter it seems like only people want to work for money, not for the enjoyment of the job.
KT- The joy of working.

BA- Joy of working is changing, the world is changing.
KT- Yup. Um, I don't know if your wife showed you the article I wrote about your father. I delivered, you remember when I used to come visit you guys? Um, but he, as you know was born on Kahoolawe.
BA- My grandfather was foreman over there.
KT- On Kahoolawe?
BA- Yeah, that's why they was there.
KT- Foreman for what?
BA- The ranch.
KT- Ah, so how much do you remember of that?
BA- I wasn't born there.
KT- I know but dad or mom them.
BA- Well, my dad used to tell me.
KT- Yeah, what did he tell you?
BA- How my grandfather was outlaw.
KT- Outlaw?
BA- He was a smart little pake.
KT- So when you speak of Chinatown, which Chinatown?
BA- In Kula.
KT- Wow, all the way up there! How they got em up there?
BA- The Chinese like the opium so we used to take 'em up there for the Chinese. Us boys call that was the reason.
KT- Yeah, um how did they get 'em up there though?
BA- Kaluhi, he bring 'em up and he get good horses.
KT- Ok, rode horses all the way up.
BA- Yeah, and then the cop trying to catch 'em but his horses faster than the cop! (laughter)
KT- So the cops.
BA- That's what my dad told me, I'm just repeating.
KT- So the cops um, were riding on….just like cops and robbers on horses.
BA- Yeah and then he jump on his canoe, they cannot catch him. He was a gambler too.
KT- So you think your father picked up some characteristics from tutu man?
BA- Oh yeah, you always get that little lean.
KT- How many in your father's family?
BA- There was only three brothers that I know.
KT- And you were the youngest?
BA- No, his side, our side.
KT- So was John, your father's name was Alex.
BA- Alex and Frank.
KT- Frank yeah, and then your father's children was. Where were you in the….
BA- I was the last.
KT- You're the last.
BA- I just lost my last brother.
KT- How old was he?
BA- Sixty seven. All my brother's died, I'm the only one left. I still got four sisters left.
KT- So, is that to say the females….
BA- Now, now all the females going like overrun me I have no chance.

KT- But dad left the business over to you.
BA- I bought that school bus business over there. The tourist one I made. I went build that one up. I had to fight Robert's, Grayline. Took me six years about three hundred thousand dollars to get the license.
KT- But now you're the biggest.
BA- No, in Maui maybe. For one small, in the price like me, them all around. But in Maui…..
KT- You got the most people.
BA- Well...up and down. But my class is the better class. You know I cater to people; I don't herd them like cattles.
KT- Ok.
BA- You know, then school buses. We was thinking about the school buses. That's why I came home for to run the school bus. Then Robert's went under beat us way the hell down to nothing just to throw us out to their control. Then Kamehameha School called if want to go back in and get into school bus they want me to run this school bus system. So I tried it, I did and then Robert's came in and under bid me. Well, they lasted one year and Kamehameha School threw them out because their service was terrible. They just want to cut you down and boss all the small guys around. That's how I started school bus again. State they can have 'em and sell 'em. They all bunch of hypocrites.
KT- You're the one working with them so you know.
BA- Oh yeah like before they, you only allowed to own fifty percent in one island. When Robert's took over they was ninety percent! How the hell that happened. Right? How that happened? Politics all that bullshit. Paying, paying, paying. And then now it's coming to the point where Robert's under bid they losing money so bad. So now they going get the State. I know they going get 'em. Now the State going suffer. Instead they leave how things was, you know, everybody takes their districts and do your thing. But you know money talks bullshit walks right.
KT- So, you said you came back. Where were you before?
BA- California. I was working for this company. I was the foreman up there.
KT- Doing what?
BA- Spices. Making black pepper, making spices for Kentucky Fried Chicken and right, I busted lot of records into making spices.
KT- So, you already had your family up there? Sandy and….
BA- No, this is my second wife, Sandy. I had another wife up there.
KT- So what made you go up there? Work?
BA- Well, there was no job when I graduated in sixty-two.
KT- From where?
BA- Hawaii.
KT- What school?
BA- Um, Saint Anthony. I went to a private school. Then I had a job actually after I graduated I went to the post office in Honolulu into maintenance. Then I waited, waited about two weeks, nothing happened. I had my sister and brother up the mainland, oh come up. So I sold my car, bought a ticket, just then here comes the government, "you got the job." I look at the ticket and I look at that going to the mainland I said, "ah hell I'm young the hell with it. I'm going." Take the chance. That's how I went up the mainland. I wasn't planning on the mainland, I see how different nationality operated you know. After I saw that they ain't no better than me because I didn't know any better. That's how I started.

KT- For how many years?
BA- I stayed up there about…. Sixty three I left here I came back 1970. But I learned plenty you know.
KT- What State were you in?
BA- California, Anaheim. It was nice those days up there but not anymore.
KT- So, coming back to Hawaii you can remember your childhood days? What did you do for fun?
BA- Fun, you had to create you own.
KT- Like what?
BA- Well, I had a lot of nieces and nephews, I was the boss. Since I was the youngest of the whole family and they was almost same age like me. We made cowboy games and I was the boss. If I go smoke or do anything you gotta have one cigarette or whatever they give you so they can tell on me.
KT- So dad was really into fishing.
BA- Yeah, he was. That's when I was young. And he always had school buses, but you know just for Kihei was small. I guess he saw in the future that it would be the future. So he kept that and run, run, run. Get bigger and bigger and I had my two brothers over here and they didn't want to run 'em so he call me up in the mainland. In fact before that I went up he went call me in the mainland he going buy buses in Chicago if I can help him go bring the buses home. What the hell, I never did drive one school bus in my life. So I went down the motor vehicle and I went try get a license. They told me you can't get a license you need a bus and everything. The guy told me what the hell just drive 'em go for it. And I never drive a school bus I chance 'em and I went. But I knew the mainland, I knew how to travel 'cause I been up there long enough and I knew it. You knew I knew the maps so my dad would depend on me to navigate how they going get back to California or Chicago. That's how I did.
KT- Wow, you had guts just to do that.
BA- I did anything, I wasn't scared of nothing.
KT- So, um.
BA- I started my own business up there too. After I quit the spice company I run my own business.
KT- What kind?
BA- Ah, mobile home. Wipe 'em, wash 'em. Do all maintenance everything I had my own.
KT- So where did you pick up those skills?
BA- I find people and people tell me, friends, "eh, why don't you quit this company and go with me." "Doing what?" "We go clean over here." "Oh yeah, let's go." I never even tell my wife, I went. I'm the type that would do anything. I not scared of nothing. You gotta chance 'em in life, right?
KT- So was dad a philosopher? Did he spend time with you guys to kind of…
BA- I was, when I was young I was always with my father. I mean to me he was my idol. But I watch him what he do and everything I watch, I watching all his mistake. But those days when you young you cannot tell your father you wrong.
KT- As an example.
BA- Like you know when we saw that some methods can do 'em faster this way. Why you do 'em this way? You don't know what you're talking about you young punk you get outta here. So, but you watch and you learn so I don't say nothing. One day I went end up with em on the fishing thing. In fact I never want to. My oldest brother died and my second brother took over,

then my second brother told me, "You gotta take over because this is my last day. I never going come back." We was my house we was partying, singing songs all night long and singing, "I ain't coming back no more." Fine over there playing over my house. I was supposed to go fishing with them I told them I not going fishing. By that afternoon I had the bad news the crash and I didn't want to. Then my other brother came from the mainland said, "Who the heck going run this business again? Gotta keep up the name." I said, "I don't wanna." No, no, no. So, ok. "You sure you going stay work, now don't lie to me." You know he come from the mainland he been up the mainland all his life mostly. Yeah, we started all right. I learned I had to go learn how to fly. I was a pilot, learn how to patch net, I knew how to do the rest but I didn't know how to patch net. I had to learn how to do all that. And my dad was still living so he kinda teaching me, you know. And my dad wanted me to get back because he wanted the name, he didn't wanna quit fishing. To me it was a hard job. But I went notarize them and I saw too much laws of the State came. You can't come down the beach, all this blah. You can't do this, you can't do that. I was arrested in Lanai for throwing in the place. I don't see no signs over there. They arrest me I said, "You no think I really…" I take 'em I fight em in court and won. But you know, just trying to make a living. Why cannot fish over there? Why, you tell me why? Because why? Resort coming, you want only haole boys, you don't want no locals around here? What the hell. So I went and went and I see they close out more place and more place and more place I say I quit. That's not the first time they arrest me down there. But I don't stop it. But, when you throw out the current can move your nets into the zone they're not supposed to be. I can't help it the current moves there. I lost about 20 thousand dollars, I gotta pull my nets out. And then I say, I think it's time to quit. I ain't going fight the government. Why should I fight the government. I mean they just going beat you, they get more money than me. More better I just quit. And I sold my fish only to the public, never to the market. The market never like give me my price. So if they not going give me my price, why should I sell them to you? I might as well give 'em to the people for cheap, dollar pound and that's it! Right? I did good for the people. Except you know, the market want to control the price. But you no take 'em all and you going control. What I going do with the rest? What I going do with the rest. I might as well take out all the twenty thousand tons I catch, ten tons whatever. Why not give 'em to the people for a good price and I still make money. That's why when I see all that coming up, politics, closing here, closing there, can't go here, can't go there. Time to quit, right? Can't fight City Hall. Right, can you fight City Hall? Just like right now they like close all the lay nets. Just like right now they like close all the lay nets why they don't make say lay nets, home use only and don't give this bull where, one hour, half an hour you gotta go check your net. You going jump in the water every night check your net? Something wrong with your head, right? And you don't lay net in the day, you lay net in the night. You going jump in the water? Are you going jump in the water? What the hell wrong with this people? What's wrong, where's our culture? I can say they stop commercial on laying too much nets. Home use, never. If you get two piece net you want to go catch some fish for your family, don't give me this law you gotta jump in the water every half an hour. And that damn turtle, the turtle all getting sick. They better stop that. They gotta control. And these damn haoles come over here they tell you, "You know Hawaiians used to control nature." What the hell the damn turtle all get lumps on the head because before get a lot of food, limu, that's what the turtle eat. There's no more already. That's why all the sharks coming in, you know that? That's their favorite food. Because the turtle hungry and it's so much they cannot handle already. They wonder why everybody get bitten by the shark. Oh that right the damn turtle, who making might of the turtle? The damn tour boats. That, we go turtle land all this pollution. And what's happening? You're disturbing the nature of the whole system. Not controlling 'em, home use right? The Hawaiian's like eat one turtle why not they go get one turtle. I not going commercial. We used to commercial turtle when we was by the by the government. My father used to catch that, I see 'em. Today that turtle around, ok go ahead let em go. And all the sharks come in and you go swim, they going get you. You know what I mean? Close the beach, close everything. They let nature alone, they be better off. You gotta control things. I can say a lot of things, yeah. Commercial ok, fine. But you cannot be stupid. Still, but where the culture? I get net and maybe I like go out there catch some fish, I never jump in the water every half an hour check my damn net, that's stupid. Right? That's not one fisherman, these guys don't know anything about fishing. If anybody fishing to protect the ocean it's me. I know how to conserve them. You know what I mean? Akule, if you like salmon it's spawn, it come big school you can never get rid of 'em. And I can see the net can hurt the grounds and all that. If it's done too much. But the Hawaiian's never did do that. They just go catch what they want to eat, right? That's conservative, but you get this other nets that come in filipino's other's start learning. They go out there and start catching for sell. Hawaiians go catch for the family. Now if you could stop that. Bad enough they're already homeless. Now you starving everything right? Why you gotta do that for, right? Stop the commercial. Akule, no worry because it's like a salmon. They spawn summer then they going come, there's so much out there. And Akule is not a shallow water fish, it's not. It's a deep water fish. But they gotta come in for spawn. And when they spawn they make millions and millions, you know what I mean, so you cannot hurt that one. That's like a salmon, right.

KT- So, when you used to go catch them it was almost like a cycle then?

BA- It is a cycle. It's Salmon, same principle. We know its summertime is the best time. Wintertime come they gone because they spawn. Summertime all the babies come in they grow up big, fat. Now they come in to schools getting ready for spawn.

KT- So, when you're not fishing before? What did you go and do?

BA- You gotta do, you know, whatever side job you can. You know what I mean?

KT- Oh, so ok. So you add.

BA- Or you go lay net for go feed the family. You know you just for you go kaukau fish. That's why the went stop lay net, a fishermen need this, he need this, he need this. He not a cattle so you take your fish you exchange with the rancher and he give you meat and you give him fish. That's how the system works, right?

KT- Yep.

BA- Right, it's no money. Nobody get money, you exchange, you exchange right? Or maybe I need carpenter job at my house, well you give the carpenter fish. He don't know to fish, so you give him fish, he help you fix your house. See, it's an exchange. But the haole boys come around here or who the hell that damn stupid state, or DLNR, whatever making all this law. Can't catch the turtle, or you can't do this. What you going do with the turtle, let em… there's no food, there's no food, there's no seaweeds out there. They went wipe 'em out, because too damn much, no control. Right? That's what the haoles say, 'endangered species.' You tell me there's when the damn thing sticking their head all around in the ocean. You told me that's endangered? You know what is endangered? The Hawaiians are endanger. If they don't have food, they don't have what they get, they all going die. That is endangered. What about all the Hawaiian's let 'em all die so they can steal all the land. In fact they like steal the ocean now. Let's put it this way. How come I no can fish over there but the haole can go there, can go snorkeling and make money. How come the Hawaiian's no can go fish over there? And you get

some Hawaiian place down Makena only certain Hawaiians can go fish. What the hell that kind law? I don't understand that.

KT- So you guys used to, what kind of airplanes you used to fly?

BA- I had two airplanes. And hangers everything, it was a big business.

KT- Where did you fly out of?

BA- Only Maui.

KT- No, but…..

C-Oh, Kahului. Before we used to land over here you know the old way that. They just built that army place.

KT- Mokulele Highway.

BA- They just built that arm place, used to be a big hanger over there. That's where we used to park our plane, my brother's side. My brother was the main pilot he went school and then I had to go school.

KT- So, during the fishing season, you guys, if the Akule schools was Kahului side you guys go that side.

BA- We go, yeah.

KT- You just run your boats, launch out there.

BA- All on trailers see we put them all on trailers yeah. Everything was on trailer. Trailer we had big, my brother had a sanpan, was alright but a lot of high maintenance yeah. I had everything. I had plenty skips. Six boats and well equip, plenty equipment. I don't see anybody was built the way I was built today. I was better than my brother, better than my father, I was more modern. But I just couldn't take the, 'closing over here, closing over there.' That's where the breeds go every year certain spots they were spawning, always ate. We knew every spot, the fish don't go anyplace they only go to certain spot. What the hell you close 'em for? And then they close 'em but everybody snorkel! And who's making money out of that? Oh you can't fish there but they allow snorkeling the tour boats can go but nobody can go, only haole boys make money. Just pull the Hawaiians ah, "no, no, no, no. Close, close, close, close." That's not right that's so bull. That's why I quit fishing. Over in Lanai they arrest me with the gun, on the boat! On my skiff now, I no even have one damn ID. On the skiff and they knew I was coming, somebody went go squeal. I gotta admit I knew was closed. I knew couldn't be there, but I don't see no sign in the ocean so what the hell I go for it. I tell you the truth I knew, but that's not the point. The point is why should you bring a gun to me on the….and they was watching me surround when my plane, my pilot was over there in Lanai waiting for go up. The cops was there everybody was there, why he never stop me now. Why he waited till I throw my net, right? Why, why you wanted to excite me with guns to our head?! And jump on my boat? You have no right to jump on my boat. That's communist. Why they never stop me? I fought them in court!

KT- What year was that?

BA- In the eighties. In the eighties, in the eighties. When I was strong, I had a big boat take me over there, I knew. But that's not the point. There's no sign there's nothing. The sign is on the land, but we're not on the land right? But the police department was there, everybody knew the D&L was there. Why you never stop me and tell me if you throw your net I'm gonna arrest you? They let me do everything, they all sit there. I saw the damn skiff out there, I saw 'em. So I went they like confiscate everything, with the gun! From that day on I say I think this is the end of my era, as if, right? We took 'em court. But they only fight me little bit because after they was wrong because they knew. Why you never stop me, right? I no see sign in the ocean. They

supposed to put sign in the ocean. I mean they made this damn laws, Hawaiians is pau already. Might as well give the damn nation go bury themselves and forget about it. It's true, that's why I'm tired of doing this, I'm tired of this bull. Damn Lingle like take this damn man away.
And Lingle fighting me in court, because this is a residential. Since we were here there was no law, there was no damn code when we built over here and we run all this business here. We live Kihei all our damn life. All of a sudden, they come over here, "oh, you no can do this."
And he get free land everything, not free land, we paid for this damn thing. We build every damn thing. There was no code on what this land is. There was nobody. When we lived Kihei there was nothing! Nothing! And when I was young, Kihei was only Akina's. That's all had.
We used to own almost the whole damn Kihei. Now all that and then that damn Lingle I tell her shove it. Tell her I said what the hell give the money back to the people. Don't give the money back. Fix the schools! Help the Hawaiians, do something! Tired of this bull. You know what I mean? I'm tired! I'm a business man, I'm not stupid. I mean if everybody listen to her the only reason she get one Hawaiian next to her is because you need the damn Hawaiian votes, that's all she needs. That's true. We've been here all our life, even when I went to the planning committee stating should've put this automatic to commercial. How come they changed this they go make this no zoning, right. All our life we live here. All of a sudden, oh this all residential now. What I supposed to do? Right? Oh, you gotta get out of here, we changed the law. Who is the people? Who is the government tell you get the hell. Eh, cost me, how much that went cost me? Shoot cost about 200 thousand to fight the case! At least 30 thousand I know to fight the case. Or else I gotta get out of here, and where the hell I'm going? There's another Hawaiian down to the grave again. What happened? Eh, I've been through a lot of courts and everything. Just to get one license. Bum bye make two of us, cost me 300 thousand dollars to fight Robert's and all these guys. Where's the poor Hawaiians? I thought the Hawaiian's, I thought the Hawaiians, you know get some rights. We have no rights, shoot we no belong here. I get more work in the damn California, I think.
KT- So when your dad was living you guys used to go all the way down Makena pick up kids? Or did they have to walk in somewhere over here?
BA- Oh, Makena hardly anyone. Mostly we pick up the whole Kihei.
KT- Just Kihei?
BA- Well, way back you know you talking about banana wagons. You're talking way the hell back. Actually if you talk school buses from my dad's time to me continue, looking pretty close to ninety years. Eighty eight is guaranteed!
W- Nineteen twenty eight.
BA- Yeah, till me still running. And then you get these jackasses that on island that never did do transportation school bus. And they come here just to throw you out so they can control 'em, just beat through them cheap, it's impossible to make money. Now they suffering.
W- Yeah, nineteen seventy there were forty one contractors in the seventies. Now there's only ten.
KT- Forty one…
W- Contractors within the State of Hawaii. On Maui, Maui had um I think about thirteen or fourteen.
BA- No, more that much.
W- No had, had. Now it's only three.
BA- Not our area, our area was only about four.
W- When we bought it, yeah.

BA- Was only about four.
W- But when your dad was….
BA- See the law was in Hawaii a contractor can own only work fifty percent of one island.
W- But we took over, yeah.
BA- No, that was the law from when I was in. When my dad was in a contractor can only own fifty percent of one island, one county. Like Lanai, and Lanai and Maui all same company. You can only own fifty percent. When Robert came in he end up ninety percent. I ask him how come is that? Well, well, well, well, well….. (laughing) Forget it, they all bunch of crooks. You can tell 'em I say too, I don't care.
KT- So Sandy, you're not from this island but.
W- No I am from this island. I'm from Waihe'e. Waihe'e valley.
KT- Oh you are?
BA- Taro patch country.
KT- So when you look at getting involved with Butch you knew that his family was literally the family of South Maui?
W- Oh yeah, when we grew up um…
BA- Everybody thought we owned the whole Kihei.
W- Yeah, um when we used to come down to the beach on weekends I always thought that beach, Kamaole I was Akina's beach. Because I always saw all their skiffs, the nets all laid out there. So we never went swimming there we always went down further. But I always thought that that was Akina beach. I was surprised to find out it was Kamaole I.
KT- Is that where your father built, he had a bar 'eh?
BA- Yeah.
KT- Right there?
BA- No we had what you call Seaside Tavern. There was a war, during the war, we had a camp right next to us. Ten thousand troops right around us. Nobody could come in, we could come in, we owned it.
KT- So during the war your dad's fishing business was still going on?
BA- Oh strong boy he had to go catch turtle for the government for feed 'em. Big kind turtles, three hundred pounds you know that.
KT- And you went out with them?
BA- I was young so my dad tell me.
KT- You had any idea on how they prepared it to eat?
BA- Oh that's good meat boy that's steak.
KT- Steaks? Like how we eat?
BA- Oh yeah! That's better than the cow. Or make good hekka, soup and you know the oil from the turtle we used to boil and save the oil. If you get burned, put that on you, never get scar.
KT- Really yeah.
BA- Never scar. We had 'em by the gallon, somebody stole 'em all. Like it would never scar, you get a burn you put that turtle oil on you, you never scar. Sting like hell!
KT- Our people learn a lot on survival.
BA- Yeah, but he wasn't, my dad that's all he did was fisherman really. He brought all of us up all eight kids. Of course he had a bar and all this but tt's like a Seaside Tavern. I was young boy. I was born in forty three after war, but my dad used to tell me, you know. I remember money, you know in the closet like, you know like we never know what was the value of money. We just go grab 'em put 'em in our pocket, what's that we going do with 'em, everything free.

Stole there, candy there you know everything's free right? So value we never know, I was young though. But after the was then times came hard because the government not around.
KT- So what kind of families, you remember, used to live in Kihei when you were growing up?
BA- Umm, never have too much really.
KT- Was the Plunkett's here? Was the Moikeha's here?
BA- Yeah But the Plunkett's was here when had the, the plantation time. You know when? You know I go Suda Store, this used to be A&B and in the back over there is the camp, the sugar camp. And had a theater, open air theater you gotta…
KT- Drive in?
BA- No you walked in but it's open air. You know ten cent and certain times you take canned goods it's all free. That's all, I remember that. And you sit next to the Filipino's they smoke Tascani no more the mosquito. (laughter) You sit next to them, they no understand what you talking about that's alright. Open air theater, yeah, in the back of Suda Store. Used to be not Suda Store, plenty people owned that before Suda but A&B used to own that used to be like a two story bedroom. In fact you know how Hali'imaile, the General Store that's how used to look like. If you look at that, look like that. I remember, I was young kid you know. But I remember a lot of stuff cause I was kinda always nosy looking around what else to do. You gotta remember you know, I'm the youngest of all. The whole family so I just remember things but I remember.
KT- Of the boys, who was the teacher in the family?
BA- My oldest brother used to be just like my father.
KT- John.
BA- No, oh the oldest boy Frank. He was the contractor. In fact he was one of the biggest contractor in Maui. Heavy equipment.
KT- What was his company name?
BA- I don't know, I guess maybe Akina Contractor's, I don't know. And my other uncle he was kinda fishing and doing odds and ends job. My old man was strictly fishing and school bus. But my uncle Frank was actually the top man. He was big in construction.
W- But your dad was doing the fishing and he was doing the wood.
BA- Wood, you know those days, survival right. For the government, he used to fly for the government everything right, that was those days but my uncle Frank actually was heavy equipment contractor. In fact when I was fourteen years old I used to drive the truck, construction. Big truck, no need any kind license no matter.
W- You folks owned Seaside Tavern before you sold it to Aunty Becky.
BA- Yeah during the war, during the war. We lease 'em, we owned all the land, when we sold the land, everything gone. We leased 'em
KT- So when you said you owned all the land, can you give me an idea from where to where?
BA- Oh Kamaole I we owned eleven acres then we owned all the way up eleven more acres.
W- Fourteen acres.
BA- We owned the land all around the place.
W- Twenty eight acres my father-in-law had in that area.
BA- We owned plenty land, you. Way up there, way up here.
W- By St. Theresa's somewhere they had property over there too.
BA- My uncle them owned more land, they owned plenty.
W- And where Billy lives too, right? Your father bought that place right?

BA- We owned land all around Akina's used to own 'em all. Nobody want to live Kihei, hardly any people. There was no sign, street name; you gotta know all the green house, the white house, that's all you know.
W- In fact when we grew up we used to call the Kihei people kiawe beans.
BA- Cause we eat kiawe beans too! You ever eat kiawe beans? You gotta get the one in the sun, just like jelly beans we call them, go eat.
KT- Dry?
BA- Yeah, good eats. Yeah the one in the sun you pick, sweet. The cow can eat 'em, you can eat 'em. Those days was starvation. (laughing) Was hard days but was good days, good days. We had no white man around telling on you. In fact white man was all Wailuku, Kahului, Makawao, Kula and all of that. Everybody scared. Till I went mainland and said this damn white man ain't better than me son of a bitch still in the sewer too I say to 'em right. And I learn right. They wasn't any better than me, in fact I was better where I was, we had a better life, cleaner life. Today, forget it.
KT- So, you never spent any time on Kaho'olawe with dad?
BA- Oh I used to roam, I used to roam that island when it was illegal I was on the whole island. I know every part of that island, I know everything. We used to go hunting, fishing, I got caught lot's of times there.
KT- Before they started bombing it.
BA- Yeah, we was on there when they was bombing. (laughing) No, when they was bombing we was there, but during the weekdays they don't bomb they let you know they not bombing. We used to go there no bother the government, the federal never bother. It's when the damn State took it over. No can go over there, what the hell's the difference, right? Now open days you can go, same federal, why the hell can't do any day. Then the Hawaiians come, oh preserving the fish. What preserving the fish? Not preserving the fish.
KT- What kind of fishes you used to catch over there?
BA- Whoa, there's a lot of fish. Any kind you like. Anything you know.
W- Like what?
BA- Holehole, moi, marlin, anything. Anything you want. Ulua's rubbish, that's a rubbish fish. Anything you name it. Opihi, you sit on the rock, you don't go da kine struggle looking under the hole. You sit on the stone and you eat. But we only go over there and get what we need for our luau's and that's it, we go home. The Hawaiian, they know how to preserve you know, they don't wipe 'em out. We don't sell that kind stuff, we just go for the..our own use. I'm a commercial fisherman. I don't go out there kill the ocean, I know how to preserve.
KT- Did dad talk to you guys about taking care of the land?
BA- Oh yeah. He would always say, why go kill 'em.
KT- Never used to have as many goats when you were growing up, I mean deer.
BA- No, that deer never come till later.
W- That was introduced by our neighbor…….
BA- No way, no way. It was introduced by the State. He was only one game warden that's all. He ain't never introduce. They brought only four I think, yeah. Actually, it was involved with the ranch. The ranch was looking for the future. That's why you got, one day the deer comes you get one on the land you going charge for hunting. It's all tricky they ain't stupid. You think the ranch like the damn thing on their land going eat all the grass? But they was thinking, what is the future, right? What the sense, you no can hunt on the land. Nobody own the land, who own the land? The ranch, where was the damn deer? On the ranch, right? So maybe one day

we go make money we go charge people come hunting in my land. You ever thought of that? Who own the land? The Hawaiians own nothing, who owns us. They went buy the ranch how long, the ranch get cattle the deer going eat all his grass. So why the hell you all that? No, that's what it is. Eh, you think I was born yesterday? You think I stupid? That's why you gotta think right? What you think, what the Hawaiians went go put 'em over there? No way, correct. The ranch went go put this. So one day they can charge people for go on their land. Today, same thing; you like go on my land, oh you going get permission, maybe I charge you. You look today, all the ranch no more cattle over there, you see any cattle? But their land, they still paying the cheap tax, right? The same as us. The sugar cane, now they selling all their damn land, making big money. Why they no get rat for all that taxes, the back tax like. They selling all the land, Hawaiian's lose all their land because the government come in and "oh, you get our land, we charge you all tax." The Hawaiian's no can afford the tax, all gone!
W- That was my father's situation. He couldn't afford the tax so they was gonna change.
BA- Too much land we own, so they push you right. They force you in the back door. The haole's from the mainland or whoever like the land raising the tax. No can afford, he no work for nobody he had nothing. Gotta sell land over there because my father was sick, he had cancer. Couldn't afford the doctor's so we had to sell the land for pay the bill. What you going do? What you going do? No more insurance.
W- So he sold it to…..
BA- Was bought by the Canadian. My father no work for nobody, I mean there was nothing in Maui, right? Really there was nothing. In the sixties, nothing. There was no job that's why everybody had to leave. You know the part of the problem is the taxes got to him. They don't give you because you live there all your life and then they tell you, "oh no need worry about the tax." No you pay your taxes or you going lose your land. And who the hell, who's the big boss? All the haoles in the back, they like grab all this. They see the future, so that's why the Hawaiian's lose every damn thing, and it's still going on today just like this land. Same principle what went happen to us. Oh, we change the zoning, you don't belong here because that's not a business zone. This is residential, how the, I was here before that damn residential came up. So I had to fight 'em in court now it costs me money. Lucky I had a little bit money. But that's why no can make money because every time I fight 'em in court, fighting in court. I getting tired of fighting, next time I'm out of money shot everybody be a renegade like Ben That's true, right? You only can push one Hawaiian in one corner so long. That's true, you want to know the truth, how I feel I tell you how I feel. I mean I help, I do this I help out a lot of families this damn jobs. And teach 'em not only you know. I teach 'em culture, I teach every damn thing. You know what I mean, haole's come in run the damn business now these boats own all these tours coming in these big boats came in, they own 'em all. They the owners. Not local people no more own tour companies. I think the last is, Robert's the last but he's going down the drain too. It's all these mainland people coming in taking all this damn bull. What you going do? You can't do nothing, right?
KT- We gotta educate our people.
BA- How can they all….
KT- Fight 'em in the court.
BA- If only the Hawaiian's get together and stick to one nation. Not one group here, one group there, one group here. No can. I'll tell you a good one. I was on the board Kahoolawe, right? When they first started. I went in the…. So we was sitting on this table, all us guys. So they ask everybody what we going do with Kahoolawe? Everybody come, well…we go and only

Hawaiian's can go over there. Fine with me. So they came ask me. I said you know what we should do? We go put one gambling casino on Kahoolawe and then that's where the Hawiian's going get some money, right? Make more sense right? Cause how the Hawaiian's going get over there? They don't own no boats, you going swim? Canoe? I don't think so. They fired my ass off the board. Never did call me back, fine with me. I don't care because I hate meetings anyways. What would you decide? I mean if you get a something, somehow you gotta create money right? Right? And if the Hawaiian's can make the gambling like the Indians you can create enough money so the Hawaiian's get power. Money talks, bulls** walks I going guarantee that, right? They fired me off the board. Never even tell me nothing, never call me back. Ever since then. Lot of them don't even know my father was born over there that's what they knew about Kahoolawe. And they never been on the island. I've been on the island before they was born. Ask my wife, I used to take her over there pitch dark I used to take her over there, two o'clock in the morning. "Where you going?" "I going Kahoolawe. I going go pitch 'em. I going park in there go sleep. Then tomorrow I going bag up fish I going home." They think I crazy! I go right in the bay, pitch dark you no can see nothing I know where to go because I've been there lot of times. And we would go over there just fish enough to go home, then we go home. Opihi, anything, but those days are gone. Forget it. Whose running that? The Hawaiian's or the State? That island right now? Who own it? I thought the Hawaiians own it but the Hawaiians' got no say. Forget about it. I tell you Hawaiian's if they don't shape up now, no can. Kihei, forget it you don't see one Hawaiian walk on the road no more. If you do they all dope up or some damn thing wrong with 'em or they homeless. Why? They did it themselves, they fight each other. Forget it, right? They don't get together, be organized right. Tell you right. Tell you straight I don't care, jeez!
KT- You know like the high top out there that didn't bring it back.
BA- I don't care, tell Mr. X that I said too, I no care.
KT- Nah, we don't need to say that.
BA- No, one time he asked for help I gave 'em all free. Then my mother in law all them wanted to go see, they had all the Hawaiian performance. I short ticket, two tickets. My father in law just like go hear music, they old people. Oh, no I no can give you that. I said, "what do you mean Mr. X? That's for your da kine, your ohana. You mean they gotta pay? And I give you everything free, go pick up all the musicians, send all my buses down there." Cannot? I don't think so. You think that's right? You know Mr. X he passed all the land you no his big mouth oh the Hawaiian's no can here. But you give him one piece of property ah, he go pass.
KT- Sandy what is this?
W- Oh I wrote the script for that when we had our family reunion. It's about the family.
KT- So, can I look and?
W- That's for you to, yeah. To, you can have, you can have it and make copies.
KT- Mahalo.
W- I had a professional come in and do the editing and taking the…I wrote the script out and he went to different places as I wrote it and he read off my script and put it together for me.
KT- Great. You got a hard copy of that script?
W- Volumes and volumes. We went through, it's binders and binders it took me a long time to write it and it's down below.
KT- Excited to look at it.
BA- I don't know. I feel sorry for the Hawaiian's and how they fighting and all this kind. I don't know. Like, what I no can understand too, get the Hawaiian homeland. This Hawaiian go inside

there he get one, then pretty soon where the hell he went? He went go sell ‘em to somebody. That’s not things to be sold. If you don’t want to do nothing with ‘em give ‘em to the next guy and he buy it. Ha? That’s not right that. That whole system’s getting screwed up. You know what I mean? You cannot go start selling or trading. And if the guy get big land all around get house everything give the first guy no more nothing. He get the first choice, right? Give him one chance. Not the kind guy get everything already. I mean they get the system wrong, they gotta check background or look at this. No, no. The next guy get ‘em. And this guy get a land over here, Hawaiian land, he still get his house over here, right? Now he go rent house. What about the guy no more nothing? How come he no more the first choice? That’s what I don’t like about this system. I don’t think that’s right. And you cannot tell ‘em if you don’t tell you gotta tell ‘em go right back into the pot. No more such a thing as selling, right?
KT- I was surprised when I heard that that’s what they were doing.
W- We know people that had three properties.
BA- I know a guy don’t even get Hawaiian blood get ‘em!
W- They sell it. They sold the first.
BA- I know guys no more Hawaiian blood. See how crocked coming. The Hawaiian’s their way, I mean. That’s why sometimes I like nothing to do with it, you know. I get 67 percent Hawaiian but I just don’t agree with that. Give the guy that need it first. If you got a home everything fine. But don’t go keep your home and then go Hawaiian land and still own over here, right? Or if you get one, give ‘em for your kids, now that’s different, right? Blood line, right? But that’s not right that. That’s getting greedy that’s what you call that right. Playing politics inside that system. That’s what it is.
W- And then you have the old people that still on the list quite a way back and never get there yet.
BA- That’s wrong that. That’s why I stay away from the Hawaiians. They call me. No, no, I don’t want nothing to do with it. I no bother no more. You know what I mean? I was kine arrested but I pau. I don’t think that’s right what they’re doing.
KT- On the maps I saw what they call this side Waiakoa Homestead. Are you familiar with that?
BA- I don’t know.
W- Kula one.
BA- Oh, Kula one that’s the place yeah, nice over there. In fact my grandmother, my grandfather is Thompson. My grandmother the one own all the land from, after you pass Kula, all the way down to Wailea, she own all that, my grandmother. Thompson, was German but my grandmother went own all the land from the King. From the, all the way up there all the way down to Kihei. You know Thompson Ranch? That’s my grandfather. But in order to get the land you gotta be my grandmother right? Had the Hawaiian blood.
KT- Still in the family.
BA- All gone.
KT- All gone.
BA- All gone.
W- She was um, what did she do for the king? The queen.
BA- That side I don’t know too much. I know my grandmother, how you going get the land those days with the king? You gotta be the Hawaiian, my grandmother the one own all that. See, the Thompson get five wives. We come from the first one. The first generation I come from. My mother was a first generation, Thompson side. Dunno all the history. What going do?

Right, we’re sorry, me I getting old already. Just gotta do what I gotta do, survive my family and that’s all I can do.
KT- So what he just said is in here? The Thompson connection.
W- This is the Akina side.
BA- Thompson is my side. That’s my mother’s side.
KT- So you got all the pictures of his brother’s and uncles?
W- As much as, some of it. I don’t really remember it was I did that in 1997.
BA- That was our first…
W- Our first reunion.
BA- We were going mostly all lost already. We just lost my brother about a month ago.
KT- Natural causes of death or?
BA- Heart attack.
KT- Heart attack.
BA- My oldest brother died in the car. My other brother died in the airplane. Terrible kine accidents.
W- Your dad died of diabetes.
KT- Really?
BA- He was eighty two. He was good shape, I don’t know why never catch diabetes long time ago.
W- Well, they knew he had diabetes but he had cancer of the colon so they did the chemo they had to stop the diabetic medication.
BA- Came worse.
W- So then when he was cured of the cancer then the diabetes came. And they were supposed to amputate his leg but then…
BA- I think that was better because I don’t think my father like be in one wheelchair, he was too hyper.
W- He was a strong man. Very proud man.
BA- Brain strong till the day he died. My mother died when I was young. I was only like about sixteen. Was hard on me.
KT- So dad brought you guys up then, yeah?
BA- Not really. Only me and him left. Everybody was gone already. I had my oldest brother around too he was just like my father, my oldest brother. And when I get mad with my parents I run too. They all come up there, if not my oldest brother come. I was the rascal one, I always moving. Like when my father them fight, you know how brother’s fight right? Me I go over there ah, it’s like nothing. I didn’t care, that’s not even my problem. I go my uncle’s house, I visit ‘em all, I no care. Right? That’s the way I was, right?
KT- So you were saying there were family feuds?
BA- Oh yeah, always one. Three brothers.
W- There were three brother, yeah. Was Frank, the oldest was Frank then John then Alec.
KT- So there were feuds?
BA- Yeah but little while, then pau, come back. I remember like New Year’s everybody get around and all the fun, party make one. The party last for weeks. One family going make, that’s one week. The other one make one week. The other one make, one week and never end. But I was youngest but I always observe things. I watch, even today in life. They tell me how come you know? I say you gotta look then you see things. Always look then you learn, right? Never close your eyes, right? Till you go sleep.

W- What was that incident at Suda Store, Akina's fight and the feuding?
BA- Yeah, my brother losing. My oldest brother losing, this guy like bust up my brother, the other one come around. My father come, I was young though, that was before my time. Family always fight each other but they forget about it. One thing with this family, they'll fight but they'll forget about it. Never last forever. Those days no more nothing for do anyway what else you do? No more TV, right? What else for do, right? You gotta think it's that way right? No more TV, you know how bad boys right? Yeah that was their enjoyment, what the hell. Nothing else for do, it's all family anyways they not bothering nobody else. But nobody better come in Kihei and play with us. Oh boy, that's it. Everybody join, they join. Ha? Cannot come you know like Makawao, Lahaina or whatever. You no come Kihei, you don't ever enter. That's how those days used to be. Then they joined back again. You know we fight each other but the one's outside come that's haole's for you. Those was old days right? What the hell there's no TV no more nothing, that's something. You can't be happy forever, right? Big families, my house had kids sixteen kids. Two sides, we was the smallest only eight! The other side sixteen. Right? And they all big, you know? It was a hard life, I mean it was a fun life but it was hard. The old man's icebox never very much food or get fish, you can only eat fish so long, right? But we survive 'em right? I think was, sometimes I look back it was better days. You thought it was hard but survival. I was young boy. I'm the youngest in the whole Akina family, I'm the youngest. I mean all my uncle's all their kids, everybody I'm the youngest. My father the youngest, I'm the youngest. You know out of the whole clan, you know the whole family, I'm the youngest. Still surviving and I'm the only one still doing business with the name. That's why I picked the name to keep the name going, right? If I go, I don't know who going take over.
KT- You no more sons?
BA- I get one but….my daughter maybe. My son is too playboy.
KT- He married?
BA- No. Playboy you know.
KT- How old is he?
BA- Twenty eight.
KT- And your daughter how old is she?
BA- Thirty. That one work hard.
KT- She come and work with the.
BA- She's the General Manager. She asked me one day, "Dad, why can't I be the General Manager?" "You want to be the General Manager, take 'em!" She's doing a good job, hell of a good job. I kinda semi retired because I let her run 'em. Give her a chance. I'm in the back, she asks me questions do 'em this way. I kinda stay away.
KT- What's her name?
BA- Cassie.
KT- and what's your son's name?
BA- Douglas, same as me. Douglas. He still playboy, never grow up yet. I get one other girl but she's in some foreign country someplace I don't know. I get the grandkids, my grandkids I take care one.
KT- The girl?
BA- Yeah.
KT- That's Hawaiian way, yeah?

BA- What you going do, throw 'em around? Get two. But one my other nephew took 'em. They adopted 'em. This one I found the father, not bad he call every time check. He cannot handle so she stay with me.
KT- Well, Butch I appreciate your time for talk story. Can I take your picture before I go? Just right here. OK.
BA- Yeah. I had a hard life.
KT- Sounds exciting.
BA- I love to invent things. I'm the type that I gotta do better than the next guy. In fact I was the one really made the tour company shape up. When they came in I bought tour buses that nobody had in Hawaii. They thought I was stupid cause the buses get video inside, TV, karaoke. They thought I was nuts. Today what? Everybody gotta do that, right? Yeah you ask my wife. When I first started tour, I came in with the best equipment ever had in Hawaii.
W- Right, right.
BA- Big shows in Honolulu, the best everything had. They thought I was nuts, today what, everybody gotta do?
KT- So your husband had a vision.
W- Yeah, he's a visionary. That's what he is; he's always ahead of his time.
BA- I gotta tell you one thing. My wife went help me plenty. She learned plenty and she did help out. Only true love stuff, yeah. She's a good woman.
KT- I'm glad to hear you say it.
BA- I hardly say it anymore. It's true though, my wife is good. She thought I was nuts sometimes but not really.

BA- Pick up and let go the rest.
W- So what we did was we called, um….Ulupalakua.
BA- They all came help us, they always come help us.
W- We told them bring whatever you have.
BA- People came from Hana. I give away over three tons to them, they don't know what to do with it.
W- Whatever they could load in their truck, they brought.
BA- Then I let 'em go the rest. Give 'em back, you know give 'em back. I never kill 'em, make sure my bag is, I let 'em go. I let 'em go. I get enough fish already and what I going tell. Day and a half was sold.
W- Then we came home, by the time we got home was like four o'clock in the morning. And that's from all day and all night and then coming home. And I thought oh my goodness I gotta go teach because I was a teacher. I didn't have substitute plans so I had to go teach, so what am I going to go do with all this fish? I gotta sell the fish. I had peddlers, my bus drivers that would want extra money. Frank them would want extra money. And I would have them buy it form me and then they could sell it. No more than dollar, whatever price I set they had to stay there.
BA- Dollar quarter you go, if I sell dollar you sell dollar quarter.
W- Yeah, if I sell seventy five cents, you can charge dollar. You cannot make too high because it's not right for the people right? And so I'm sitting in the, full of scales, in the bathtub I said what am I going to do with all this fish? So I called the three stations, I used to always advertise with the Filipino's yeah because they love the fish. Three stations and then I said ok I gotta go to school so Iwent to get my kids ready to go to school And he drove bus and then in the afternoon I went running down I said oh you pick up the kids and I'm going to go into town because that's

where we had the whole thing situated in town at one of our bus driver's property. And I said I'm going to go help her and he said help her? Help her what? I said sell all that fish because we had tons we had about 10 thousand pounds we brought out. And so he says, "there's no fish left." And I said, "Are you kidding?" No, people had like, it was like a circus they said. It was around that Mokapu, Mokuahu, I forget what street. But anyway um people were lined up. Even the mayor's wife was there.
KT- Who was the mayor then?
W- Hannibal Tavares. And lined up.
KT- Japanese?
W- Yeah Japanese and Filipino's.
KT- No but the mayor's wife was Japanese right?
W- Was Japanese yeah, loved that fish. And they just, it was all gone by the time school ended at two o'clock.
KT- What year around was that?
W- Had to be in the eighties. Yeah, had to be in the eighties, late seventies, early eighties.
KT- So you guys were really busy yeah?
W- Oh yeah. You know at one time we ran five businesses.
KT- What were they?
W- We had um, rooter service. He was the first one to have to do rooter service on Maui, before Roto Rooter even came. And then we had um cesspool pumping. And the bus business we ran for my father- in-law. And he used to blow wells, he had um these wells that he had to blow for people when they would get clogged.
BA- Oh yeah I never tell you how many businesses I used to own too yeah?
W- I said five, right.
BA- And that was all same time.
W- Yeah, and the fishing and then I was doing real estate on weekends. And I was teaching.
BA- I was the first guy brought Roto Rooter in, in Hawaii. Maui, I mean.
W- It wasn't Roto Rooter, it was Maui Roto Rooter.
BA- But same principle but I name 'em different. In fact Roto Rooter like sue me because my name was too close to them. So I had to name 'em, what I went name 'em, Maui Rooter? I had to change the name, they tell me that or I going sue you so I change the name.
W- We had to change the advertisement too because the….
BA- Change advertisement, what I had? Pumping.
W- You had pumping, you had cesspool, you had Rotor service, you had the blowing the well and the fishing. And we were running the business for dad, school buses. And then I was doing real estate on weekends and on top of that I was teaching! (laughing)
KT- So what made you guys do this?
BA- At that time I had nothing to do.
W- Survival. We just had that energy before, you know. We were very young, we were young and we knew we had to make it.
BA- I was in my thirties. I'm the type that will go for it. Nobody teach me, they teach me little bit. After that I do it my own.
KT- So after how many years, you retired from school teaching?
W- Um, I started in '69 and then I went to the mainland and then I came back in'71, no '70 and then I started teaching again, yeah. I retired actually after vice principal at Maui High School and that was in '95 I retired with enough years of service and you can, I have 22 years accredited

of full service. But that's because I took like part time work. You know I do part time teaching so I could run the business, the businesses with him so I could help him.
BA- The reason why I went into pumping, I tell you why. This one guy, he did all the pumping. So I told him one day, "Eh, give me your card. I got a lot of jobs for you." To drain, I know the cesspool whatever need 'em. He look at me and he walk away. Eh! Ok, come home tell my wife I'm going to be a pump business. And I did it! He take one week, I took one day and finish the job. That's how. I threw him out of that business. I ask him I get a lot of jobs give him customers I can tell 'em call you, he walked away! Oh no! After all that I going into pumping. (laughing) And I went go see this guy he get building this, he get big tanker, I like 4000 gallons. I like this I like that. "Eh, you sure?" "No worry." Ok no more afraid. And what he do throw 'em water everything. I didn't want 'em all I ask him I just get job for you. That's all I said and he just walk away!
W- We even sold fishing nets, we went to town.
BA- Oh yeah, plus I had, I build nets, I build everything. I sell 'em. I had a big business going on, on the cart everybody.
W- We could get free yeah? Our nets, we brought extra and then we put the….
BA- Back then was too expensive so I went Taiwan buy all my nets for all my fishing. I tell, eh I going buy 'em might as well build all the net, build everything.
W- And then we would sell it to the people.
BA- And then I tell people I sell regular net and I had longer net and better price. Geez, I made a killing. Pretty soon I get tired you know. I get tired of business, ah I give this up.
KT- Bored.
BA- Bored! I had everybody come over here all these guys, you like drink? Yeah come over here drink maybe. Oh, we go make lead. Eh, they like that they had fun. Of course I teach 'em right? I teach 'em how to make net, they all learn. I think my wife did.
W- It was, yeah he taught us. All my kids, we make um the nets and he would tell us, ok.
KT- You had a system.
W- He would say I pay you at the end of the summer so you have money for school clothes. Crazy we would have to whistle, we never got our money. That ok we all had fun.
BA- What they learned?
W- It's like the fishing too, was like a family thing because this kitchen was built for that. For their fishing.
BA- That's how this kitchen was built.
W- Because I had to cook and I have huge pots. I had to cook pots and pots and pots of food and I had to take all the beer and all the fish you know in the back of my, my I had a station wagon that was like should be for a taxi.
BA- I bought her that station wagon because we had a Mustang. That damn Mustang ain't worth shoot, I go turn 'em in brand new. I said I should've keep 'em worth a lot of money. Ah, turn 'em in go buy the station wagon so we can make use of all that. (laughing)
W- So I would see the kids out of the tuna boat, yeah? So we pack up. I couldn't go down to the beach with less than seven cases of beer. And all this food and all the fishermen.
BA- That's all my kids always with us on the beach.
W- Yeah, who would all come with their family, and they knew they he was going to be there.
BA- All his family and his kids all come. We would stay overnight, two days, three days. Sometimes one week and all the family come and everybody, right?
W-They're families were there.

BA- And you know all those kids small and then but all taken care of right?
W- And everybody had to work when you get there because you had to haul fish, you know. Everybody had to work, we had to haul the tadai's hundred pounds we have to carry. And those days, you had to lift it up and give it to the guys and dump it into the big containers with ice yeah.
BA- And all my equiptment was A-1 shape. I had mechanics take care of everything. Painting, all nice, we not going on the beach look like one junk. Everything was look nice. Painted all scrape up.
W- And then we would come home and then it was up to me, what I going do with this fish right? And these guys all too much you know and everything so I had to call for ice. And I would have to drive the truck. I tell him, "you take home the kids." I just take my oldest daughter, that was his oldest daughter from his first marriage.
BA- Was steel covered.
W- Yeah, I would take my oldest daughter and we'd go, we would drive up to Wailuku and they would open the plant for me. The ice, for the ice, block ice. They load it for me in the back of the truck, come back here my daughter and I, two o'clock in the morning we were loading ice into the big truck to save the fish because these guys were all…
C-What do you mean? Had the Bank of Hawaii manager deliver ice for me.
W- Yeah, he was our ice man. We used to have all kinds of people come.
BA- The bankers deliver ice to me that's his job. Sleen my car was.
W- Alvin, Alvin Nishihara.
BA- And he go on the boat too! His job.
W- And he loved that! He enjoyed it you know it's so different from what he had, the pressure of the bank, right? Come out and do physical labor.
BA- Had all these business guys used to come, run with me. All business guys come help me.
W- And everybody get paid with fish. Take home fish.
BA- Well, that's better than money, no tax. And when I give fish, I give fish. People would come help on the beach if I see one old people over there on the beach, I tell 'em take this and go give to that old people. If I see old people at the beach, you know Hawaiian's like that sitting around, go take this fish and go give them. Because they get too much pride I know that. Take 'em, give 'em.
W- I couldn't sell. If we caught less I couldn't sell. That we would have to give.
BA- I would give away.
W- All of that give away. That was my father, my father in law always told me that Akule, Akule, that kind of fish you have to take care.
BA- It has ears.
W- Yeah it has ears to hear and you must take care and you always give, you always give you don't just keep you know. And we learned that and we did well.
BA- Lot of old people I see them around. I know they hungry they like eat fish but get too much pride. And whoever working with me, eh go over there take this fish, maybe take twenty pounds, go give that to the lady over there. I think maybe that's Pele or something. Go give 'em anyways.
KT- Clear that up with me again. If you don't keep, catch a thousand pounds.
W- No if we, if we.
BA- One ton.

W- Yeah, we had to catch, for me to sell it has to be over two thousand pound before he would allow me to sell. If less than it's all give away.
BA- Cause I get all my fisherman, I get all my friends. That's all give away. I won't sell anything. If I catch two thousand pounds to us that's bad, bad, bad. I rather give 'em away. I lost anyways so what's the difference, might as well give 'em away. If you going lose might as well lose all the way. I give 'em all away.
W- Well, it's always taught, his dad said you gotta give.
BA- No, I always give. No matter I catch 30 tons or whatever, but it doesn't matter it's. I already lost money on two thousand pounds so not going help me anymore, might as well give 'em all away so people still come back and help me.
KT- So, um dad said that's the Hawaiian principle or just an Akina principle?
BA- No that's my principle.
W- Oh no for the…..
BA- No, no this one. You give away this one ton it's my principle, I was the one say.
W- I don't know where dad got that from but he always told us….
BA- No but give 'em one ton not from my father. My principle is if we catch less than one ton, it's all giveaway. I don't care what. Because I already lost money, I know that. So what the hell, it ain't going help me, give 'em away. But I get more in return than I could sell 'em, right. Because I cannot make money on dollar a pound on two thousand pounds. That's only two dollars out. Everytime go out cost me four five thousand. The best way you give 'em away, when you catch big that's how you come out make 'em. So, better to give 'em away.
KT- Most of the time you used to catch big though.
BA- Oh yeah, I catch twenty, thirty, forty tons. Ten tons, our average. I make my own. Those days everything cheap, yeah? I had mechanics for my plane, wash my plane everything. Pop the plane yeah they take care our mechanics car, they wash the car. They all fish with me. Everybody had their own job, everybody had their own job.
KT- So, dad never used to go fly to see the fish.
BA- No, no, no.
KT- Who went train you, your brother?
BA- I went school.
KT- To see the fish from the….
BA- Oh, I would just go with my brother. I knew already. I just go with my brother. When I was young everyday I go with my brother. I was young, sick. I come down puke and ew sh**, I don't want this sh**. (laughing) But when I took over he said, "Well who going fly the plane?" I guess I'll do it and then I went learned how to fly, buy my own plane, buy everything.
KT- You guys are the last Hawaiian entrepreneurs. I mean the volume of business….
BA- I get a lot more ideas I like do but I too old already. See my son was up to grade I would do it. I get lotta more years, I don't think so. I tell you what I going come, you like know? Hmm? One professional gambler (laughing) That is my dream and I can do it.
KT- Yes, if you can make the money.
BA- No, not greedy just make enough to make a living, not to come millionaire. That's impossible but to make a good living and have a good time that's my dream.
KT- You gotta take care health first, though.
BA- Oh yeah, I take care my health. Either one doesn't matter, you know what I mean? I no kid you. Just because I say gambling you know not out there but I know slot machines. That's where the money is. No, you don't get greedy, you not going come rich. No way! But, you

going have fun, win and you going to make enough. Like you make enough I talking about six thousand a month, that's good enough. Right?
W- He studies it like everything else.
BA- I study and I study everything and read, I read books. Any book, I read 'em. Anything I want to do with my life, I going to study and I'm going to read about it and I'm going to do. That's my dream, that's my last dream. No hard work right, it's only brains. I'm gonna beat the damn system that's my dream. And then I going write a book.
W- So he has a computer and plays, you know the disk and he plays it. Two o'clock in the morning he's up.
BA- Practice it.
W- Practicing. He finds a method, a system that he tries and he flies off to Vegas or Reno and tries his system. Oh, didn't work, back to the drawing board.
BA- Back to the drawing board. But I get fun with it anyway.
W- So it's not just gambling just to gamble.
BA- No, gambling it's not the gambling.
W- No it's to beat the system.
BA- It's not the gambling. The gambling, I hate gambling, but I'm a challenger, let's put it that way. I'm a challenger. Any human thing made, it can be beat. Hmm, if you're smart enough. You know you just gotta be spunky enough to beat 'em right? Right? Anything human beings make they think they can't figure out but, you know if you think about it anything human makes can be beat. Hmm, true 'eh? So that's my challenge in life, I mean that's a hard one but that's the kind I like. But one good thing about it is it's not hard work. You just using up here and doing things; practicing, practicing, practicing. But it keeps my mind going right?
W- I told him it's fine with me as long as you don't the company money, you use your own money.
BA- No I don't touch that. I don't touch no company money, right?
W- Yep.
BA- I don't take money. I never touch company money to gamble, hmm. I not greedy, I just go in there. All I want is to hit, make six thousand or break even or make money. That's all I want. I don't want the guys go, I don't want the twenty million. You keep the damn thing. I don't even want the jackpot on the damn machine. All I want is the two hundred, hundred dollar, fifty dollar, that's where you're making money, right? And you're having fun, right? Why be greedy. Just like when I used to sell fish. I could've sell 'em for two dollars a pound, make big bucks. For what? What I going do it for? I want to help the people, I want to do this, I want to do that right? When I made enough money for me to experience and enjoy my life I didn't care. I made lot of people happy, right? Then I'm happy.
W- Even when he did his Rooter service. My sister in law Mele was his accountant, right? She'd say, "ok when you come home empty your pockets." Ok. "What? You don't have any money?" "Oh no, I did." This was when it first started out, people really didn't know about it. And he would go to these home and would had poor Hawaiian's.
BA- I sit on the porch, like this sitting there. They get the money here, plenty kids around, ah sh**. I look at the money, I take enough for one six pack, here that's enough. (laughing)
W- Yeah, that's what he would do because he would feel sorry, yeah. And his sister said, "how you expect to make money in this business you just getting enough for a six pack of beer? Gotta pay for the bills."

C-I survived. Somehow God bless me, right. I never was greedy. I seen too much people you know poor and the rich, that's the worst one! Whoa I see poor people, I look you know and their kids. I walk in the house I can see everything. I see on the table they get the money ready. Not the rich, oh they going try to chew you down. The poor always get the money. I can see they get hard time already. I looking around, I tell 'em, ah only need one six pack enough to go store buy beer and the rest is for them. No worry about it. (laughing) I can't help it. I just can't help it. I'm not selfish but I work late but what I going do? Can't help it. I used to go a lot of people. If fact when I went quit, people was still calling me. I wish you was back in. We getting ripped off.
W- We didn't quit, we sold the business.
BA- Yeah, but they getting rip off, same thing.
W- And we told the guy, see I was flying back and forth with my teaching profession. I met these, at a party, I overheard these people talking about Rotor Rooter wanting to come to Maui. But they couldn't come to Maui.
BA- They had 'em in the phone book!
W- Because they couldn't come to Maui because there was one company there, I didn't say was my husband's and my company, that were the prices were so inexpensive that they couldn't make money if they came here. So when we sold the business to his friend we told him, he told him don't raise your prices too much because you'll volume in the whole island.
BA- You going invite 'em in. I had 'em controlled the whole island.
W- You'll get volume but if you raise your price, Rotor Rooter is trying to come in. They're in the phone book already but they haven't been able to come in because the prices were at a point where they weren't going to make money. No, he didn't listen. They raised his prices and they came right in and then everybody came in and then he closed up. He ended up, he ended closing up.
BA- I used to go all the way Hana help 'em.
W- Yes, we'd go all the way to Hana.
BA- Had this one guy I went go do. Twenty years he suffer on this one line so the plumber's going do 'em. Going cost him 20 thousand dollars, twenty grand. So he call me up he just happened to see in the paper or whatever, he was this teacher from Baldwin High School. Forge his name already. So I went over there he ask how much going cost to clean this drain, I mean twenty years and.
W- Les Skillings…..
BA- No was one Hawaiian, Kamai….
W- Oh, Kamahiwa.
KT- Oh, Hinano.
W- Hinano.
BA- Yeah him! He call me, how much cost me? I said, "twenty nine dollars." I look 'em right. So I went in there, five minutes he was done, open. He was so happy tell me, "you stay over here, don't go, don't go no place." "Where you going?" "No you stay here." I sit down write the bill. He went down the store, he bought pupu, beer. Eh, lucky I never have one other job I got so drunk over there. (laughing) He was so happy! Cost him 20 thousand dollars, the plumber wanted to charge him to fix that one line. And he suffered for 20 years. I did it in five minutes, twenty nine dollars. I said how many people I help like that.
W- That was Mrs. Kamehiwa's husband. Yeah, the principle at Kihei School.
BA- Yeah? He was so happy I never seen one somebody so.

W- What's her name? Andre…
KT- Yeah, Andrea.
BA- I did it in less than five minutes and was going cost him twenty grand. You know how much people I went help rotor rooter and save their life. How many people I went help in Maui. When I went quit, man, people was still calling me. They can't beat you. I was honest, ha? I was there I finish the damn job, I no care how much went cost me. Because I really wanted to find out what's wrong, the more you learn right? It wasn't the money, it was the knowledge right? The more I learn the more I come better, right. Money wasn't everything to me but knowledge, right. Just like I tell all these young kids today what, when you go school, the school pay you or you pay the school? (laughing) Right? Listen, but not only listen pick up things and learn, learn, learn, right. Do your own experiment, right? Do 'em because this guy taught me….no, no, no he only giving you one fundamental, right. The rest is up to you boy. Right, you have to, you have to. You cannot, if somebody teach you that no mean that's all you going learn. You gotta learn by yourself too.
W- All your family members were entrepreneurs right? Your father, your uncles and then your sisters.
BA- Everybody run their own business.
W- All of them.
BA- Only me the one, the youngest and went come up this big.   That's why when I named my company I wanted to keep 'em for all my family. My uncle's and the whole Akina, that's why it's named Akina. I wanted that name, I'm the youngest so I keep up that time, right? And I'm the last one doing it.
KT- So how many buses you guys have with education, school buses?
BA- Oh we get school buses, all the equipment there's about fifty or sixty.
W- Fifty, about fifty increment we have.
BA- Had more and I kinda going down, I don't want too much because I getting too old.
W- Hard to find drivers.
KT- Really.
W- We're looking for an accountant if you know anybody who's an accountant. Someone to work in our office here.
KT- Question so is it certified kind?

Interview: MD Alborano

By Keli'i Tau'ā/ Kimokeo Kapahulehua

KT- Keli'i Tau'ä
MA- Consultant

KT- Today is January 31st, I'm talking to:
MA- MD Alborano
KT- MD doesn't stand for anything?
MA- Medical Doctor. No! (laughing) It stands for Marie Doreen and nobody calls me that so MD is good.
KT- Okay, spell your last name.
MA- A-l-b-o-r-a-n-o.
KT- You were born?
MA- I was born in Kihei, Maui. June 26, 1935.
KT- Your maiden name was?
MA- My maiden name was Miranda. M-i-r-a-n-d-a.
KT- What generation of….Portugese?
MA- Mmhmm.
KT- What generation was mom and dad?
MA- Generation? How old they were?
KT- No, there's several, like Japanese got Nisei and Sansei…
MA- Oh, I don't know.
KT- So, when did they come?
MA- They were born here.
KT- When did their parents come?
MA- Their parents. Oh, that's just what I was reading. My grandfather on my father's side came in 1888.
KT- Okay.
MA- But my mother I don't know. My mother's mother was born in Kauai.
KT- So when he came what was his purpose to come here?
MA- To Maui.

KT- No, to Hawaii.
MA- He was eight years old. He came with his mother and his father left. So it was his mother, his two brothers and two sisters I think.
KT- So what was the Makua and the Kupuna doing?
MA- I don't know what she was doing, but she bought property. How'd she do that, yeah? She had a son that she came with that was 25 years old. But that son, they all landed in Honolulu and they came to Maui and that other son went on to Hawaii and that Miranda there is from the Kukaiau Ranch in the Big Island. They were all cowboys. My mother's side, my grandmother too was born in Kauai. And he came, my grandfather. came by boat but I don't. That side I don't know, I didn't do any tracing.
KT- So anyway you're here in Kihei, born in Kihei. Where did you go to school?
MA- I went to St. Anthony.
KT- You're privileged to go.
MA- I was privileged to go and I rode a bus. It was a cattle, it was a truck that they covered with tarp.
KT- Whose bus was it?
MA- Akina.
KT- Yes, of course, I just interviewed Millie. So, you can recall the bus ride? Ok, tell us.
MA- Um, it was interesting. I mean I was a little girl. My god, six years old, then the war started 1941. And it was frightening actually because we had to practice with gas masks and have um, what they call that under…foxholes, no.
KT- The building underground.
MA- Yeah, we had to go underground shelter with our gas masks and the gas mask was such a Closter phobic thing, my god. Um, but we lived through that and I continued at St. Anthony, I graduated from St. Anthony. So I went to St. Anthony 12 years as a little kid. And you know it was so wonderful in that time because Kihei used to rain and when it rained it flooded. And constantly during the winter it would rain. And I had to walk from our house which was in the back.
KT- Where, where, exactly where?
MA- On Welekahao St. Welekahao, it wasn't called that. There was no Welekahao. I'd have to walk up this path, of course it fit a car, that's the only way we got our property was through this path and just drove the car in through there. And I, it was raining, it had rained so much the night before and I walked, walked, walked I was like eight years old. I got right to where the bus was and I fell down! Uniform was covered with dirt and the bus driver told me, "you go home change your clothes, we wait for you." Isn't that something? How can you beat that? How can you beat that?
KT- That's Hawaii.
MA- That is Hawaii.
KT- That's what we cannot capture but we can try. We can try.
MA- Cannot, cannot. You can only remember those things. You will never see that again.
KT- Yeah, that's why this is valuable, this interview or these types of interviews that we do. Um, so because I'm familiar with the area you're describing, wetlands.
MA- No, no, no, no! That wetland is like if I had to guess it's like a piece of property maybe put all together is an acre. The front part that used to get water, but only when rain.
KT- But right now the existing wetland on the side of Welekahao, on the side of south Kihei.
MA- That side you tell Makai?

KT- Yeah.
MA- Makai, yes! That was our property too.
KT- Yeah, so wetlands.
MA- Yes, that was.
KT- Of course, not where your house where I'm familiar with Welakahau was not wetland, but I'm describing..
MA- Yes.
KT- Kihei surroundings, even right now to McDonald's was wetlands.
MA- Definitely.
KT- Yeah.
MA- But when you talk wetlands in Kihei, you only talk when rain.
KT- But the bottom, the Makai side always held the water.
MA- Has water. Yeah but for how long?
KT- Wetland still wet over there.
MA- Just rained. Behind Long's, yes. They corral that water, they corral that water to make that a Puanwaia, or whatever to make it. But you know we never, I mean the rain never stayed. There was a ditch along the road on both sides that when it did rain, it collected. The rain went into the ditch. The ditch ran along, ran along and got to by St. Theresa's Church where there's a pond.
KT- Right.
MA- And when it rained real bad they break the pond the water goes in, no problem.
KT- So ocean?
MA- Ocean.
KT- To the ocean.
MA- Plenty Samoan crabs.
KT- Before.
MA- Long before.
KT- You used to go there.
MA- We'd go catch.
KT- How you used to catch?
MA- I know my father did. I was scared of the damn thing. I was scared was going bite me. (laughing) It's huge you know!
KT- So you only enjoy eating that?
MA- That's right! We used to eat turtles too. Poor Honu, they cried.
KT- How did you catch them?
MA- Again my father how he caught 'em, I don't know, net? But anyway it was a different, different whole life, my god.
KT- So what did mom and dad do as an occupation?
MA- My dad worked for the State highway before, before he even did that. My grandfather was an entrepreneur.
KT- Okay.
MA- He bought property in Wailuku. He bought property in Kahakuloa he raised sheep there. He bought, and he was like, you know they didn't have banks before. He was like the banker because he had this money he would lend people. And dad's just sorta was going through the deeds, you know the tremendous deeds that he had you know, that he left behind. And then he did a store on Market Street.

KT- What was the name of the store?
MA- Miranda Store.
KT- Miranda Store. When did it finally close?
MA- Um, if I had to guess. It had to be around 1935.
KT- What is the replacement of where it was located?
MA- I think there's a Vietnamese, you remember Ka Market? Ka that's exactly. That was my grandfather's from the corner of Vineyard on Market all the way down to Wakamatsu. That was his. But he ran the store out of the Ka side after Kamea came in you know.
KT- So nobody picked up his characteristics?
MA- No, the family you mean?
KT- Yeah, from being an entrepreneur.
MA- No, no. They all left. My father was the only one left back here and across the street too he bought. Dodge cleaners, do you remember that?
KT- Yeah.
MA- That's hundred years ago. So then he had a home up Vineyard, up the top of Vineyard and it's like a Spanish type home.
KT- So between Kihei, you moved Wailuku come back Kihei.
MA- No no, no, no. My father was born in Wailuku.
KT- Ok. And just him and then you guys moved down here.
MA- My grandfather raised all 13 kids in Wailuku. In a house there. And he built a house in front of that after he had little bit more money. And he died in 1935 and he started building like in 1930. And it was interesting how he got the lumber up Vineyard. I mean the boat would bring the lumber at Kahului Wharf and just dump 'em in the water. They would get trucks and there was a milling. A mill that did saw wood, you know.
KT- Where?
MA- In Wailuku. Amazing, but I not going into that because I don't know that.
KT- Yeah, yeah. Yeah, you… it seems like you know a lot of detailed stuff so move it this side.
MA- Okay, we going Kihei now? That's where I'm going.
KT- And Honuaula. (laughing) Look at the map!
MA- Okay, so then my father was the one that helped my grandfather in the store. When my grandfather got sick he told my father you going to have Kihei. You have 56 acres there where he raised animals to sell at the store.
KT- What kind of animals?
MA- Chickens, ducks.
KT- Small kine.
MA- Yeah and cows, he had cows but not, you know.
KT- Not the ranch kind.
MA- Not the ranch kind and pigs, plenty pigs. And goats. And by that time there were other nationalities that were moving in like Filipino's loved goats.
KT- Yup, and they still do.
MA- Yes. So with that big property he had he made a farm and we worked hard. Let me tell you, we worked hard.
KT- That's why you're young.
MA- Yup, that's why I'm tired. But anyway he um.
KT- So it was going to school, come home work on the farm.

MA- Before school honey, before school. You water all the rabbits, you make sure the rabbits have water and they have food.
KT- But your father's not standing over you.
MA- No my father is my.
KT- You do that automatic.
MA- Yes, my father would have gone to work by then and my mother was home. My mother was more, she'd do side jobs like clean house. This is after the white people moved in they needed people to clean their house. She did the part time and she also helped David Ping, now you know David with the boats, he used to have Aku boats. The boats used to come here to the store there was a dock there and they would go pick up the Aku and fish you cannot sell they used to dry. So on top of David Ting's garage was this fish dryer, huge fish dryer that my mother would go lay the fish after it had been soaked. Or you know, just salt and pepper…salt.
KT- David passed already?
MA- Yes. Elsie is here so you gotta talk to her.
KT- Well, you gotta set me up.
MA- Okay I set you up. Anyway, um so she used to do that and we were very good, they're very good friends. They had four boys and whenever she went to the hospital to have a boy the kids stayed with us, you know. We were their hanai people. And um, my dad would go help him when the boats came in go help him take the Aku to Lahaina and my dad loved Inu. So he's to Lahaina, and I was always his shadow, wherever he went I went. So ten years old taking Aku to Lahaina in tadai's, huge tadai's. We get there and everyplace we stop, Henry, one drink. Well, Henry wasn't able to drive home at the end. So MD, I'm sitting on the pillow ten years old driving the Pali and I couldn't wait to get home because I know my mother was pissed. Oh, god he caught it. But that was interesting because we met no one on the road. And you know this was like 9:00pm that we came home.
KT- So was it still model T's or what kind of car?
MA- Yes, shift, the shift kind.
KT- Shift kind you had to crank.
MA- The truck, the truck. No, no I don't think we crank it up. You gotta crank?
KT- Well, mine. Our model T's you have to go in the front crank the guy up.
MA- I don't think we had to.
KT- Yeah?
MA- I don't think so. But anyway if we did, he the one went crank and off we went.
KT- And then the choke.
MA- Yeah, the choke, the choke. No, no, but it was a shift put the clutch in and shift so maybe started by itself.
KT- Okay.
MA- Okay that was an episode. And then.
KT- So, what was your neighborhood like?
MA- Our neighbors were like one mile away, nobody around.
KT- Wow.
MA- Nobody. Our neighbor's were the Akina's. They occupied a lot of property right next to, you know across Willie Akina. Um, John Akina. Alec, big Alec was the big Alec and small Alec. Big Alec drive the bus, small Alec drove the bus. You know if was not him, that was his son. The small Alec, gotta be. But you know was interesting because you know those were my

playmates on Sunday, Alma Akina. Um, Peggy Akina. And I just saw her, her brother died, Donald. That's the only time you see local people now.
KT- So, what did you do for fun.
MA- Um we were cutting Keawe wood for the Fudo's and selling the wood and feeding the rabbits and feeding the chickens and heating it up.
KT- What would you feed em with.
MA- Scratch feed.
KT- Where did you get it from, you bought?
MA- Yeah my dad bought it from someplace up in Kahului.
KT- Because Millie said that she used to, her dad used to collect all the kids and go pick Kiawe beans.
MA- Oh, hell yeah. That too. That's for the pigs and the rabbits. But we used to pick Kiawe beans because we had all this property and people from Puunene used to come and pick beans in our property too. And you get these bags, pound them down to make em small and make them where, because you get paid right. We didn't get paid. But anyway, yeah we feed them that we feed 'em the Kiawe beans and my father would go around the neighborhood and collect garbage. You know he would come with the truck with the hook. With the can, take the can down give them and put the other can up on top and of course I was with him to do that to help collect the garbage. And he'd cook it because you never know what's in there, might kill the pigs yeah. And you know that was our daily job, that was our job.
KT- After school.
MA- After school and before school. But after school within time you run into dark. You cannot.
KT- Sun up to sun down.
MA- Yes, Saturday and Sunday was play you know. But still we had to work and feed those bloody animals because they need to eat.
KT- Yeah, so what was play about?
MA- Play was, we had a basketball court. We had a basketball, my father had put the basketball rims both ends in the front of our house because it was solid, solid wood you know. Solid dirt, you can bounce it ok. And the kids in the neighborhood and we'd all play basketball. We also had horses. My dad and I would go rid e horse on Sunday after church. And we'd go up and down Kihei, go up to Suda's come back down. One time we rode all the way from Kihei, Wailuku and come back no problem. No cars, no nothing. This was in the early fifties which was so wonderful.
KT- So were there any significant areas that were Hawaiian things that you can recall? What about this area, Honoaula?
MA- Where's my house?
KT- Wailea is here, so it's back here.
MA- Well, they had no such thing as Wailea. We called everything below, you remember the road ended at Kalama Park.
KT- Okay.
MA- Anything below Kalama Park go futher down, Makena. The whole area was Makena because we didn't have names as far as we knew.
KT- Yeah, well, according to the older maps, Honua'ula was the Ahupua'a that included Makena which one of these things over here. Because over here is already where they're calling La Perouse Bay.

MA- Yes, they called it that because that man was here yeah recent? He was here recent that I know yeah.
KT- So this is in alignment with Molokini of course right? So, in that boundaries, anything Hawaiian you can recall? Somebody told you, somebody told your parents or any cultural things?
MA- Well, my father used to go help bring the cattle from Kahoolawe. I mean nothing Hawaiian about that but that was a thing.
KT- But that was part of the history.
MA- Yes, oh definitely. And the cattle used to come in to Makena, I don't know where. Anyway it came in and they herded it up to Kahului.
KT- They herded it to Kahului? Why there? They had slaughter houses all over.
MA- In Kihei? Oh, I didn't know that. Did they?
KT- Yeah? Our last interview that we did Kula, man the cowboys were talking about it.
MA- Kula has. Kula had plenty cows.
KT- Yeah, no but slaughter houses was all over this island, amazing.
MA- Oh, I want to hear that.
KT- I can get you that.
MA- No, out there I didn't know about that. But I knew that he was there when the cattle because used to swim into shore.
KT- Right.
MA- The poor things, okay that's.
KT- So he enjoyed cowboying then?
MA- Yes, and he farmed and he had animals but it was hard work. And cutting Kiawe trees for fudo's and for the Aku boats to cook on the boat. But Hawaiian stuff like oh, they used to have you know, during the war.
KT- Well don't limit by me asking you that question because you were going to exlude the cattle and stuff but that's part of the culture right?
MA- That's what happened here, yeah of course, of course.
KT- And a rich culture to be um…
MA- There were people living on Kahoolawe and my dad used to know the people living there.
KT- So it was a nice little community.
MA- Kihei, yeah but far away people were, far. You cannot go say, "oh I going walk to Joe's house we going have a beer." You gotta drive.
KT- So, you lived here so you saw the changes. What type of other, you saw Suda store start and you saw it go down. And what other stores, or….
MA- Azeka, Azeka's. First was Tomokio.
KT- Where was Tomokio located?
MA- Across Kalama Park where Azeka's, Tomokio sold to Azeka. There was a store there and you know nobody ever paid at the register, everything was charged. The gas pump was there too. During the war a big change came about. That's when you saw people, men all over the place, all over the place.
KT- Did you go pupuna them?
MA- No, I went you know I was just, you're kind of hesitant because you don't see that kind people you know. And I was a scardie cat, I tell you.
KT- So did mom and dad try to keep you at home?

MA- Well they warned us that you know that these people are not Hawaii people. These people don't think like us you know. They may do bad things, you know. And um thank god I stayed close to home. And you know we'd walk to go to the beach you know even if our house was inside. We'd walk down Welakahao to the beach no rock walls. I mean you could walk on the beach to St. Theresa's where I can't swim I had to touch bottom before I could swim. And so we'd walk to St. Theresa's and that's where we swam and had fun and then which was kinda far from home in case something happened. But we managed you know we always went with a bunch. Summertime we spent the whole three months there after we finished our chores. But getting back to Tomokio Store, they had the, they ran the store across Kalama Park. And then Bill came in. Bill took over and we all loved Bill. I mean there was a little place in the back that had you know my father found all these places that you could find inu. I mean go with him horseback ride, "Oh, gosh stop! Get a little taste here." So we stop Azeka's and I'd sit with him. Then we go down to Fuku's suck 'em up. Then we go down Aunty Becky's .
KT- What was her full name?
MA- Aunty Becky Lyon. She was living with Lyon's in Maalaea but this was Akina place. Akina started the restaurant in the bar. And um, we'd stop there and had Kiawe trees, you know um. Oh, you know what I have a film from Burdick that is supposed to be shown to education, for an educational purpose. You might want to see that.
KT- Is it video?
MA- VCR. It's long.
KT- Well, let me go look at it.
MA- And there's paper's to go with it.
KT- So you're saying I can take it to go look at it and come back.
MA- Well, I trust you.
KT- Oh, MD.
MA- You gotta give it back to me.
KT- MD
MA- Maybe you don't want to look because it's personal too you know.
KT- I'm only going to filter out what's gonna relate to this. But it can give me some more ideas.
MA- This is about Kamaole One, yeah turn that off.
KT- So we talked about the people but the activities within this neighborhood, were there anything that was developed that you're proud of that Kihei is known for? Now I know Uncle Alex because I interviewed him and I was able to get the information.
MA- Who, Alex Akina? About the bus?
KT- About his fishing and was nice. I used to write for Hawaii Fishing News.
MA- Oh, fantastic. He was born on Kahoolawe.
KT- Yeah, so we had an extensive interview.
KT- Anyway, um. So, you know the leaders in this community and during your lifetime.
MA- I know.
KT- Obviously uncle Alex.
MA- Yes, definitely.
KT- Who else?
C-. You know another one too was Johnny Ventura. Johnny Ventura was a postmaster.
KT- Okay.

MA- And his son and I are classmates, Wendell. And he would take us during the summer, he would do plays. And we would go to the Kihei theater which was open air. Kihei don't know rain so no need roof, it's open air.
KT- Where was that located?
MA- That was, do you know where Suda's is, was?
KT- Yes, of course.
MA- Where they do now the market kind, yes the open market it was like in the back maybe like a half a football field.
MA- And they would show movies and is rain you gotta go home. But it was really fantastic. Anyway that's where the movies were shown. Johnny Ventura would take us kids from high school and do a play, and it was a musical play. And I would never forget, I forget what the name of the play was but we, everybody participated. Can sing, cannot sing, can move you know. I was in the first row to come up doing something like this and I could never ever get the note because I didn't know when to come out. But he did it, our parents all came and we were so proud. We were like 15, 16. We had our little dance hall of which he was again the chaperone; he would bring the music and play. You know, I mean it was just for all the boys and girls to have something to do.
KT- So he was visionary then?
MA- Yes! Yes, yes. Because by that time there were a lot of people from Puunene who they closed camps down, they had to go someplace. They came to Kihei, cheap the land. Wow, what a revelation! Move to Kihei. So we had tons of new playmates now.
KT- So, um you're telling me it wasn't so developed. Not that many houses and stuff?
MA- No. At all, at all.
Kt- During your early childhood.
MA- Oh, early childhood there was nobody. I mean you'd have to go pedal your bike.
KT- So that, so the visionary people that you're making mention are really, were really the builders of this community called Kihei today.
MA- If you mean building their homes, yes.
KT- Building the community and having activities that you just described.
MA- Oh, yeah! That was yeah.
KT- Bringing the people together.
MA- Yes, exactly, exactly.
KT- Developing activities. I mean who would have thought of having kids do a play.
MA- Of course, of course. And be able to pull it off, you know. And then during the war now, you gotta understand all these service men were here and they used to have U.S.O. actions, no I don't want to say actions. They used to have gatherings, U.S.O. would come and say ok can you do hula aunty, oh what's her name from Lahaina? Emma Sharp. I was one of her students, you know. She would bring us all down there to dance hula for the troops and it was very interesting. You're dancing on the stage and all these servicemen, tons and tons and tons are watching. And when you start dancing they throw money on the stage. And I'm wondering what is happening? Why are they doing that? And so I'm thinking, who's money I'm dancing? Who's money is that I wonder? Do I pick it up after I finish cause oh I want that money! (laughter) And I think I did. You were allowed to go get your money. And that's at Kalama Park. You know gazebo, that's where. So that was there for a reason.
KT- So the reminiscing brings back many fond memories?

MA- Oh, fond, fond memories. Fond memories. And I mean you know excellent friendship too my goodness. I mean we, at our house we had seventy five coconut trees. Seventy five. Now if you have seventy five coconut trees, you have about two thousand leaves that fall down and the coconuts fall down. Somebody's gotta go get em and put them in a pot. And we would, during the summer most of the time. Collect our leaves, make a big pile and burn it. And guess what, nobody stopped us.
KT- Nobody because no more laws.
MA- And that was the highlight of our summer.
KT- So, didn't you guys sell the coconuts, nobody wanted to buy because everybody had 'em.
MA- Everybody had in their yard, oh yeah. And you know what was so interesting then? You know when people got lost, you know when they come Kihei nobody, Kula people they don't know Kihei. Kihei people don't know Kula so they'd come to Kihei and they'd drive in the traffic and um, "oh you know where um, let's see. Kuana, you know where Kuana live?" And my father would say, "yeah you go down you follow the road and you pass the four coconut trees. Then you come down to the plumeria tree. And when you pass the plumeria tree you turn right."
KT- Dirt road?
MA- The Kuana's were past Kalama Park so they were dirt road. He owned all that property from Kamaole I. Ten acres all the way up.
KT- Who is he?
MA- Kuana. I don't know what his first name was.
KT- Kuana isn't that his first name? Wasn't that part of…??
MA- I know Joe Kuana. Joe Kuana still lives, he lives down there.
KT- What about Kenolio's?
MA- Yeah, Kenolio's I knew too. They lived down here or up there. Now see this was the back, this was Keawe's. He lived down here and you would have to drive up a long road to get to his house. And Kukahiko.
KT- Kukahiko.
MA- Kukahiko. I forget what the first. He used to work with my dad and he was the funnies guy! And my father used to always talk about him, Kukahiko. And he had a sister Kuulei. Kuulei Plunkett is Kuulei Kukahiko. And Dorothy, Dorothy was more my age.
KT- Kuulei passed away then?
MA- Yup. Plunkett. And I don't know about him. Papa Plunkett, did he die?
KT- I'm not sure.
MA- It's so hard, yeah? Too many things happening to keep track of all.
KT- Well, hopefully this kind of record you can just go through the records and see.
MA- Oh yeah, this is so good. I want you talk to Elsie Ting.
KT- So you could set it up?
MA- Yeah I could set it up.
KT- You got my number you going let me know.
MA- Yeah now I have you're number. I've got to go with you, or whatever.
KT- That would be great, set it up or let me know.
MA- Because she's willing to talk about it. She talk forever about everything, she has such a good memory. Good memory. Eighty years old. Her house
KT- You're kupuna? Me too. Her house

MA- Was, you know Lipoa Street? All the end to the ocean? Turn right little bit, that corner right there. That's where they live with the fish, the dried fish.
KT- Where she live now?
C-She……see everybody had to sell. Nobody could afford taxes, so people sell. You have no choice, it's not a choice given you. I want to tell you. Turn that off, I like tell you something.
KT- Wait, wait, wait. So keep talking the outside of when we finish, tell later.
MA- What was I going tell you though? Oh, ok. You may want to include it.
KT- Yeah.
MA- That's fine you can. We don't need names.
KT- Okay talk about that, the concept.
MA- The concept. Of having to sell you almost are put into a position where the taxes are, I means there's no way in God's earth you can. If you have 56 acres of land the property taxes are incredible because you're not making money off that property, it's Kiawe wood. Kiawe wood don't sell anymore. And if you're going to farm you're going to make beans. Anyway we sold the front property. And we did ok. You know I was able to buy this house. Thank you sweet Jesus and retire without a mortgage, okay. So then now we're going to sell back. The back is like 20 more acres and you know by this time it's established, this was like about 4 years ago. And I go to the gym and I have friends that are realtors, you know. And they don't know me from a hole in the ground, they just know that I've lived here. Ok so, um this one girl. They have a opening, they have a what you call that? They're going to have a little party because they bought the property. And they invited us. And I would not go had my brother been here, because my brother handles all. He's in the mainland and he tells me to go, okay. So I go there and the lady that is on the side of buying the property representing the buyer is there and is my friend from the gym. So we go there and there's a tent and pupu and everything and you know I'm very honest yeah? Because you know I hate. This is my playground this is where I've lived. I get up there and I'm walking and she sees me and she says, " what in the world are you doing here?" And I looked her right in the eye and says, "This is our property." Which made me feel very good. Then she said, "Oh!" What is this brick bag otherwise say yeah, I know exactly. But you know that's how it is thought, you know. There's a division. Beside them, beside us. There's gates keep these people out. They don't need to come into our place. That's what really pisses me off and that's what when I see this kind. This place they going have gates?
KT- Um, you can take a look at what a open community they put in the box already to…
MA- Yeah but I'm not talking about that. I'm talking about the people buying it. The high end people, right. They're definitely going to have a gate. But you know sometimes you can't get around that kind.
KT- Well, I'm not involved in the development of this. I'm involved in this part, I want to make sure that they hear the message.
MA- Oh yeah, but you know?
KT- Which you folks are…
MA- Yeah.
KT- At least the message can be going out, of the feelings of the people.
MA- That's true. And that I'm greatful for because it could be just another you know kind of thing that nobody cares they just…That kind of you know. Because when the first people moved down here, the Puunene people, it was wonderful. You know, it was fun and games because they came down with their children. They had as many pennies as we had. There was no gloating. Where is this? Is this part of the Haleakala Ranch?

KT- It's um, Mauka of um….what's um Beverly Hills down here?
MA- Maui Meadows.
KT- Yeah, that area which connects to Makena Resort area.
MA- Yes.
KT- So um what they're trying to do is collaborate put in millions of dollars in improved roadways and stuff so that to try to prevent continually what has been done before.
MA- Roadways are going to connect?
KT- They're trying to. It shows it in there somewhere about trying to improve…
MA- Not Ulupalakua right?
KT- No.
MA- Just go down to Makena because Makena ends, La Perouse, there's no way you're going to make a connection there.
KT- No.
MA- Okay. I don't see a name how come? Well, I'm glad they got you involved! Oh, this shows everything, ok. Is there ever going to be a time where we cannot continuously go down. Is it going to be blocked off the..
KT- This is what this is. To hear you folks say that they're. And this is the proposal demonstrates that they want to do everything to make sure that there's no blockage of um, what is the terminology….gathering rights.
MA- The what?
KT- Gathering, going Mauka to Makai. Hula dancers need greenery. Fishermen need passages. So this is what this is. To prevent that kind of things from…
MA- Because you know for me, I feel I'm allowed to go anywhere I want. I was here first, dam nit I get to go there. I don't like seeing people come in and begin to tell me "you know what, this area is shut off. You cannot go from over there." And I see it on Halama street. There's big boulders blocking so that their houses don't get washed into the ocean. We can't walk. Can you walk along the beach? Bologny, you can't. That stuff.
KT- Once the people community started protesting is when we stop these newcomers to do their things.
MA- Exactly, I must say this much. The Kihei Community Association has done a very good job.
KT- Well, they gotta pick it up somewhere.
MA- They have to. They have to pick it up. But they, I mean all the people there are not local people. I'm the only one there most of the time that's saying, "you know I really appreciate this, I really appreciate." Because they go. I tell you big Kahuna's, we don't.
KT- Yeah. So that's why Kimokeo sits in on all of these.
MA- Yeah, he does. He's at the Kihei Community meeting.
KT- Yeah, and he represents me because he passes it back on.
MA- I go too. And I like make it a point to go. That party they had was excellent. Excellent at the VFW bringing together people. Where's the local people. I saw the Kenolio's there, I was really happy to see them. I called Perriera that Ludine Perriera who was across the street. Her father was here, grandfather was here in Kihei too married to a Hawaiian lady and bought property in Kihei. And I told 'em come but they're not interested how can you make them interested if they're not? You know.
KT- Say the name again so I can get it.

MA- Ludine, her name is Ludine. I don't know what her married name is. But it was Perriera and I told her and I called her and told her, "you gotta come." And I saw her at McDonald's and she said, "oh did you go, you so good. You go all the time and you tell me what's happening." So damn typical, you know. She and my brother are classmates I think, I'm not sure.
KT- So this Ting wahine, she doesn't work?
MA- Oh no she's 85.
KT- You have access to setting up we can…..
MA- Oh yes I do. When you want to do it?
KT- As soon as possible.
MA- Okay the point is, maybe I'll just sit. You know this week is not a good week for me. I'll get Elsie Ting. I think she'd be more than willing.
KT- But not good for you to meet sometime this week. Weekend no good? Oh this weekend no good.
MA- Nope. It's Kung Hee Fat Choy.
KT- I thought was last week.
MA- And you'll be pau with this?
KT- I going try my darnest.
MA- That's treasure.
KT- Oh, that yeah. I'll finish that. I'll have it back.
MA- Because it has in this paper it explains what you wanted. So that's….
KT- So the commitment will be by the time I come back, hopefully I can have…
MA- When you going come back?
KT- You set it up next week. So it's 2:52 we'll call it. How many years you been retired already?
MA- 1990. How many years is that 15?

Interview: Eleanor Burns

By Keli'i Tau'ā/ Kimokeo Kapahulehua

KT- Keli'i Tau'ä
KK- Kimokeo Kapahulehua
EB- Eleanor Burns

KK- One of the problems when we was talking to Papa Chang. Papa Chang said.
EB- Papa Chang who? Eddie boy?
KK- Eddie boy. He said no more, no more um people's last name. They go by their only name yeah, like this one probably be….you know when they, when they had make land deeds, they never put their last name. Before they just put the name of the person yeah.
EB- Ok, let me…..talking about land used to be, you know Aunty Flora Haynes?
KK- Haynes?
EB- She was a Ka'ai.
KK- Sam's family.
EB- Well, actually she was related to my mother but when we first, I came from Boston, six of us were born in Boston. My mother and dad were from Hawaii. My mother was a Will's my dad was a Burns and my dad was in the Navy, it just happened that they had Hawaiian music and my dad was with Rochelle them and Kanakanui he became the first Hawaiian admiral. So there was Hawaiian show that came to Boston so my dad and my mom went and they met each other. But my mother had gone to Sacred Hearts and daddy had gone to St. Louis so they knew each other.
KK- In Oahu?
EB- Yeah. And then six of us, all the girls were born up there and my brother Paul.
KK- So how many girls?
EB- We had nine in the family all together.
KK- Whoa, big!
EB- Five girls, four boys but two, my older sister died. That's her picture there. Yeah with her husband, that's a Kalahiki yeah. My sister Louise died and my brother Chester.
KK- So all the rest stay?

EB- All the, my sister Josephine, my brother Kenwall, they live in the mainland. And my sister Lucille and I live on Maui and my brother Paul lives in Honolulu. He's married to Kanoe Nahulu.
KK- So, you're maiden name is?
EB- Burns.
KK- Bruns. B-U-R-N-S.
EB- Um hmm.
KK- So Eleanor Burns. And what year born? Out of the nine of you, what you the middle the top or the bottom?
EB- I'm the third.
KK- Third oldest, so the one above you is still here?
EB- Josephine, she lives in Arizona.
KK- Oh she's the oldest still around.
EB- 1930.
KK- And her, what is her?
EB- Well, she's a year older than me so 1929.
KK- So her name is Josephine?
EB- Auld. A-U-L-D.
KK- And then your second one is?
EB- My older sister…
KK- Is Josephine.
EB- No that's Louise and she's married to Ed Kalahiki from Kahaluu. You know him? Kuku pile a family that.
KT- Yeah, big family.
KK- And then um, after Louise, who's after Louise?
EB- We was the oldest, Josephine then me, Eleanor, then my sister Lucille.
KK- Then Lucille is um.
EB- She's two years younger than me.
KK- She's still here?
EB- She lives in Pukalani.
KK- Oh that's the one you said live on Maui, the other sister.
EB- Maybe I take you up there to visit her.
KK- Yeah, and after Lucille?
EB- My brother Paul, Paul Kekoa Burns.
KK- And then after Paul?
EB- My brother, my sister Marlene.
KK- Marlene…..
EB- Oh, she lives in South Carolina.
KK- Long time?
EB- Yeah.
KK- And then after Marlene, one more?
EB- Um, my brother Bobby.
KK- Yeah, one more brother, yeah?
EB- My brother Robert and then my brother Chester and then my brother Kenwood, the youngest.
KK- So get five boys four girls or five girls four boys.

EB- Five girls four boys.
KK- So all the girls born in Boston?
EB- Yup.
KK- And the other people was born here?
EB- Five girls and my brother Paul born in Boston the rest born here. But my brother Chester was hanai by my aunty. Aunty Lou was a Keahou family and then she married to Hunt.
KK- Oh, kuku pile ohana, yeah?
EB- Yeah was from the ace of spades. No mama, you know we used to, Mama would go to the genealogy. When the Kukahiko sees through and the Kupuna would go through the genealogy, from the ace of spades to the blonde blue eye, Mama would say you're all related, you're all cousins. My mother in law, was really nice.
KK- Uncle George's mom.
EB- George mother yeah.
KK- And what was her maiden name?
EB- Um, Kulaloia.
KK- Oh, aunty, um…
EB- Leslie, you know know Leslie?
KK- Les.
EB- The father is Mama's brother.
KK- You know I told you before yeah, Lucille, his first wife. That's my cousin yeah? Lucille Costa.
EB- Oh, that is? Yeah, she was from Kauai, yeah?
KK- Yeah from Kekaha.
EB- Oh, Kekaha, did you know Eleanor Blake?
KK- From Koloa?
EB- I don't know but she's related to Hartwell. I didn't know until I asked, um Edie's husband Raymond. Well, I'm named after her.
KK- Eleanor Blake. Oh really?
EB- Eleanor Blake, yeah my mother and her went to school together.
KK- That's, I don't know if that was Heartwell's wife or Charlie's wife? You know had one Kahu in the family, Charlie Blake. Big, big guy.
EB- Oh, I don't know. I didn't know who uh. I knew she came from Kauai and I was named after her, but I never met her. But I knew Heartwell because of Hawaiian Civic Club.
KK- Oh, yeah, yeah, yeah. Well, the son, the son he's a attorney yeah. He's still around.
EB- Oh, yeah.
KK- And then the other brother is Teddy Blake who's in Tahiti, he's still around. So how long you guys live here, in this place here, in Makena?
EB- I think since '92 I think.
KK- Ninety-two. Already had road then. Before never had road yeah over here.
EB- Only the dirt road.
KK- The bottom one, by the hotel.
EB- Yeah. Well this is the one you used to go to Makena.
KK- Right here. The top one yeah, the one come down from your house. Right up here at the dirt road.
EB- This was the road.

KK- The dirt road, yeah. Because I remember when we came here before in '70's for go fishing was all bumpy. Was this dirt road with stone walls. But now no more the stone walls, they went take 'em down I think.
EB- Oh, the Hawaiian stone walls.
KK- Yeah we used to go inside here, go diving. That was uh, '63 or '62.
EB- My husband transferred from HPD that was in '62, we moved to Maui.
KK- Then he came Maui Police Department.
EB- No he was in HPD, he used to work with Larry, Metro Vice. And then when there was an opening he transferred. So we had to go to Lanai.
KK- For?
EB- Well when you transferred to Maui, you either had to go to Molokai or Lanai before you could be stationed on Maui. So that's.
KT- Mrs. Burns, do you speak Hawaiian?
KK- She understood Hawaiian.
EB- I only, when, I moved to Maui, Mama always she always speak Hawaiian so I learned then church, in the church yeah was all Hawaiian.
KT- What church was that?
EB- Keawala'i.
KT- Who was the Kahu?
EB- Well, I remember used to be Kahu Kukahiko and….
KT- Which one, Earl?
EB- The father.
KK- Oh, Halelana.
EB- That's all my husband's family, Earl.
KK- He was Halelana, yeah? He was Halealana in Honokahau, in Honolua and then over here.
EB- Then had one tutu Daisy Kalopa, I'm not sure the name you know. Uh, tutu Jack from Upcountry.
EB- No that's, that's a name. Because when we used to have Ho'ike, they would like, Makena was known as Makawaohema? And there was Ulupalakua, Kanaio and Makena. So when every quarter we have Ho'ike they would, the cowboys would come down on the horses with all their leis, their hats and the Hawaiians all in white. And then they would have a luau and whoa, I mean.
KT- Is it okay that I call you Eleanor? I just want to point out, just that is so much information that our keiki's don't know etc., etc. So to have that anxiety feeling that you had, "oh I don't know nothing." That's not true. These things that you share with us are so valuable.
EB- Well, I um. My aunty, when we came back, my aunty Lou Keahou she kinda was my dad she took care my dad when dad was young. And aunty um, aunty would speak Hawaiian. But you know we didn't know. I mean like when we first came back I went to Kapalama School which was English standard, and my haole teacher asked me if I was pau. P-A-U and I never heard the word in my life and she was going to make me stay after school. Lucky Mrs. Carter was Hawaiian. She said "no, we're Hawaiian, we just moved to Hawaii." (laughs)
KK- From Boston.
KT- So we're talking about you going Kamehameha, Kapalama.
EB- No, I didn't go. Only my two brothers went.
KT- But you were at Kapalama?
KK- No, down yeah?

EB- Kapalama School used to be on King Street, used to be standard.
KT- Okay.
EB- Kapalama then Stevenson then you go to Roosevelt.
KK- Kamehameha get one Kapalama here but Kapalama School, then Kapalama Heights.
KT- Okay, understand.
KT- So how old again were you again when you came home?
EB- I think we came back in 1939.
KT- So how old were you?
EB- I think 9.
KT- Was a culture shock then?
EB- (laughs)
KK- You went feel haole yeah? I know but when you come back.
EB- Let me tell you this. When my dad was off the ship he worked at the railroad station because my godparents were Italiano and they were very family oriented and they took care of us. And I thought they were gangster's you know because they cars have shades and, when I was young now I thought that, but they're very like Hawaiian's, you know. So we came across by train and then we came home on a British ship.
KK- Oh, from the mainland to here?
EB- From the mainland we went to Vancouver. And those days they didn't allow Chinese in, I understand.
KK- From where you guys originated, the boat?
EB- Went to Vancouver. Except I think there was a strike or something so we came home on the British ship. So my sister who looks, one sister looks more Chinese, my dad would pull her hat down. We used to wear tams those days, now they call them bearings. We went to Vancouver we came home on the British ship, the Orangy so my sister stayed in the room all that time because…
KK- Not suppose to go roam around.
EB- No because Chinese yeah because I, I was surprised. So when we came in the Hawaiian band was playing.
KK- The Royal Band?
EB- Royal Hawaiian. And my mother went school with Lena Macheta at Teresa Malani.
KK- Oh so she knew them.
EB- And they were, Teresa Malani was singing and when Mama got off the ship she said, "oh look!" And she recognized my Mama. (laughing)
KT- Kamehameha contest, Lena Machado.
EB- Umhmm, Aunty Lena. That Greek girl, that's my grand niece. I can't pronounce her name she led the Junior co-ed I think.
KT-Wow.
EB- That's uh, Nahulu, you know Nahulu? That's Eli's, I mean that's the niece.
KT- Eli Nahulu now in the Big Island?
EB- Yeah. Elias' sister is married to my brother Paul.
KT- Oh wow.
C-Yeah they live in Nanakuli. You comfortable? Oh, can I get you something to drink?
KK- No.
KT- We're good, we're good.

KK- So you know when you guys came off the ship, so the Royal Band was playing music on the dock, Aloha Towers?
EB- Hawaiian Band? No right at the pier.
KT- Pier 35.
KK- Pier 35.
EB- And when Mama heard the news she was so aloha, yeah. She was so happy and Teresa Malani said here yourself. My mother, they would just group together you know with Lena Macheta. And Mama said Lena Machado she don't want to study, she only wants to sing.
KT- I had many students like that but that's the Hawaiian nature.
EB- Yeah really!
KK- So you said that they called this place Makawaohema, Makena?
EB- Yeah. Makena, Ulupalakua and Kanaio; that's the district. So when Kahu Kukahiko, before you know um….Oh I forgot her name, she was a Hawaiian Kahu, she used to ride the horse just to go out to these Hawaiian churches. That's what Kahu used to do so we would take turns. One month…
KK- Oh, so you would rotate.
EB- Yeah, that's how my kids saw the island. Every summer they would come up and stay with my mother in law.
KK- They would go by horse.
EB- Before, I forgot her name, we did something at church and we got…. She was from Hana and she traveled to all the churches Upcountry by horse.
KK- Not Aina yeah?
EB- I forgot the name.
KK- Not Janie Aina.
KT- Maybe later on you'll get it. Like I said we're going to transcribe this, come back to you, maybe by then you might have recalled the name and we can put it in.
KK- So no wonder Papa Kukahiko used to go all the churches 'cause he went Honokahau, Honolua, and now he come over here.
EB- Yeah Kahu.
KK- And he came by horse him?
EB- He traveled by horse. I don't know if he did but I know the old Kahu's before used to come by horse.
KK- You know when you said the cowboys used to come for Ho'ike yeah? So those guys from Kanaio, Ulupalakua, Haleakala area they're like, Haleakala like Keokeo yeah.
EB- Yeah up that country that's what Mama would say. We used to call up that place, we used to call 'em Beverly Hills.
KK- Oh, up there.
EB- You know across the landing, not by the landing. Where Eddie boy, where Uncle Eddie had his, they used to have a old road go up.
KK- Right, right, right. Right up here on the hill.
EB- Yeah, so that was all our family, Hawaiians all cousins and so we used to call that Beverly Hills, Hawaiian Beverly Hills but they would come down on the horse.
KK- They refer that to Beverly Hills because they had the la'i, the la'i or because they had plenty stuff?
EB- Oh no because, because Hawaiians. You know why because the haimakamaka's used to live on the hill, yeah.

KK- I can remember when I was small my aunty is Aunty Maybeloa.
EB- That's my mom and dad up there.
KK- The one by the bowl with the glasses?
EB- That's my father with the glasses and my mother. And those are all my kids.
KT- So you're kids went Kamehameha School?
EB- Two, the two boys. You see they have the uniforms. Oh my daughter too; Gretchen, George and Everette.
KT- Can you remember what year?
EB- George was '69 and I think Everette is '72. My daughter fell in love so she didn't want to go back to school, that's when she met Burt. Heidi went to Kaiser. She used to baby sit for Angus yeah, in Honolulu. And Gina, Baldwin and my son on that went to Lahainaluna.
KK- Keven?
EB- Keven, uh huh.
KK- Well, that's where Wailana went over there. Wailnana graduated from there. Wailana worked down the beach with Hokuloa.
KT- Hokuloa?
KK- Hokuloa.
KT- Oh, right now?
KK- Wailana, yeah.
KT- Right now?
KK- Yeah Wailana work on the pool and Hokuloa work out on the beach. They same height.
EB- This is my brother in law, Ed Kalahiki. You know Arthur? May Parker?
KT- I gotta see the…
KK- Oh, good looking guy.
EB- Almost all family.
KK- He look like Danny Kelekini, yeah?
EB- My brother in law?
KT- Where were they living?
EB- This was Maui and that was the Hawaiian Civic Club. Aunty Ellis Johnson was our song leader and Uncle John Wilmington was our prayer and he was a representative for Kamehameha School too, for years.
KK- Uncle John?
EB- Uncle John Wilmington.
KK- The one with Na Kai Ewalu? The one the house on top Sand Hills?
EB- Yeah.
KK- Da kine, the daughter selling 'em. That's uh Charlie's….
EB- Tamalei, try look at Kahakuloa.
KK- What the name?
EB- Tamalei uh, she married haole but she's a Chang.
KK- That's Uncle Eddie's sister.
EB- Eddie's sister, uh huh.
KT- How many of these people passed away already?
EB- Ellis Johnson, she's gone. She's gone.
KT- Who's this?
EB- Oh she's um, Awai.
KT- Awai.

EB- I don't know about her. Aunty Angie Luuwai, she's gone. This is Kealoha Lake, I don't know.
KT- Passed, passed.
EB- I forgot her name; Momi, I can't think of her last name.
KT- Momi, Momi…..Kalehuawehi, Momi. Uh, who's this?
EB- I think Edith Wong.
KT- Oh, looks like her. Is she still living? That's boy Kanae's mother.
EB- Yeah, no she's not living.
KK- No she's not living, she passed on.
EB- I was just talking to Yvonne at the funeral we went to.
KK- Who's funeral?
EB- Who was that that died?
KK- Recently?
EB- Yeah recently, just a week ago.
KK- At Waiola Church?
EB- No, was at Norman's. That was Sandy and was um Saul Hoopii. Saul yeah, that's family too.
KT- Who's this?
EB- Um, she was married to.
KT- Still living?
EB- I don't know. I haven't been seeing them in years.
KT- Who's this?
EB- That was Gertude Mahi. That's me and this is her husband.
KT- Okay let me go through this whole line and then we come up here.
EB- Oh, oh, oh. This is La'a, um Aunty La'a. Aunty Alice Kululoio's sister.
KT- Oh wow.
EB- Pat Trask, Betty, I forgot, Betty Biga. I forgot her name.
KT- And the men.
EB- That's Jimmy Biga, that's her husband. Uncle Wally Kulaloio, Uncle John Wilmington, and this is Moggy Kulaloio. That's, he's I don't know, Sgt. Mahi. And this, I forget.
KK- What school is that?
KT- No, no, this is Civic Club.
KK- Oh, Hawaiian Civic Club.
EB- Hawaiian Civic Club, yup. Oh, I cannot even think of; I forgot his name. Oh, Mafea__ forgot the first name.
KK- Better get that guy the picture, what's his name? What his name, the Hawaian Civic Club guy?
KT- May I take a picture of this?
EB- Sure.
KK- What the guy name, the Hawaiian Civic Club guy now? That, I'm trying to think that guy, that guy! The guy stay in the school, MCC. The president of um…
EB- Not Kewani yeah?
KK- No um, what his name? Kumu.
KT- Is he Hawaiian?
KK- Yeah the one in your halau.
KT- Oh, Louie.

KK- Louie, what's his last name?
KT- Hokoana.
KK- Hokoana, yeah he the president.
EB- Oh, Hokoana, oh! Oh, yeah Louie.
KT- What was the name of this Civic Club?
EB- Maui, Central Maui Hawaiian Civic.
KK- What is this, Fast Pitch Club?
EB- That's mama and daddy in there.
KK- Oh, who's that baby in her hand?
EB- I don't know and um….
KK- He paele looking yeah, your dad?
EB- That Podagee, he's Podagee, white Podagee.
KK- Oh, what that, he look dark in that one, yeah? What is that? National Federation of Republican Women? This is yours.
EB- That's my husband's, my husband's.
KK- Classmates?
EB- No that's my class.
KK- Oh, that's Kamehameha.
EB- My son when he was playing football.
KK- Who's this Linda Lingle? No that's you and Lenor.
EB- Yeah that's me and my, who that Au?
KK- Yeah.
EB- So John. This nice yeah, look like Kahoolawe yeah?
KK- Yeah, it is Kahoolawe.
EB- Yeah.
KK- Who's that?
EB- It was just a painting.
KK- I think that is Kahoolawe.
EB- And that's our church.
KK- Oh down uh…
EB- Keawala'i.
KK- Oh somebody made a painting of that.
EB- Who taught you to ________?
KT- I did.
EB- What year you graduate?
KT- I'm a '60 grad from Kamehameha.
EB- Oh, '60. You know who's Agabu?
KT- Agabu?
EB- Kalahiki, he's the Cazimero's class.
KT- Oh he's '62 and '63 then. Roland and I together wrote the Hokulea album. I did the words and he did the music so we've always been close.
EB- Good boy. He was close to my nephew um, Kalahiki. We used to call him Agabu.
KT- Anyway, you move here at what age?
EB- We moved here in '62 I think.
KT- Sixty two.
EB- My husband transferred.

KK- At 32, she born 1930.
KT- So when you moved here, this wasn't the original place you moved to yeah?
EB- Oh no, no. We lived in Kihei.
KT- And you've seen a lot of changes?
EB- Oh yeah.
KT- What can you recall when you came here that was still exisiting?
EB- Was not developed. We came on the old dirt road.
KK- That's the one the bottom of the Maui Prince.
KT- How did you come on the old dirt road, car?
EB- That's only road they had. Yeah, I was a; Tutu Man Kanoho, you remember him?
KK- If I see the picture maybe.
EB- He used to live behind, across you know the back, Kanoho.
KK- But you know who I know that used to be over there, you know Malama? Malama Chun? He used to live by the dirt road over there the family, the grandmother and the grandfather. Chun.
KT- That's a nice pose can I take your picture right there?
KT- Your hand just like that it balances everything as you keep talking. So don't even think of me taking your picture. Do what you just did, it really makes the…yeah and just look at Kimokeo and keep talking.
EB- Um, that is what?
KK- Well you know the house you used to have by the Makena golf course? Had right where the convention, the turnaround stay? That was one house, yeah. But used to have or that was um…
EB- Remember when my husband was fighting for the road?
KK- Right, right.
EB- Fighting all these haoles.
KK- Right, I remember that.
KT- How did you folks get this land here?
EB- We exchanged My husband when he was dealing with them he said, "The Japanese think only haoles and Japanese are smart." You figure anybody darker stupid.
KT- Now he's talking about himself because he was haole, right?
EB- So my husband he said, my husband laugh, so exchanged the property. We exchanged. I used to own all of this but my husband knew because of the taxes in the future that was like to help us out in case so that's why we sold. So the attorney that made up, that set up the transactions, he didn't physically go look where this property was. This was for the show gun. who owned stables. So real stupid, yeah? They stupid because this was I heard right on the water.
KK- Yeah but I think they're style of doing business was get it done for what they wanted.
EB- They thought my husband was one dumb Hawaiian, really.
KK- That's good though.
EB- I gotta tell you this about my husband. My husband was accused, I don't know, but we were reading about this couple's fired had all the headlines because he, um malicious conversion. And I think that was in the '60's and we, I told honey…
KK- Was he on Lanai then?
EB- No he was Maui. And you know because he used to work at the jail and those, the old cars they towed in, my husband used to be a stock car driver see so he loved cars. So he had

permission anyways so the accused him of malicious conversion. Actually that was politics and then when we had the case at court they brought in the FBI. So that was to intimidate us, you know. My husband had two cases we went to Supreme Court. The first time we went our attorney wanted us to be visible because normally when you to Supreme Court, I used to work for a law firm at one time, you just send the briefs. So I knew Judge Richardson because I used to stop by his office, he knew my dad, but he didn't know who I was and my husband. So instead of sending the brief our attorney wanted us to be visible. So my husband and I so we went there and Richardson look at us said, "This ain't no malicious conversion. Maybe Keoki pa'akiki."
KK- No listen.
EB- Hard head. And we won unanimous, two times we won case in Supreme Court.
KK- The brother live up here, eh George Richardson's brother? The brother, Judge Richardson, the brother live up here in Haiku?
EB- Oh yeah, I don't know him.
KK- Bo Richardson, uncle Bo.
EB- Oh, I didn't know they were related.
KT- So, are you folks land taxes high?
EB- Oh yeah, extremely.
KT- Okay. Here is inside information that is on the law, on the books. That any property owner plants kalo plants, it doesn't state how much, their land taxes will literally disappear. Something for you to consider. Put kalo on your land then when you declare, you can show you have kalo on your land.
EB- Yeah because I got six acres further down.
KK- How much acres?
EB- Six. But that's where we had the farm, you know George used to sell duck eggs and chicken eggs.
KT- So consider that.
EB- That's where we have the horses.
KK- Yeah, yeah, yeah. Waipuna stay over there.
EB- But my husband, he don't sell 'em. He give to Kupuna's.
KK- I remember he was giving eggs away.
EB- Yeah, we just give to the Kupuna's and you know.
KK- But Waipuna stay over there yeah?
EB- Yeah, well he's here and he's there.
KK- Yeah, is he back working construction?
EB- Yeah.
KK- That's why I don't see him.
EB- He just started again.
KK- Good for him.
EB- Yeah, that's good.
KK- Yeah.
EB- And he told me he was praying on it. Yeah, that's good.
KK- Oh good. Anytime our kids pray on something, that's one thousand good for us.
EB- Well you know, we were always brought us take it to the Lord in prayer. My mother always said, "have faith." Mama just like my mother in law, Kupuna always pule yeah?
KK- Always.

EB- Yeah, and Mama was very positive.
KK- When I was paddling canoe, every time we went the older guy always tell everybody, "come, come, come." Then everybody in prayer, and then go paddle. Everybody go home.
EB- That's the point. Hawaiian they always pule before they go in the ocean.
KK- Yeah, and then go home.
KK- Make the paddle clean, make the canoe clean, make up all the place make sure all the rubbish pau then we go home.
EB- This is my husband.
KK- Stay over there, right there Kumu, right there him and her on top the wall.
EB- That's him.
KK- And then on the right and him on the left.
KT- Take picture of that.
KK- And that's her mother and father up there on the bowl.
KT- What is your home phone number, what number can I call you at?
EB- 879-3034.
KT- You got a cell?
EB- No.
KK- But the, um you need her address Kumu?
KT- No.
KK- You know this guy you had in the front here, he paddle with us you know.
EB- Which one? Who?
KK- The caretaker.
EB- Oh for that house.
KK- Yeah, what his name. Yeah, he paddle with us, yeah nice guy.
EB- Oh, that's good.
KK- They're pretty quiet over there nobody stay there yeah?
EB- We're having a family reunion next year.
KK- Over here?
EB- On Maui, we rotate. Mainland, Hawaii I let you know.
KK- Yeah, let me know if you need help. Yeah, then we can help with the….
EB- Come dance hula.
KK- We can help with the kalo like that so you need the luau let me know, I get the luau leaf for you.
EB- You know Heidi yeah? You know Heidi and Dexter yeah? Au.
KK- No, maybe if I see them.
EB- My Heidi that's, the Chinese. Dexter's from Hau'ula.
KK- Oh, but we stay in Honokahau yeah. Remember before I told you I was looking for the property. So I got nine acres in Honokahau. So we stay doing the Lo'i.
EB- Good for you.
KT- How old was your husband when he passed away?
KK- How long was that, four years?
EB- About five years.
KT- So how old is he now?
EB- How old do you guess there? Oh, he was about 67 I think.
KT- Sixty seven, what did he pass away from?
EB- He had a heart attack.

KT- What kind of diet was he eating?
EB- My husband was always in good condition.
KK- Oh, your husband.
EB- Actually, don't quote me now. My husband died because he was without oxygen for 2 minutes and he cannot live longer than that. So I went take him and he waved to me and they went down. And when they came back he was sleeping. My son tried to make a case, Everette, and attorney wasn't going come from Hawaii from out of Hawaii. So I had to subpoena the records, couldn't get it.
KK- Really, funny yeah?
EB- My son Everette, that's the one the cop. Right now he's in Korea.
KK- What he doing there?
EB- He's in the Air Guard too see.
KK- Oh, wow.
EB- He was in Japan and now he's in Korea. That good you talk with him.
KK- My boy is in da kine, Korea.
EB- Oh, Everette married Kau'i from Kauai. Wilfred.
KK- Yeah from Kapa'a.
EB- Yeah, nice family the wife's Japanese.
KK- He was a cop to I think, Wilfred.
EB- I think one of the sons. She used to be the operator at Coco Palms before.
KK- They went reopen 'em you know?
EB- Yeah I saw them they were…
KK- They going reopen yeah, Coco Palm you never see?
EB- Oh, good.
KT- So back here did you walk around with your husband just looking at the land and stuff.
EB- Yeah, that's what we used to do we used to walk around there.
KT- What cultural things did you see there? Maybe your family said oh that was Kuula or fish rock or that was heiau or that was…
EB- In regards to Hawaiiana I was so ignorant but my mama, my mother in law would like I saw things I never saw before and you know. Like Mama one time, during the summer my children used to come up here. Then Everette got sick so he came home but Miriam you know who she is?
KT- Yes.
EB- Okay, when they took her to the hospital Aunty Miriam said that was Hawaiian sick. And so my Mama pule. Pule, three days we fast yeah, pule and she was all right. And then when we came Mama said because living, and Kaupo Mama said they worship the old way.
KT- Yeah.
EB- And um, when my husband was the baby Mama said they were fishing and the night marchers were marching and my husband went and Mama said was nearly dead but because had ohana in there he was all right. And you know I never used to hear things like that but I remember my mother, my mother, said she remember when she was young. Mama they used to live on Keanu Street in Honolulu and mama said they would hear the drums and they would hide. Don't look yeah, Mama said. Just pule. Eh, I mean you don't hear things like that but trust in God yeah. Mama was at Sacred Hearts yeah. And then um, we had one class reunion, and some of my classmates you know when we meet underneath. We never did talk about those things before. I didn't know till I learned more from my mother in law family. Mama always

pule and always make things. Like we were taught my mother, always make things right if we whoo, whoo, because we might never have another chance to do that. We were brought up like that, yeah. We never used the word shut up you know. I not saying we were angels but that wasn't our vocabulary because not even dumb or anything like that. And um, I know every month we took an opening, but not only us you know, we grew up…
KT- What included in the opening? What kind of opening?
EB- Well tree nut, you know castor oil.
KT- Okay castor oil, homemade or the store?
EB- The store you know that blue bottle. Anyway, when we grew up nobody went to the doctor. You didn't have medical. Even the Portuguese, it's like so we were healthy. And we walk, walk, walk. We walk to town from my street, we walk home. Walk. That was a luxury to ride the bus. But our generation that's what we did, we all walked. And then during the summer we worked in the cannery. You know us to earn money we used to iron clothes; baby sit and my brother's would shine shoes. You know had the military here too yeah and we would iron clothes for soldiers. Baby sit. One dollar.
KT- So when you folks transferred over here your husband continued in the police force and then some other things. What did you do during that time, housewife?
EB- No I used to work at, I worked at Maui Lu. I worked at Buzzy's. In the morning I used to cook breakfast for George Tam, he had a restaurant. After that, when my husband was fighting his case.
KT- Where was the restaurant?
EB- Oh, on Lower Main someplace.
KK- Chinese Restaurant that?
EB- Yeah this was George and the wife was related to my husband.
KK- Donna? What her name uh, no, Dorly!
KT- How come your husband is haole but he related to everybody over here.
EB- My husband is Podagee.
KT- Oh, Podagee.
KK- Ferriera.
EB- Ferriera.
KT- Okay, so that's his genealogical line.
EB- My husband's Portugese Hawaiian.
KT- So his family came here straight from Portugal?
EB- Well, I don't know when daddy came, my father in law.
KK- What was he like?
EB- Oh he was rascal. I remember my husband telling me they cleaning the yard yeah. And they started to cut the grass and mama valaau, valaau he'd get irritated. Put the lawnmower down he go get the scissors cut the grass. (laughing)
KK- He went take more long.
EB- Oh, and Mama said, you know Mama. Well, Mama valaau too much daddy him, and my father in law he so rascal that, you know Podagee. Mama so….you stupid Podagee. My father in law, I think there were twelve they came from Madera. And about half marry Hawaiian like Kapuneai and um anyway half them marry Hawaiians. My young son Steven, he used to cry he not Podagee, my young used to cry he not Podagee, he not Podagee. And I said, you Podagee because daddy Podagee. So my husband tell 'em, " I'm black I'm Hawaiian, mommy Podagee."

(laughing) But like I said you know, we all the same, we all family. Podagee whatever you know. But that's the beauty of Hawaii, you know.
KK- My mother's mother, she's pure Podagee. Costa, and her family was Perriera, Ferriera, Mederios from Kauai.
EB- By the way, how's Jean?
KK- Jean? Oh Kelly, oh good. She stay in Honolulu.
EB- She was a student with my husband. You know when they came?
KK- Yeah, yeah, yeah with Kamehameha. Her daughter's teaching.
EB- She just hug my husband, my husband said she so tough I think you doing break my bones.
KK- You know why yeah? You know why the wahine's was building stone walls over there. You know for their house, while the husband go catch the animals and I stay outside working When I went go there with my father, our cousins, the wahine's they was lifting up boulder's they was putting us to. All the stone walls around the house is the wahine's. That's why she broke your bones but her daughter is the….
EB- She hug my husband, she came church, it was so nice she came church you know came to our church and then we was taking pictures and my husband he was telling, "whoa that Jean was this strong bugga that. Eh Jean it's okay we need people like you." (laughing) Kule kule waha.
KK- Her daughter is the principle now. You know the one graduate in the song fest? That her the principle.
EB- I was watching that lady from Niihau, she was talking about, you know she's so polished in her English and her Hawaiian. And when her children were first going to Kamehameha School's was so interesting. She and Kelly went to school with my husband but she was underclass. So one year we had three of them from Niihau came to visit the Hawaiian churches. You were there yeah? Then she came to our church. Our Kahu was Kamehameha too.
KT- Where is that?
EB- Um Keolahoalika.
KK- Alika.
KT- If you had control of life, what would you like to see that continues on here in Hawaii? For here in Makena. If you had control.
EB- I want to see more brown people.
KT- We no more control on that. We no more control on that. This guy going with haole, I going with haole no more control.
EB- No I remember when mama was all, and the men were much thinner, taller and healthy. And I remember when we have luau mama said the men, the men take charge they do all the, you know. And then they would delegate to each family and we then the Kupuna to my husband and he tell us children how to work. It was so orderly yeah? That's why you know Kahu he wants another luau and I tell him oh, look at our choir, mostly Hawaiians. I said "come inside, come inside." "Oh aunty all white, they not mud I see all these white people." I said, "you know what I check their blood red, not blue." So I told my choir, I told them you folks were all Podagee. They haole's yeah!
KK- But they're there, but they're there.
EB- But they love and they're willing to learn the Hawaiian yeah.
KK- So he like make one more luau?
EB- Oh, for our anniversary. For our 175th anniversary. So I wrote a song, well I didn't write it down but I was telling Kahu about the words.
KK- What is that?

EB- Um. There stands an old Hawaiian church in Makena. All the kings tied together like me. Keawala'i by the sea. we have come to worship thee.
KK- Oh, that's nice.
EB- Keawala'i which means peaceful bay along side the king's highway. Where the birds chirp in the trees and the sky meets the sea a feeling of peace and tranquility.
KK- Oh that's beautiful.
EB- Keawala'i where our Kupuna gather to pray and our ohana meet still this day. Surrounded by God's beauty and his glory, where we stayed and prayed and shared the old, old story. With our ohana from across the sea we praise and glorify thee. Aloha keakua at Keawala'i.
KK- Oh that's nice.
EB- Aloha Keakua Keawala'i.
KK- Is the guy playing the piano still over there for that?
EB- Danny Brown, oh he's good. He's so good, he's so inspired.
KK- He played that song with you.
KT- Please copyright that, you know how to do that yeah?
EB- I call you. I not ma'a.
KT- All you gotta do is put it on cassette tape and send it in to the copyright that song.
KK- Try sing that.
EB- There stands and old….by the way you know who um, Kamana, you know Creighton yeah, the sister? Yeah, Creighton and my husband they go way back. He was Kamehameha but he was done with it. And they were all on the police force. I think when they went in had Lai, my huband, Creighton.
KK- Had Long yeah was here, had Long.
EB- Most Hawaiians that went transfer to the police force.
KK- Then when they was doing that they had the brown uniforms. The Maui police they had brown uniforms they never had like the army blanket.
EB- That wasn't like Honolulu yeah?
KK- No.
EB- Yeah that's right.
KK- And you remember Long? The big boy, he was a cop.
EB- Yeah.
KK- Cause, he went like arrest us in Lahaina. And we told him, he told us we took somebody's surfboard. I said no we never take nobody's board. We don't have a board. And then aunty Emma Sharp.
EB- That was a luxury yeah.
KK- And aunty Emma Sharp was my first wife's mother's good friend.
EB- First wife? How many you had?
KK- Two, and her name was um…
EB- What you marry, haole yeah? Two haoles.
KK- Haole Hawaiian, haole. Elizabeth, her name was um, Elizabeth Morrison. She was close and aunty Emma Sharp sister still live yeah. You know her sister, she's a writer.
EB- Aunty Emma gave me a video of the family.
KK- Right. So you know that, she going be 91 I think yeah?
KT- Who?
KK- Aunty Emma Sharp's sister.
EB- She died yeah.

KK- No, no, no.
KT- Make.
KK- The sister?
KT- Aluli.
EB- Oh aunty Erma
KT- Yeah.
KK- No, Aunty Emma make but….
KT- Her plus Aluli passed away.
KK- When was that? But she was a writer yeah Kumu. But just recently?
KT- No, couple of years.
EB- So I wanted to show my family the video because it reminded me of us. I said you remember we always loved to sing and we do things together and um. So when we used to have every Thursday at Maui Lu, you know Jesse played?
KK- Oh yeah, Nakaoka. the luncheon. The luncheon.
EB- Aloha Mele.
KK- Aloha Mele.
EB- Was that and Aunty Emma would Emcee. Hawaiian would fly them up free. And to Kupuna they going imu, so I would work late. Was good, good fun with the Hawaiians. And the Long house was packed. Our capacity 512 but we had over 700.
KK- Well he had a big luau following yeah. And then the luncheon…
EB- When Mr. Gibson was there yeah. And we had good dance music.
KK- Yeah, and he had a good show. Everybody used to go there. That was like the luau thing of the island.
EB- I just remember we had that on all the time.
KK- Oh, that's all right. Try sing that song one more time, one more time. The Keawala'i Church, the one.
EB- There stands and old Hawaiian church in Makena. Follow the King's Highway to Keawala'i. Keawala'i by the sea beckons to you and me. So we have come to worship with thee. Keawala'i which means peaceful bay. Alongside the King's Highway where the birds chirp in the trees and the sky meets the sea. A feeling of peace and tranquility. Keawala'i where our Kupuna gather to pray and our ohana meets still this day. Surrounded by God's beauty and his glory. Where we sing in praise and share the old, old story. With our ohana from across the sea we praise and glorify thee. Aloha keakau at Keawala'i. Aloha keakua at Keawala'i. Sound all right?
KK- Oh that's beautiful!
KT- What is the title? Okay this is what I'll do for you. Take what you just did and write it up, try to capture the music, I'll bring it back to you, you sign the papers and send it in to be copyright. It's a beautiful song. You should have it copyrighted before somebody go out with it.
EB- You see we have a 175th anniversary and the words kinda just came to me.
KT- You shouldn't sing it to anybody because today people…let me do that before you sing it to anybody else.
EB- Well, I gotta sing. I'm really an alto and then I, that's why I don't sing in the choir, I cannot reach.
KK- I can sing the last two words. Aloha Keakua Keawala'i.
KT- You get somebody who really can get it popular.
EB- What year you said you graduated.

KK- What time is it now Kumu?
EB- Can I get you something to drink?
KK- No, I just went pau drink plenty stuff.
EB- I like talk story with you. You so good Bully, you so interesting.
KT- Yeah but we like info from you. I no like him talking. That's why he's always talking. (laughing)
EB- Eh, you know my husband was the one started the Pony League and the Kihei Canoe Club. And that's when Papa Charlie and Aunty Plunkett yeah. And they do the Hawaiian way yeah. Ok, clean, pule before he go in the ocean. And then when the haoles. That day wasn't just to win, was to work together yeah? And when all the haoles got in they join they want to just win yeah. That's why my husband got disgusted.
KK- Aunty Paula used to tell me, Kalanikau, where they used to Kalua the pig by the Keawe tree, you know the big Keawe tree? Where they used to do all the thing over there. She come around, Aunty Paula. Get the Kalanikau face yeah.
EB- Yeah because when we moved here my husband noticed didn't have much activities for the kids. So the Pony League baseball my husband started. And of course you too would, the Hawaiians, had Kahauhaahaa yeah. I'm telling you before my husband said because he used to work with metro and vice yeah with Larry. One time had fight in Kihei cause you know how those hippies. Remember across the park had that bar. So had Kahauhaahaa and the Hawaiian's, who's the one the plumber? The cops young, cannot handle guys all these Hawaiian men come over there help, yeah. My husband cuff 'em, handcuff 'em and they would help them. But then when we had trouble, troublemakers as a lot of hippie's niele maha'oi, the chicken's, steal the goats yeah. I mean. One day Aunty Aida and mama we chasing this goat.
KK- That's what he had over there, he had goat too by the house, by the Makena golf course.
EB- Yeah we had goat, we had two goats. And then we were chasing, my kids chasing down the street because the goat. When you think about it it's not funny.
KT- You folks go fishing at all?
EB- Um, not me.
KT- No but did the family go fishing?
EB- Oh yeah.
KK- Yeah, George used to go. George used to go over here.
EB- No when mama and before Kihei, they know when going have fish. And Mama said plentiful so when the farmers come down they exchange. You know from Upcountry. And they would exchange.
KT- Nothing to be ashamed of, like I said your children will appreciate, your grandchildren will appreciate when they get to be because not too many people do these kinds of things.
EB- My grand daughter, she teach at Pulnanaleo.
KT- Right now?
EB- It's Everette's daughter.
KK- In Wailuku?
EB- So when I have to put things in Hawaiian language I call her. Shondelle Ferreira. Everette's daughter.
KK- Everette stay by the house by the corner yeah?
EB- So he's going; he'll live here when I'm gone. And everything's in a trust yeah. I'm trying to tell him to build a new house up there.
KK- How long is he gone?

EB- I don't know military yeah.
KT- But I hope you folks consider putting in kalo to lower your taxes.
EB- Oh kalo, yeah.
KT- And I'll try to get a copy of the law so your whole family including you look at that law.
EB- You know where the six acres yeah? You can go show him.
KK- Okay Aunty Eleanor, thank you so much.
KT- You were answering that question but. So what would you like for your family of the future? Again you know, if you had control of everything, what would you like to see for your family, your extended ohana?
EB- I want to make sure they all go to church. The children need to know the Lord, which they do because we are going to be accountable. And I know we're going to have hard times coming. And even Mama used to say that, my mother in law, "teach our children to be strong because you know that's the only salvation." Like sometimes our church we have a lot of widow's even haoles and they don't know anybody so we are our brother's keepers. So I'm a deacon at church so I introduce them and make them feel at home. Lot of them haole's and so sad so we go have lunch and valaau talk story and I invite 'em to my house and they so happy.
KT- So the son that I met over here, he goes to church then?
KK- Kimo.
KT- So Kimokeo tells me he works with my son.
KK- No his son, his son.
KT- Oh, his son works with my son.
EB- Oh, Wailana. Wailana yeah he's still. This one is my most po'o ka kiki. George's brother is rascal. George is the thinker you know.
KK- But hard worker, hard worker, he work all day.
EB- They all have their own talents. And this one he when I need help he's the one but short fuse.
KT- Like his dog over there.
KK- This boy graduate Lahainaluna.
EB- That's why you know, when we have our family reunion, my family Burns gotta sing Lahainaluna now.
KK- Oh yeah, well that's the only school get the Hawaiian alma mater.
EB- In Hawaiian and it's so nice.
KK- You know who working in the hotel with us, Hoku.
EB- Hoku.

Interview: Papa Chang

By Keli'i Tau'ā/ Kimokeo Kapahulehua

KT- Keli'i Tau'ä
KK- Kimokeo Kapahulehua
PC- Papa Chang
W- Wife of consultant (Mama Chang)

KK- Papapauka…There's Mala Wharf, right there we was over there.
PC- It was by Maui Prince Hotel, yeah?
KK- Mmhmm.
PC- But from this map, smaller maps come. If you read over here that's two one yeah?
KK-Yeah. There's the edge of the lava flow.
PC- And it doesn't clearly say Honua'ula but Honua'ula comprises most of this area. Yeah, but then you look at the like area seven. Map seven, right here. This map just to give you an idea. So you take map 2 one which gives you the names, that's one of the few maps that has all the old Hawaiian names yet, you know. And some of the old Hawaiian, you see this that's all Mahele's property that. A lot of it's been erased and changed..
KK- But you know these these guys they had um they in Hawaiian. The bureau conveyance they never transfer em because they was too lazy and they get 'em in records.
PC- Sometimes they better off to leave it that way. Somebody translate it, they change the meaning yeah?
KK- Yeah they do.
PC- Cause no more Hawaiian meaning. Hawaiian words are so clean by itself, yeah. They don't have legal terminology for so many stuffs.
KK- No more. No it's pretty much a spiritual culture terminology. And it's for the people over there, yeah. It wasn't given for the people everywhere. That's why everybody was indifferent in the ahupua'a. Then they can tell you who you are, what you are because they know your ano(nature)already.

PC- Ok, you look at this map this is the old Ulupalakua Road that used to come to Makena. Makena landing is over here, yeah? We're over here, you see that lot right there, that's our place.
KK- Like this kind lots, Keauhou.
PC- Yeah, but there's two Keauhou. There's this one and I guess this is the ahupua'a. But anyway then if you want to look at tax key seven, this area, that's what this map is. Just to give you an idea of what references you might be using, or we might be talking about. So this is map seven. See this is my lot right here.
KK- Wow. What's that in the front? The State?
PC- In front here? It's now State. Ulupalakua was claiming it.
KK- Oh, multiple claim.
PC- This is one long darn story. You know, Ulupalakua sold this property and sold Makena Landing which is all this stuff over here they sold it to my great grandfather. Kukahiko. John Kukahiko that's the one buried down here by the Kukahiko house. You know the big grave? This was John and Kamaka.
KK- By the beach?
PC- Yeah, on the beach. He was the one that bought this place in 1883. This place and this place. And then later on he bought some stuff back here. But then this lot and that lot he bought from McKee's daughter.
KK- Oh, the original people.
PC- Yeah but the story with McKee's daughter, McKee had a daughter and son. He passes away, he gives the property to daughter and son. The daughter, one of the daughters, well the daughter marries a Raymond who eventually buys Ulupalakua. Raymond passes away, she becomes the owner of Ulupalakua Ranch by herself.
KK- McKee.
PC- McKee. And then later on it's transferred to uh, I think Baldwin at that time. The Baldwin's wasn't the original owners. And when you start looking at who owned Ulupalakua Ranch before McKee, now before McKee is before Mahele, you know. Cause Mahele's start in 1840's yeah? We bought this in 1883 had passed away before that.
KK- Forty three years later.
PC- Yeah.
KK- Wow, that's not too far away, forty three years. From Mahele to….
PC- The story goes that much of the land that McKee bought, now we talking about approximately 20 plus thousand acres to 30 thousand acres. Much of that land that he bought was leased to McKee, not sold to him.
KK- By the Hawaiian's.
PC- Uh, no from Kaläkaua. This is before Mahele now. Oh, ok Kaläkaua's the one that give to Mahele.(correction-Mahele from King Kamehameha III) So he leases 'em when you go start tracing records it's hard to find how all property all got transferred to this one man. But somewhere along the line you'll hear of Talbert Wilcox. Yeah, Talbort and Wilcox were people that bought property to farm. The original farmer down here was one haole named Nolan. And then he joined Wilcox. Wilcox or Talbert I'm not sure which I forgot. I used to know.
KK- This Wilcox is the one same….
PC- But Nolan sells his interest so now Talbert joins Wilcox. So when you look at a lot of these maps, these maps were done by Talbert and Wilcox to claim the property that they thought they bought, or they thought they lease, and etc.

KK- They make their own map.
PC- Yeah, you gotta realize that a lot of this stuff that you see over here that's all been subdivided at one time by Mahele. And now comes one guy and he buys the majority of this property under one name. But he gotta go and keep these titles clear yeah? And back in the old days during my father's time you pay the tax for seven years, you're the owner. You no need put notice in the newspaper.
KK- Automatic. They take away.
PC- Yeah, yeah. You can become the claim owner. The quiet title process is changed. Anyway, come back to this story we were talking about when my father, my great grandfather buys this piece and this piece in Makena landing which is. Which, when you look at the map, it's this piece and that piece. And you question is, who own this? When we go try trace the owners. See what happened was my father thought, he always thought that Baldwin never own next door. This was way back after WWII. You know from Keawakapu all the way till this lot they went subdivide it and so had half acre lots all that stuff was sold long time ago. Had owner's already. So they took this land along the beach, and at that point in time Ulupalakua came through and they went stake this property, our property. What they sold to us they come through one stake to sell, to make a long story short. But this used to be the old Makena Road that came through here.
KK- Through the Prince Hotel?
PC- That's all part of it down there.
KK- Down by the beach yeah?
C-Yeah.
KK- Right over there come down through you?
PC- Yeah.
KK- That one come through, you know that Angus lot?
PC- By the hill yeah, yeah.
KK- The road come through there, that paved part?
PC- Yeah, that's the old road, this is the old road, a part of it down there. You see Uncle Charlie's place over there? That's the old road. Now that old road we call is, is not the old government road. It's the World War II road.
KK- Oh the military road.
PC- Yeah. Because if you read, you read some other stuff about this the old government road was in here. You gotta remember that Maui had a road completely circling the island.
KK- On the ocean side. The Kahakai Trail.
PC- That's right. That's the one we call the government road but it was built by uh, well they named the road now.
KK- Well you know it's funny because when we stay Kipahulu, this um this guy Teddy his mother's mother they had this property on the road. They show the road and the lighthouse, and Hana Ranch took 'em. Like Ulupalakua you know they call like how you state it.
PC- Well, you hear the story about the road in front of Prince Hotel, the one go past the church and dead end then circles around. And what's now an old road that they kept as a walkway, etc. That's part of the old King's Hwy, the old road, ok.
KK- Yeah.
PC- When the urbanized Makena area, the County and I guess in conjunction with the State, went take that road and swap for the new road. Now comes Dana Hall and Leslie Kuloloio and my father and George Perreira claiming that they don't own the road. It's the old King's

highway and nobody owns it except you know from the old days. It's a traditional road, leave it alone. You don't have the right to change.
KK- Hui O Makena.
PC- Yeah, Hui Ala Nui Makena.
KK- Wow.
KT- So, what came from that? They won the claim?
KK- No they never win.
PC- They settled it by leaving that area open but not for commercial traffic. But that road is still, it's a walk path, it's a pathway now and it dead ends on both sides. And then that George Ferriera got a big settlement. Hui Ala Nui O Makena got I think, two or four acres, above the golf course. Three acres. George Ferriera.
KK- Because we went to see Hui Ala Nui O Makena when we were starting up, they said was supposed to be for cultural yeah? And we like go over there with the canoe's, they said no, not for you guys. And the we went go see Roy Figueroa and he said, "oh I cannot discuss that." So, was me and Jimmy Ross because we wanted to go for the keiki.
PC- Yeah I think Hui Ala Nui O Makena has the place of what it is to be used for and how it is to be used which is according to what I understand is a cultural thing. But, I don't think 500 thousand is enough money to do what they had intended to do twenty years ago. You know, dollars have changed yeah?
KK- Well, they're doing the same thing as Olowalu now, taking on King's trail. The County taking on King's trail and surrendering that for something with them so. Aunty Patty just called me yesterday and I said I dunno you gotta get.
W- On the King's trail?
KK- I don't know some road that belongs to the Hawaiian or city land and then the county went swap with them or something just recently. They still doing that today. They doing the same thing down at Haiku on Holokai Road. Holokai Road was a King's trail along the ocean and they kinda gave it to the subdivision, the county. You know what I mean? And people fighting over there because the owner's stopping the fishermen from going inside. And they been using that trail for years.
KT- So the Ku'ula next door, by the hotel.
PC- Yeah.
KT- You guys ever relate to that?
PC- Which one?
KT- When you walking down the path to the ocean.
W- Kukahiko, you mean by the graveside?
KT- It's just sitting over there by itself, going through the hotel, what is that hotel.
PC- The Prince Hotel?
KT- No, no, no.
KK- Makena Surf.
KT- Makena Surf.
W- Oh, the little cove there.
KT- Get the Ku'ula right there. Any of the family ever use that over there? It a fishing shrine, they got it locked down.
PC- Yeah, yeah. We used several things. One they got a canoe hale the other is the fishing shrine. I not sure what the proper Hawaiian terminology was, but back in the old days when

they, before they start closing that area it had stone wall built around it. It wasn't very large maybe it was you know.
KK- This hale's over here it's all separate hales for your brothers and your sisters. Kukahiko one is everybody?
PC- No. It's not everybody. This place my father bought from the Kukahiko's. The place that's down there that we had built, that I had built for the Kukahiko's. I was the President at that time for the Kukahiko Corp., the remaining heirs in the Kukahiko Estate that still had Kukahiko property. See most of the Kukahiko property owner's sold their shares. They sold their share to Jimmy Campbell, and the houses that you see up above Makena Landing and all those houses that you see before the Kukahiko house, except for the Lu'uwai house, was all sold to Jimmy Campbell. Kukahiko got two lots out of that place. Two of which we sold and we built this place down here. But the remaining owners incorporated it because they didn't have a large enough share to have one legal lot. And there was some sixty owners at the point this property was finally awarded to the Kukahiko Corp. There was sixty owners. Now there's a lot more because there's more keiki's yeah. Cause that stuff was awarded back in 1974. Well this one here, this was my father's property that he had trusted to his kids. And what we intend to do is to have a family subdivision here.
KK- That's nice, probably going be only the local family left around here.
PC- Yeah. But one of the blessings that we had is my father, the State changed his taxes. Excuse me, changed the zoning, this place was all ag. The State came through and they said, "on the water side it's rural. On this side it's agriculture." And then his taxes went up as a result of the change makai side of the road to be rural. Of the old road, this road here. So, he went to court, at first he went challenge the taxes, they wouldn't allow it so he went to court. The court gave him ag dedication, which I still use. So I pay for where the house sets but all the rest of the stuff is ag. So I hardly pay any taxes, I don't pay the taxes like the Kukahiko's pay.
KK- Awesome!
PC- So as long as I do some kind of nursery and some kind of ag, which we intend to do, our family subdivision going be, we'll build on the ocean side and the side mauka on the road will remain ag.
KK- What's the ag right here with all the trees?
PC- Yeah.
KK-Those trees was always there long time I remember now bigger the trees.
PC- Yeah, well had papaya here before. Before that my dad raised alfalfa. there's a well down there. Built by one of my dad's brother's in 1920.
KT- Still get water.
PC- Oh yeah, yeah. The water's not as good anymore, they dug too many wells above us and I , no what I think what happened was if you dig a well too deep you hit the fresh water and then you think you going dig a little more and you going hit more fresh water. Sometime you hit the salt water. And once that salt water mixes with the fresh water everything down below gets mixed. And I think that's what happened. The water used to be colder, not as salty.
KK- Too many guys digging. They splitting 'em up maybe.
KT- For the record can you give me your full name.
PC- Edward Quai Ying Chang Jr.
KK-Quai Ying Chang?
PC- My father's name father was Quai Ying Chang.
KT- Try spell.

PC- YING CHANG.
KT- I don't know if Kimokeo told you, our kuleana is um, we're going to have this transcribed come back to you have you look it over make sure everything ok and submit it as part of our work. I'm going to make sure we got everything.
KK- Oh that's Stan Garcia's place? They going subdivide? They doing it already?
PC- They're in the process.
KK- I seen 'em at the church. Because this place over here stay…..
PC- I mean you got, you got a heiau in there yeah.
KK- Yeah get, eh? Right in front the house?
PC- Behind. Well, next to him, next to him the Garcia's is David Lono's place, yeah. Old David Lono. And had one old house with the swings in there long time ago you remember? It's torn down now.
KK- Had all ducks and animals all running through there?
PC- Yeah, that was George Ferriera's place that he got from one of his aunt's, or our aunt's, Mary. So there were two plots in there in front which Farrington them bought already.
KK- They went subdivide already.
PC- No they bought. And now they're going to put, uh I don't know 4 houses or was it 2 houses. Four houses wasn't it. And then Sam Garcia's bought the church from that, yeah?
KK- That one they went go get the meter before the lot to divide it because you can do that. So they got their meter before get the lot subdivided. They get all the meter. Then the question was brought up how come you guys get the meter you know you never even sub.
PC- Who is this, Sam? Or Farrington?
KK- No, Farrington. Going get all the water meter for that lot.
PC- Yeah because what Farrington does is he builds individual houses but he condominumized the area so that by condominumizes the area he can get lots to supply each building. Not lots, meters, to supply each building. It's a State process.
KK- It maximizes the lot.
PC- Yeah, yeah. This Makena place over here you look all individual houses but they condominumize. The house owner owns the property the building sits on but everything else is condominumized.
KK- But the one next to Kukahiko they only going build one house, eh, those people. They went make one lot on there.
KT- So how old are you now?
PC- I'm seventy four.
KK- Whoa, young man. And you, mama?
PC- Yeah.
W- I'll be seventy three this month.
KT- And you lived here all your life?
PC- Uh, no. No, I moved here about age four or five I'm not sure. I can't even remember that young.
KT- Where were you born?
PC- I was born in Wailuku. My dad, my dad worked for Kahului Railroad way back then. Then he got tired of working till somebody else came back and started farming. That's about 1937, I think. All my brother's and sister's were raised down here from kid time but I wasn't raised here till about four or five years old.
KK- But Norma Lei went go Kentucky.

KT- Who were your neighbors?
PC- Mostly family, the neighbors uh, we came down Ulupalakua Road yeah.
KT- So give us some names.
PC- Uh, well there's my great-great grandmother which was a Haihai and then her sister Moloa, who lived down Makena landing. And later on the World War II came they throw all those houses down and then John Lu'uwai came down. John is Boogie Lu'uwai's father. And then across the bay there was Piho's, the Piho's lives now where Dogul lives, you know where Dogul Milney just before the church.
KK- Oh yeah on the top the hill.
PC- Yeah and then where Eardmen lives now, Eardmen's house is, that's the place they call Apuakehau where the Hau tree is. And that, that island out there that I don't know it's referred to as my father them referred to Dickson island but I think at one time it was owned by a guy named Pikanela. Pikanela was the Chiefs down here, the Ali'i Chiefs down here Makena area for that Hau.
KT- Doesn't sound Hawaiian but.
PC- That's a funny kind Hawaiian name and he's recorded as Pikanela, yeah. And Boogie said you know that word means something but we forgot already yeah.
KK- In front there get one fish pond?
PC- Between that island and Erdman's road or Eardman's house there's a fish pond, yeah.
KK- Get one fish pond yeah over there. Cause get on the map all the fish ponds, yeah.
PC- This is that island I'm talking about, this is where Eardman is right. No, no wrong side, wrong side, this is the church yeah? Uh, the fish pond is right in here, right in here, right in this general area. If you look it's got all kinds of rocks, low tide.
KK- This is where we went with the canoe for the funeral?
W- That's right.
KK- That's why I asked you about that, because that day I seen all the rocks in here. Was so clear the bay, you know. It goes round and round you know everytime I go around looking oh what is this.
PC- Small kid we used to go down there you know with the kind bag pole has uh, net has two poles. Throw stone make lot of noise. Everyday get Weke inside, sometime get Pananuu inside.
KT- Even today?
PC- Yeah!
KK- But the State own that.
PC- But it's not as good because the inlet has been ruined, yeah. You said the State owns that?
KK- Who owns this?
PC- I think it's all privately owned.
KK- They should redo that wall.
PC- Yeah.
KK- Get one nice fish pond by the church.
W-Used to have clams through here, I know we used to see clam shells.
PC- Still get clams down there.
KT- So where did you go to school.
C-I went to school at Ulupalakua.
KT- Wow.

PC- Yeah, up the hill. My father and mother used to drive, see they had a bus contract from the County and drove all the kids that lived down here up to Ulupalakua then went up to Kanai pick up those kids and brought 'em to Ulupalakua. And then the afternoon they took 'em home.
KK- Where is the school over there?
PC- Ulupalakua, uh before the Catholic Church, next to the old Congregational Church. Uh, you know where the baseball park is?
KT- Yeah.
PC- Uh, you go and then there's a baseball park go down and then there's a bunch of houses and then you see one, is that church still or just the site there? But there used to be a camp retreat. It's all overgrown you can't even tell there was anything there. That camp retreat is right next to where the church used to be. And then you go further past it's all empty grounds, yeah. You go further past it's where the Catholic Church is.
KT- From kindergarten through eighth grade?
PC- Uh yeah but only three rooms. Was first grade to eighth grade; never had kindergarten when I was young.
KT- How many kids were going?
PC- Let me make a guess. My graduating class was six people.
KT- Who was the teacher?
PC- So, uh the teacher I had was the principle who was Furokawa. My mother was a teacher for a while, and Furokawa's wife.
KT- Was she a college graduate, you mother?
PC- Uh, no my mother was not.
KT- Just high school.
PC- But the other two teacher's were college graduates.
KK- Had one school by Keokea too, yeah?
PC- Yeah.
KK- Right here by the gas station below.
PC- Yeah, yeah.
KT- So you guys had that bus service going that way and Akina's going that way because Akina's serviced Maui High and Baldwin.
PC- But you gotta remember we never had road between here and Kihei, you know.
KT- Right, right.
KK- All separated.
KT- Never came through.
PC- This road over here was built during World War II by the army.
KK- So you guys only can go up you guys no could go this way through the trail?
PC- Yeah.
KT- So if you came to end of Kihei Road you guys had to walk in over here? Or you never did come this way?
PC- We very seldom went that way, there was no need to. You know, over here when we were kid time if we went that way was probably to go fishing or to go store. During my father's kid time, see my father, my grandfather had a store in Makena.
KT- What was the name of the store?
PC- Uh, Chang Store.
KT- What was the merchandise?
PC- Was a General Store, yeah mostly food stuff, yeah.

KK- And how you guys went get your guys stuff? You guys go up this road?
PC- Ulupalakua, order from wherever.
KK- But no more boat come inside deliver nothing?
PC- Back then they did, yeah, there was some delivery yeah. You gotta remember that this harbor was in before Kahului Harbor was.
KK- This was after this.
PC- Makena, yeah. Makena actually had two harbors, they had one by the church. And then later on when Talbot and Wilcox built Makena landing, Makena landing was known as Talbot's Bay. Talbot's Wharf, that's where they shipped all their stuff from, you probably heard some history where they were raising sweet potatoes down here and selling it to the gold rush days. That was part of the Talbot and Wilcox thing.
KK- Oh, out of here?
PC- Out of here. They brought in animals and shipped animals from here. Ulupalakua used to be sugar cane.
KT- Wow.
PC- Way back, you know, way before I was born.
KK- Because they used to store the sweet potato underneath the ground yeah, before the ship come? Or in the like, Makena Golf Course they show like all the little imu like that look like they store things before.
PC- There's plenty, there's plenty stone wall that's closed off you notice? No more opening like some walls had? And then look like one plot where the stone is loose that they keep stacking 'em up to, uh somebody claimed that that was used to store potatoes.
KK- To keep 'em cool.
PC- Yeah, you know, rock wall and I think they probably had something on top to shade it, you know.
KK- The sweet potato was a Hawaiian sweet potato or something else?
PC- Not sure.
KK- They talk a lot about the sweet potato up here.
PC- But the success was probably with the Hawaiian sweet potato. You can't come down here and experiment with that success.
KT- So how did the people survive around here? Your father was an entrepreneur building a store?
PC- Other than my farm and a few other people that, most of the people had back yard stuff, chickens and pigs. My father little bit more serious, he had plenty pigs. At one point in time before World War II he had over a thousand pigs. Then World War II came we had to cut back because we couldn't get commercial feed. We cut back to about 400. But the rest of the people, a lot of them lived off the land and fished. This place had plenty fish before. Was easy to fish.
KK- I remember coming down here in the sixties hunting down here somewhere with the truck. Like passing stone walls, all dirt road.
W- Right down here.
KK- There we go night dive.
W- The road was right here in front this house.
PC- I remember kid time we used to see schools of Manini and big Uhu traveling with them in this kind of water. And you see 'em outside all you gotta do is wait a couple days at the right tide, they come right inside. And you could reach 'em with the throw net.
KK- Manini was big.

PC- And we go hukilau, we gotta let some fish go ‘cause no more place for put ‘em.
KK- I seen the Manini when I first came down here was like this big. You hit ‘em though spear would fall down with ‘em.
PC- Yeah, yeah.
KK- When we came down here before, night dive, yeah daytime too we see the queen all the time. Now I never see the queen, the golden Manini. Never ever see ‘em.
PC- Yeah. We used to go fish once and a while in the evening when we get plenty company, we just paipai maybe the paipai net is only like forty feet.
KK- What about the Opelu? Pleny Opleu out here.
PC- Opelu was more on Molokini.
KK- Nobody go with the canoe out there?
PC- Uh, one of my, one of my great grand uncle’s did.
KK- He went go with the canoe?
PC- Yeah, Kawakani. He was the one that went out there.
KK- Koa canoe?
PC- No. I think was the, was the, when I was born they had plenty red wood type canoes, yeah.
KK- Because the one guy we talked to, the podagee, what his name?
KT- Mike. Mike Boteilho.
KK- We talk about a cowboy up here, they talk about finding canoes up there.
PC- Hmm.
KK- Because I know Keala went find one canoe someplace around this, around the Pimoe, Pimoe area in one cave the found one remnant and how the thing was lashed. So they took the picture and try to recopy the lashing. Was able to do that.
KT- So what inspired you guys to build such a big house at a later part of your life?
PC- We had planned to build that house sixteen years ago but I got side tracked with a lot of other stuffs.
W- Clearing off this land the title……
PC- One is if you remember Angus used to live down there, right? And I wanted to make sure we had clear title to what we owned before my father passed away. My father owned 95 percent of this place. The other five percent which is about an acre of land was owned by 51 people, Angus was one of ‘em. So, it’s not only Angus that we had problems with other people would say, “if Angus can do that, where can I go?” So we went to court, we partitioned our share from everybody else.
KK- You partitioned your share, what is that? You take ‘em away.
PC- No. We own 95 percent of this lot but we don’t know where so we went to the court and made claims of where we think we should be, ok? And what, what the fortunate thing Angus had already built, bigger than a quarter acre place over here. So we said let them have that, we’ll take the rest. So that’s how we partitioned the 51 people from us. And the fifty one people, majority of them wanted to sell. They didn’t want to incorporate, they didn’t want to do nothing, they just wanted the money so.
KK- They sold.
PC- They sold.
W- Took us 13 years in court.
KK- To partition?
W- That’s why we’re late in building this. And at the end of the 13 years the Kukahiko’s had the land issue.

PC- It’s not that simple. You don’t just go to court because it’s the land issue, you go through all the rightful owner kind stuff and how you arrive at that we did it basically by genealogy. We all came from the same family. Old man Kukahiko bought this place, he had ten children. And he deeded it to ten children and one grandson.
KK- Who was the grandson?
PC- Uh, John Kukahiko. He used to live Kihei, was the daughter of, son of Kukahiko’s daughter.
KK- So Earl Kukahiko fought for Earl, not down this side…
PC- But he’s from this guy. Earl Kukahiko is from Mahele, John Kukahiko had a son named Mahele. Earl Kukahiko’s father went by Mahele more than Kukahiko when he was younger. That was the style in the old days, yeah? You Lu'uwai, you Mahele, you Mooloa, hardly ever carry the last name.
KK- Yeah, parts of the thing.
PC- Yeah. And wasn’t until we started had to do birth certificate and everything we start putting a real name. My mother’s uh, my mother’s father bought the Mahele land in Molokai. The only thing the deed said is Kamai. And I’m sitting here wondering, how I going prove that Kamai is my grandfather? (laughing) That’s true story, I mean when he signed it only Kamai! But the family knows Kamai to be Able Kamai Laumanu, which is my mother’s father. And then his brother buys same thing, an adjoining piece of land, Kumahele, they call ‘em Waiweia, that’s it. That’s the only name on top the deed. Waiweia. And then there’s a book, you know the Indye?. Have you folks seen the book the Indice? The Indice has all the breakdown is a like a Reader’s Digest version a shortcut version of all the breakdown of all the land awarded during the Mahele. And most of them are first names. The one’s that no more first name happens to be haoles that were given lanyed from chief’s or kings. Because they used to use first name, last name, etc. Us, we not used to. My father, my father’s father comes here and he marries one Hawaiian. Tutu Aihai’s daughter right, which is the Kukahiko. They call him A’ana, they give him one pake, one Hawaiian name right away. He’s not known as Ying Chang. We know him as Ying Chang, but the Hawaiian’s all call him A’ana.
KK- Oh they give ‘em, they talk to him Hawaiian, yeah.
KT- Were you raised here too?
W- I was raised here. I was raised in Wailuku, Omaopio and um during the War years in Waiakoa.
W- Yes, went to Waiakoa because my parents felt it was the safest place instead of Wailuku in case they came they would be up in the mountain. So went up in the mountain, my parent’s was farmers so we went up there.
KK- Where’s that Waiakoa? The ahupua’a Waiakoa, Kula.
W- Right below the Elementary School, where the Post Office is, in that area?
KT- Now Haleakala Waldorf.
W- Yeah, that’s Waiakoa.
KK- Oh, the old man was telling us used to get slaughter house up there. Pig house, rabbit house, chicken house, cattle you know. Slaughter house.
PC- Ulupalakua had a big slaughter house. In fact slaughter house used to be down here, Makena Landing. First it was in Kana'ena . Then he moved out to someplace in between, uh, what the hell’s the name of that place. Uh, Kana'ena. Kana'ena is just before the lava flow stops where all those people go snorkel diving, that small bay is called Kana'ena, yeah. And then it moved to Makena Landing. And then I think it attracting too many sharks, about that time they

stop putting in the wharf for ship stuff yeah. And the way they used to ship pipi was they put 'em in the cow pen. And the cow pen is that, you know where the restroom is? You see that area is stonewalled, yeah? The stone wall used to be that high. They chased the pipi inside and then they chased 'em out to the beach, outside get launches, they strap 'em one cow to each side and drive 'em out strap 'em in the heel lift 'em and put 'em in the boat. Yeah.
KT- You actually, you saw it?
PC- I saw it, yeah.
KT- So the cows swim themselves?
PC- Yeah cause I was old then. By 1988 I was sixty years old, so from about then I started knowing already. You know but about three, four years old, I no remember nothing.
KK- They swim right through the wave come up, if rough and all. If the boat come inside rough, they swim the cattle right through the row. The thing swim.
PC- They just hook 'em right around the head and they drag 'em out with the launch, motorized launch.
KK- The one they get out there they gotta carry 'em by the stomach, no more dock. The same what is in there now. And when I went look the cattle seen them the first time the guys drag 'em…whoa the bugga swim! And like you said the shark, the thing stay attracting sharks because the slaughter house stay around.
PC- Was there yeah.
KK- Funny where they get the cattle, they going make one slaughter house.
PC- Yeah, but Ulupalakua had a large slaughter house. They had tanning operation and everything, you know for the hide.
W- Keli'i, you see the gentleman over there?
KT- Yeah.
W- He's eighty five, his name is Charlie Aki and he's probably the oldest living paniolo for the ranch today.
PC- He work Kaupo Ranch.
KT- Is he ohana or just friends.
W- The wife was ohana.
PC- The wife was ohana to us.
KK- He working contractor?
W- No he's just, he works for our contractor. He's non labor, you know he just likes working. He doesn't want to stay home and do nothing.
KK- He stay down here early, last time I came here was…
W- Yeah, he works full eight hours. He doesn't stop he just works. Only stop he did was lunch break, that's how much…
KT- Where he live?
PC- He lives uh, homestead in Waiehu.
KK- Waiehu Kou.
KT- How does he come, car?
KK- He drive his own, he get his own truck. He get one white truck.
W- He still can ride a horse yet.
KK- When he come here, early.
W- He still does some, when the lunch have round up, he still goes.
KK- He's Aki, last name?
W- He's actually Kahaleauki, yeah?

KT- I saw a name, Kahaleauki somewhere over here, right here, Kahaleauki.
PC- I tell you one story. Charlie and I are talking. I always knew Charlie as Charlie Aki but his legal name is Kahaleauki. Kahaleauki.
KK- Ceclia Kahaleauki.
C-Yeah, yeah. Anyway, I said "Aki, how come Aki?" He said, "Oh, um my father part Pake." I said, "Oh, yeah." He said, "yeah, my father from China." And you know the reason why I ask is almost all the people that got "Ah" something is part Pake, almost all of them.
KK- I show you the map Honokahau get Ah Sing, the whoe balance get all the Pake's and then get the Hawaiian connection, right. But like you said get the Pake. And he is a Pake, like all those, all the Chun family, the Keahi family, they all Pake.
KK- The name is from Kahikinui where the Tahitians went arrive, Tahitinui. You know Kahikinui, that's where the name come from, from Kealakahiki go right to Kahikinui.
PC- That's how you going justify it for him anyway right! (laughing)
KT- What can you recall that you liked to leave. As I said we going transcribe this, we going bring you a copy for the family, put the pictures in. What would you like your family to know? Your offspring, you know, that might be significant.
PC- Oh you know one of the things I think we losing track is the places, the names of the places over here has changed. Now I agree, I tell my family. But it's names of places is almost something you gotta live there to know the point, the fishing hole, the bays that are named separately, you know as you go along this place. I was probably taught a lot more names than I can't really remember. You know I didn't live here all the time, I don't use the names all the time. So the consequence, I would like to see the names of places change. Like, one of the things I hate to see Palauea become part of Makena. Palauea to me is Palauea. You know there's some key places on Maui.
KT- Let's look at so I can relate to what you talking about. So right there in between….
PC- See Palauea's way down here yeah.
KT- Right.
PC- This is Pu'u'ola'i
KT- So what you would like to see is keeping the ili's like it used to be instead of adopting what the people are doing with it for their convenience?
PC- Yeah, right. At least keep some of the major, you know Palauea is a pretty big sand stretch. No go change the name to whatever they want to call it.
KT- So, as we looking at this map here, anything significant happen here that you'd like to relate?

PC- About four to five years old. Went to Ulupalakua School. When I graduated Ulupalakua I went to Lahainaluna. When I graduated Lahainaluna, this was 1949, I went to the mainland to school named then I went in the army and that's where I met my wife. I got out of the army, went back to school, went to work.
KT- What was her maiden name?
PC- Laureen Sakugawa.
KT- Sakugawa, okay.
PC- Yeah, she's a Maui girl, but I lived in the mainland for 39 years. I was gone between the years 1949 and 1988.
KT- So, question. That life, you think, gave you the edge now as a Hawaiian, in Hawaii?

PC- Well, you know my parent's were, were they wouldn't sit still for unfairness. My mother always thought that many Hawaiian's got cheated because they were, they lacked the energy to challenge certain things. My father was the same way, you know and I was brought up that way and my going to the mainland perhaps made me keener about certain things.
KT- What did you do up there?
PC- I worked for a company named Leber Brother, you know I started as a chemist and then went up to manufacturing and…
KT- How did you get the expertise, Military?
PC- From working.
KT- To be into that occupation that you got.
PC- That field? Oh, from my college, yeah because I got a degree in Biological Science. You know my minor is in Plant Pathology actually. And I went graduate school at Southern California, you know.
KT- How many children you have?
PC- I have five children. One son and four daughters.
KT- What do they do?
PC- Well, they're all married now, except my son. Um my daughter's, believe it or not, all graduated from University of Hawaii. They started elsewhere, they started. Momi didn't, she graduated from California, but she went to University of Hawaii for a while. But they all started different places. One started in Los Angeles State, the other one started Indiana State. Another one started Indiana University, another started in Missouri, yeah. And those, the three oldest ones came home to Honolulu and graduated from UH. The youngest one however went back to the mainland to finish.
KT- So what kind of field of work are they in?
W- You know our oldest, Keiki Kawaiaiea, you know her? That's the only one that's in the Hawaiian movement.
PC- She's in Hawaiiana, she basically does Hawaiian curriculum, yeah. And my second daughter's a school teacher. My third daughter, what she got two degrees? She's in art but she's basically a home wife. And my youngest daughter is a house wife now. She just gave birth.
KT- None of them are asking that they want to come home.
PC- Well, four of the girls live in the island. Three of the girls live in the island, one lived in the mainland. Two live in Honolulu and one live in Big Island, the oldest one lives in Big Island. And they're a little too young to retire so.
W- has three and then the oldest one by the way graduated with her degree in teaching Hawaiiana. She teaches at Nawahi, she's a school teacher there.
PC- In fact she went to the first class of….
W- Immersion school.
PC- First immersion school in Honolulu.
KT- Oh really?
W- She was the graduated out of the University with a degree in actually in Hawaiian teaching Hawaiian. She's a school teacher. She's the first one of the Hawaiian immersion kids to graduate out of college, so we're very proud of that girl. And she's teaching there you know in Nawahi and enjoying it. And she enjoyed and she's working right now on her Master's.
PC- My oldest daughter used to go stay with relatives like my mother and father speak fluent Hawaiian. So my relatives in…
KT- Your mother and father? You father was Chinese you said, right?

PC- No my father's only quarter Chinese, half Chinese rather.
KT- Your grandfather was pure Chinese?
PC- My grandfather's pure Chinese.
KT- Ok, but did he learn? Do you know if he learned Hawaiian?
PC- You know I don't know. He must have learned a few words, you know. All the people he delt with at the store were Hawaiians. There were no other Pake's here except him.
W- Well you grandmother spoke a lot of Hawaiian.
PC- Yeah my grandma spoke, his wife spoke fluent Hawaiian of course.
W- She must have.
KT- It's the principle of immersion, living right?
PC- Exactly, he was immersed!
W- You remember in the class what you told us one day? You got kind of frustrated with all of us trying to learn Hawaiiana?
KT- I cannot remember anything!
W- You got up and you said, listen you said, "don't be afraid to speak what you're learning now because you'll never learn to speak Hawaiian unless you speak it." And you told us and discussed Oleo in Hawaii. You don't remember that? You don't remember that right? And that influenced a lot of them, our haole ones, started to speak Hawaiian. Better than us.
KT- One of the most challenging thins for me is, you remember me, yeah? Come one I mean how many people I meet right? You remember what I said? Just like you telling me…..
W- Gee! We were with Hokulani at that time, she was one of the first kids in the immersion program learning. Kupuna's, Tutu's coming in … I haven't forgotten you, yeah. Gosh, you were the only male at that time, you were the first male, oh other than Boogie. You and Boogie, you remember that? You and Boogie were the only male that came.
KT- Yeah. So most of your children you had on the mainland or you had???
C-All my children was born in the mainland.
KT- All?
PC- All of them yeah.
W- But our oldest daugther she was akamai. To learn Hawaiian she went to the Kupuna's, she went to the tutu's. She came to Makena, she went to Molokai during her spring break you know and things like that to go learn the language. And that's how she, and then she tuturoed a girl from Ni'ihau. You know, English and she would tutor her in Hawaiian.
PC- Ni'ihau dialect.
W- Yeah, so that's how she picked it up really fast. So she was very smart but she was really into it. That's what she decided she was going do for her life career.
KT- Lot of the kupuna's are, really made an imprint in my mind. Loud and clear you said the problems with us Hawaiians is we want to be jack of all trades and master them yeah. So I cut back half, so I just focused on…and even now I'm coming back again so I'm really getting back to my language and trying to satisfy the hula area. And to make impact in trying to retain what you guys are telling me about these culture things. In fact the guy that I'm recommending you guys call, I'm turning over my history on Maui and History of Hawaii class to him to sit in for a semester. I want a break but by me doing what I'm doing, this is another reason. It works together, you know because coming to meet you folks I learn new things.
W- What's your reason for doing what you're doing with Kimokeo, working with developers?
KT- If we cannot come out, don't do this, who will do it? Haole? They won't put in the true and the Kupuna will not talk to them. So they won't be putting in what really used to be like. So

what kind of impact are they going to make? If we are true to what we say to you folks then you going to see it in the report. And that's my take on this. You know I look at what can I give back? Kupuna have given me so much, the Aina has given me so much, now's my chance.
W- Do you get, you know because you're doing this kind of stuff, I'm just curious because you're doing this kind of stuff. Do you ever get feedback where our locals are saying you're working with the developers, you're working with…they don't know the true meaning of what you're doing and they say they don't realize that the reason you're doing this is so that you get the true feeling, the true value of the aina to the developers.
KT- You guys follow; you guys take Maui News?
W- Yeah.
KT-You guys follow the Oluwalu thing, okay?
W- Yes, I have been, yes.
KT- Okay. So Kimokeo and I walked into the local boys because the local boys who were leading that presentation are canoe people We never know, we just do it. Kimokeo and I you know, we don't ask for permission anymore. We just do and later on people going to say wow those guys really were on it, they were sincere. Here is their works.
W- I ask you that question because for so long Ed and I have been sort of activists too, yeah. I don't like that word too much but there was a reason for us doing that. We've always been very particular about Makena, yeah. And there's certain things we have been and we did that because we felt that we had to do that for our kids, yeah. And then of course when we get different kind of throw backs from some the local you know but that was just kind of thrown out the window. But you get it both but for us, for him, Makena is such a passion for him that I'm, I fell like it's important. Like we support Makena. And people don't understand really why we support Makena. There's a reason for us doing what we're doing. We want to make sure that things are all right the way it should be, you know. But we think, but people don't understand that. But that's why I ask you because it's a hard place to be. It's really hard.
PC- You go up there and Makena is asking, Makena Resort is asking for rezoning parcels, roughly 100 acres. And uh, you know they're the only developer along this coast that doesn't use coastal waters for development. The shorelines are free; you can still roam in and out of that place. You know the stuff in front of the church they never owned, you know they owned stuff behind the church. They're very community oriented even as slow as we are but the people that speak against development think I'm a developer, I'm not. I'm listening to this developer because I don't trust the other developers. You know that's all that's there.
KT- Kimokeo got me involved with them too. When the lead archaeologist found out that the father and I worked Hokule'a, he said I want to meet Keli'I because he knew the connection. And so he's been telling developers that he's working with me. You guys gotta use these guys, they're sincere guys.
W- He's so akamai about archaeology and his father is too. And that's why I admire, I really admire.
KT- And he's sincere, that's important.
W- He's really sincere.
KT- He tells it like it is.
W- Yeah, we have found that out and it's a hard place to be, because you're now with Charlie and I can understand why you're doing this because you really don't want just anybody to do that. It's important. And I wish local's would understand that.

KT- They eventually will but at this point in time, it takes time. Our people are really, you know, they ku'i first before they listen. And that's why they all in back of the bus.
PC- And there's some truth to what some of the locals say. You know they used to come down here and all open space and I said to them, "you didn't feel you were trespassing then, but you feel you're trespassing now?" I said, "You're doing the same thing then. I said the difference is you might have behaved differently." You know you pick up you're opala (rubbish) after you left, you know you kept the place clean. You didn't come down here and dump your cats and dogs and your rubbish and all your old junk. I said people do that here, you know. It wasn't uncommon to find this lot, when the road was going through, with old engines. Rubbish people just dump out of the car, you know stuff like that. Guess who's picking it up? Another local, now why are they doing that?
KT- It's still happening today?
W- Yup, it's still happening.
PC- Yup.
Kt- I keep asking myself, I mean where are they? Where is their brain? I mean what's making them do it? Every time I tell myself I run 'em, write editorials and say when they do that, they're not only defacing but they're also abusing their right as a local. They're abusing their local gods because eh, who going have to live in a cesspool? So, and it's not only local, however you know locals participate in it.
PC- Back in the old days you didn't have a whole bunch of people. We've owned this place since the 1940's. You know and before that is was still family property, my great grandfather bought it. And even as a kid in the 40's and the30's hardly anybody came down here. But when the road's came then a lot of people came. And the island people they were much more humble, "oh can I stay over here?" They asked. You know it's such a nice thing to have a local say, "Uncle Eddie, can I park over here and go down there?" Oh, yes! But no, you find that the other people they come here and they say, "Oh, you not supposed to build a house over here. This supposed to be open land, blah, blah, blah." I says when do you start paying the taxes over here? You know 'cause taxes were always the principle ownership around this place. But the thing that's really changed is may people bring liability concerns. And the liability concerns makes all the residents really a lot more cautious of what they're allowing to go on. You know, so. Where before as a kid, we never worried about it. But our old folks kept us straight. You don't do this, you don't do that, you know. You stay out of the water from certain kind water. You always have somebody with you.
W- You know a lot of the responsibility, the things the Hawaiian's, were losing. They didn't keep up with their responsibility and nowadays they want to ku'i first, you know. And it's sad and it's sad. It seems like they're strong people yet they needed leadership to tell them you have to do this, you have to do that. They need to learn to do it themselves. And I hope the new generations are learning this.
PC- I have a really mixed feeling on how the Hawaiian's get blamed. A lot of the Hawaiian's they can stand around and look and watch what's going on and compare it to yesterday versus today are not really the property owners so therefore cannot really speak. You know, where before as a kid the people I knew were all property owners. They lived here, they paid the taxes. Now they have left they've sold their property, you know transplanted by people that don't own property. They use the place, I don't mean they misuse it but the fact is they don't have the same passion for the place therefore don't treat it likely, you know. And that's what I see. Once your main space leaves, if you don't get good replacements, it's going to change.

KT- So right there is developed. That where Angus used to be.
PC- Right.
Kt- What is coming up over there?
PC- Ah, oh that? The pipes and so forth. Angus lives further down you can't see where the house was but Angus lived, you know where the parkinglot is? He lived right next to that, yeah. That development is something I have to do because when I….in the process of settling my court case I rezoned the property so that I could sell a smaller lot. Then I had to subdivide it. I had to actually subdivide away from this tax fee what it is I'm going to sell. And in the process of subdivision the County requires certain improvements. One is I had to put a swail that took care of the drainage that came through this property. The other is I have to put in a 12 inch water line fronting the property, at my cost. And they called me a developer. And all I'm trying to do is save family land.
KT- How it's worked again. We gotta be training young kids to do research so they turn it back.
W- That's right, that's right.
KT- Yeah, because..
W- You know what? These kids coming up I tell them if you haven't made a choice yet but you love land go be archaeologist. Go be archaeologist because I don't want archaeologist come from the mainland to do archaeology work here. I'd like to see our locals do our work.
KT- That's why I have a nineteen year old I've been trying to. And Aki wants to train him but young boy right? Rather surf than be with Uncle Kimokeo and me so what can I say?
W- But I wish our kids would kinda look down that way.
KT- I hear you, yeah. Lawyers, you know, all the key positions that can help prevent further taking of all our things that we value.
PC- You know when I was a kid I couldn't do anything unless I did my work first. I had to do the housework, the farmwork, before they let me go out. And then they gave me freedom to do that. But they always knew where I was you know.
W- But today is different, today get cars today. They hele on now.
PC- Well kids live at home but they don't have responsibility as a family and I don't understand that. You know, I still feel responsible for my family. And for my father and mother's way of how they brought us up, how I think was a notion of theirs to begin with. You think our kids think like me, or like us? I think, yeah to a large extent they do. But I can point to families that didn't make any kind of an effort that way. And I think maybe it's brought up in this big city syndrome, you know. They got all the kinds of activities they belong to different kind clubs and different kind training.
W- You Kula? How come I didn't know you went out there?
KT- Seventh grade I went out to Kamehameha.
W- Oh, I see that's why, you went to Kamehameha.
PC- So what year did you graduate Kamehameha?
KT- Sixty, so Hoku Padilla came later.
W- Did you know Hoku them?
KT- Uh, no later.
W- She's a remarkable woman.
KT- Kamehameha is a good foundation for our children. I don't know how Maui Campus going to fair because my daughter is going to graduate from Oahu
PC- All day students?
KT- Maybe from Molokai and Lanai.

PC- Cause I told her I went to Lahainaluna and boarding school at the age you go through those four years you know from 13 to whatever.
KT- So what year was that?
PC- Forty five to forty nine.
KT- When did Earl Kukahiko go through?
PC- Uh, he graduated '51, I think.
KT- Oh, wow.
PC- He was at school while I was there.   I think he was a sophomore when I was a senior.
KT- Cause we research Kahoma. And you know like I'm saying we just getting into this so. The other thing I haven't answered you is, I didn't know but what's happening now is two more things; it gives me access to talk story with you folks, more intimately than I would and the second it gives us the keys to go into these areas that we wouldn't be able to go into. Like we research Kula 1800 which is the across, the farm county over there coming down Pulehu.
PC- Oh, Omapio area.
KT- Omapio, okay. It helped me determine because I knew King Kekaulike had petroglyphs. I knew another one had petroglyphs. We went to an area. No so my final report was we came to a bed of petroglyphs from here to that coconut tree. At the end was a big pohaku like this with Kanji writing's on But the final report I wrote that there were pockets throughout all the beds comings down. Because after interviewing the different peoples up in Kula they told us where they had petroglyphs on different streams, there was an indication that the families would be bringing stuff down, stopping point. To document you know, writing story about their lives. So, I would've never known that everyone of them had. So it's become very rewarding personally to take this. And Kimokeo, you know, I told Kimokeo if I going do this with him, he go get the contracts. I'll be the writer. I'll do research and stuff and it's working out good. So now he wants to expand to Big Island because he has some contacts. And Kauai is his home island so we already went Kauai look at what we would want to participate in. But anyway, thank you guys so much for your time.
W- Thank you for the information.

INTERVIEW ON VIDEO on Makena Resort
KK –Kimokeo Kapahulehua
C-Eddie Chang
KK- We are talking about the Makena Resort owned by Dowling Company. We are trying to get more information to assist in the cultural preservation plan. Please introduce yourself, place of residence, etc.
PC- My name is Ed Chang and I am the oldest son of Edward Chang born in Wailuku, Maui raised in Makena.   I was born on February 29, 1932 so I am 77. My father was quarter Hawaiian and my mother was three quarters Hawaiian which makes me half. My father's Hawaiian side come from the Kukahiko 'Ohana. The original Kukahiko came from the Big Island, Kona and resided at the Makena Landing about 14-15 years old. John Kukahiko Had 10 children one of which was my grandmother who had two children, one of them named Kathy married a Chinese man named Chang and that is how my father and I have our last name. My grandfather

Interview: Kupuna Chock

By Keli'i Tau'ä/ Kimokeo Kapahulehua

KT- Keli'i Tau'ä
KK- Kimokeo Kapahulehua
KKC- Kupuna Chock

KC- My uncle is buried at that old Hawaiian church, Charlie Kanoho.
KK- Yeah.
KC- Uh, what is the name of that church?
KK- the Keawalai Church in Makena?
KC- Yeah, yeah. He was married to Poepoe, Kawehi Poepoe.
KK- Oh, Get one Poepoe still but get little bit Poepoe's around? But that's the family now yeah?
KC- Yeah, yeah.
KK- So this work that we're doing is for Honua'ula Company and Kumu and I are being contracted to do cultural assessment. So when I thought about our first meeting I remembered that you're up from up Kula country up at Pulehuiki area. So we come here for that papa. So what is your real name?
KC- Well, my father is pake, his name Chock so I go by Stanley Ahana Chock.
KK- Stanley Ahana Chock. How you spell Chock?
KC- C-H-O-C-K.
KC- Pake name.
KK- Sound like a haole name too yeah, Chock.
KC- No, no.
KK- So, what year were you born?
KC- 1933, May 19, 1933.
KK- Oh, you was a student of the Mahele days.
KC- Yeah, yeah, yeah.
KK- Mahele, you was still in the Mahele days, yeah?
KC- 1933.
KK- So that makes you how old?
KC- Now, 72.

KK- 72.
KC- Yeah.
KT- No Hawaiian name?
KK- Ahana.
KC- No, Ahana is pake name. But my mother's maiden name, my mother is a Kanoho, with the Kanoho family from Upcountry. You know Freddie Kanoho? Freddie Kanoho, yeah that's my cousin.
KK- Any of the Kanoho's still stay around?
KC- Yeah you get Freddie, Freddie Kanoho Jr. I think he was working for Good Fellows.
KK- Oh, oh, oh.
KC- Yeah, yeah, yeah, he was a foreman.
KK- Construction?
KC- Construction. And then uh, oh my mom passed away about 5-6 years ago I think so.
KK- And how old was your mom when she passed away six years ago?
KC- About 82.
KK- Eighty two. What was your mom's name.
KC- Patty Lou Chock.
KK- What was her maiden name?
KC- Kanoho.
KK- Kanoho, and then what's your father's name?
KC- My father's name Clarence Ahana Chock.
KK- Oh, same like you.
KC- Yeah, yeah.
KK- And then you were born where?
KC- Um, from what I heard I was born in Honolulu at River Street. Yeah, I think that's where my mom met my father, my father is from Honolulu. So, I don't know they probably stay up in Honolulu but I don't know about that.
KK- What year you came Maui?
KC- From what I heard, soon as I was born I came Maui. And my mom gave me away to her sister which is my aunty up in Kula, Pulehuiki.
KK- Pulehuiki. And what was your aunty's name?
KC- Uh, same like my mother's was Hattie, my mother was Hattie Lou. Her sister was my aunty I call 'em tutu because I was given to her I heard. I was about 3 months old.
KK- Wow, and then what, she had a husband?
C-I think her first husband, my aunty was Hanamakai.
KK- Hanamakai.
KC- But when my mother gave me away to her sister at Pulehuiki she was staying with one old man Ha Chu Chond. C-H-O-N-D, Chond. So I was raised up at Pulehuiki from 1933. Yeah, '33 and we stayed up there till about 1938 or '39. And then somehow my uncle and my aunty they was staying up at this property, they had pretty big sized property. I think one uncle that's uncle Robert Kanoho, he was staying on one side of the road. He had about, oh, I think about 3-5 acres.
KK- Oh.
KC- And then the aunty stay on the other side. The other one the one was staying with Ha Chu Chond, she was staying on the other side of the road; brother, sister. That one, I think that one own about a little over 300 acres I think. No, no. Not 300 acres, about 3 acres. But they sold

'em. They sold 'em to the Japanese farmer. I don't know who the farmer was but they still up there yet. I think this must be about the 3rd generation, Nakamura. So about '38-30 we moved because we lost the place. We moved to Kahukuloa and I was raised up in Kahakuloa.
KK- You know Joesph Saro?
KC- Yeah we went school together.
KK- Oh, you guys went same school, what school you guys went to?
KC- The Kahakuloa old school.
KK- Oh, the old school in Kahakuloa? Oh, so you remember the area like Wailea, Makena have you been down there by the beach when you were a young boy?
KC- Yeah when I was young I remember with Hoopii, Walter Hoopii.
KK- Walter, right.
KC- Old man yeah. That's the one took care of me in Kahakuloa at hale, you know where Waihale is? That's the next valley over from the Hawaiian village. Next to the Bell Stone. Yeah, yeah, yeah, get one house in the valley that's where I was raised up.
KK- What one Hoopii just passed away yes, Uncle Saul.
KC- Yeah, Saul. We went to school together.
KK- So is that Walter's brother or father?
KC- Saul?
KK- Walter, Walter Hoopii.
KC- Um, no that's brother.
KK- Brother.
KC- Actually Walter Hoopii, he's a Apuna boy. I heard he was hanai'd by the Hoopii, Frank Hoopii Sr who was married to Abigail.
KK- But in Pulehuiki did you guys ever go from Pulehuiki down to the ocean with horses or buggies?
KC- No, no, no. I was young that time so. But from Kahakuloa with Walter Hoopii and we used to go Makena. We used to go fishing at Makena and all that area when they had only dirt road, eh.
KK- Was that a trail or only dirt road? How you guys went Makena? What kind transportation you guys had? Ka'awila.
KC- Ka'awila, old Ka'awila.
KK- So that was in the forties or fifties yeah the cars? The model A's, model A's yeah?
KC- Model A's yeah.
KK- What kind of fish you guys used to catch in that area?
KC- I was young so I watch them. They used to go catch Uhu, Palani all that. But them days they use mostly harpoon,
KK- Oh, abundance of fish.
KC- Yeah, so much fish that they hardly go.
KK- So the harpoon you guys use was that from the whaling days harpoon or you guys made your guys own harpoon?
KC- Uh, I think they made their own.
KK- Made their own yeah and speared from the reef yeah?
KC- Throw the harpoon from the reef. I remember the old Makena days…
KK- What about the landing area, you know Makena Landing? Was it active then, were their boats coming in and out?

KC- Uh, no I no remember. I no remember because most of the time we stay on this side, Kula or Kahakuloa. Once in a blue moon we go you know Makena but uh. My uncle, Charlie Kanoa, I think he was staying in Makena. So he married Kapehe Poepoe, Annie Poepoe.
KK- You know of any old stories they talked to you about that area like Makena, Honua'ula, um Wailea, Kihei?
KC- Um, my mother and my father and I think was two, one brother and one sister that was staying in uh, somewhere in Kihei I remember we used to come from Kula. My aunty used to take us go visit my mom and my father down at Kihei and then I remember Kihei, uh from that old Kihei store?
KK- Oh, Suda.
KC- Suda.
KK- Azeka, Azeka.
KC- Yeah, used to be the old store way back in the 30's and the 40's. We used to, I remember the road from Azeka's all the way down to the Kalama Park used to be only about 2 car lane. You know, one going and one come back eh. And I remember the old St. Theresa's Church.
KK- You remember the military down there?
KC- Uh, no. No military.
KK- Marine's or army.
KC- Marine's and army I knew was up, up uh Kahului and Upcountry yeah.
KK- How many in your guys family? How many sister's and brother's in all?
KC- I get five brother's and four sisters.
KK- Oh, are you the oldest?
KC- No, I'm the second oldest. My oldest brother passed away about oh, in the 80's I think so.
KK- Everybody else over here.
KC- Then everybody else living. But, uh I get only me on Maui. I get one brother living in Honolulu, one brother and one sister living in Honolulu. And uh, three sisters and one brother living on the mainland.
KK- When you guys used to get sick what you guys used to do? Was there a doctor or you guys use the la'au lapa'au.
KC- No, we no had no doctor's those days.
KK- La'au lapa'au.
KC- Yeah.
KK- You remember the medicine's you guys used then?
KC- I remember my aunty up Kula, Pulehuiki, she always, we no have doctor's so like say we catch cold you know we flu we catch cold. See, she go pick up the Eucalyptus branch, the leaves bring 'em home, put 'em in one pakini and boil the hot water, boil 'em and throw the leaves in the pakini. Then cover our heads with some blankets in the pakini to catch the medicinal scent of the leaves.
KK- Oh, for breath the air.
KC- Yeah for breath all of that. Oh, I tell you. Then after next day we up and going.
KK- Right on.
KT- What was auntie's name that did that?
KC- Uh, Hattie gee I forget. Hattie Chock same as my mom but she get one. Hattie… I think I forget. But she, she was married to a Hanamakai. So that's why Walter's wife Mary that's my cousin. And you remember Rachel Kalanikau?
KK- Yeah, yeah.

KC- From Kihei. That's her sister, that's my cousin. So that makes me and Moke them, Kalanikau, yeah we're cousin's.
KK- Yeah, yeah. I just talked to aunty Paula Kalanikau. She uh was talking about what they're doing in Kihei. You guys raised any animals on the land?
KC- Well, in Kula while staying with Chong we had pigs and I remember we had pigs and he had planted beans, tomato, cabbage, you know, and corn. That's my um aunty.
KK- When you finished your young days you went to work. Where did you go work?
KC- Well, from Kahakuloa, after we moved from Kula to Kahakuloa I was staying with Walter those days because he adopted (hanai) me. So in Kahakuloa we had animals too. We had cows we had pigs we had ducks we had chickens oh, I tell you. So my life when I was growing up in Kahakuloa, eleven, ten, eleven, twelve years old you know I was working just like one man.
KK- Full time.
KC- Yeah because my job was to milk the cows in the morning. We had about two milking cows and before I go to school in Kahakuloa School I gotta get up maybe about 5 o'clock in the morning and go outside in the pasture and just with the kukuihele pō(lantern). You know when they had plenty….you know you're ten eleven years old, twelve years old you kinda uh maka'u(scared) 'eh for go outside there. But force us for go, no choice, it's just my chore. You know.
KK- In the dark.
KC- Yeah, because Walter Hoopi'i at the time he was working in Wailuku I think for WPA or something so at that time the road from Waihee to Kahakuloa was pilau(bad). Was only dirt road, bumpy so instead he go home everyday, he stay in Wailuku and stay the whole week and then the weekend he come home. So in the meantime during the weekdays that was my job I gotta take care the animals. Feed pig, clean pig pen or cart, in the days before um we had back in the thirties and the forties never had electric so was mostly kukuihele pō and salt.
KK- So the kukuihele pō was that the kukui nut or just the lamp.
KC- The lamp, the lantern, yeah. I used to go outside in the morning, early in the morning, bring the cows home, milk 'em.
KK- What about activities, you guys do any activities like canoeing like you guys had canoe?
KC- No them days uh Kahakuloa never had canoe. I think was the Kaha'a family, Moke them. You know them?
KK- Yeah I know Moke Kahaa.
KC- Yeah I think their family had canoe for go outside and surround akule like that.
KK- Kumu.
KT- So how many students in the class?
KC- Oh, that year, I left Kahukuloa in 1945-46 and that year I think Kahukuloa we had less than 50 families. And I think about less than 20-25 students.
KT- So after, you went from first grade to eighth grade?
KC- To eighth grade.
KT- And then no high school?
KC- No, my mother, my mother….well, my mother pulled me after I graduated eighth grade my mother took me back from Walter Hoopii. You know so I was about 13 years old by then. They moved. They were staying here by lower Waiehu Beach Road, so from Kahakuloa I moved with my mother in 1946. Then I went from Kahakuloa School, I ended up in St. Anthony High School one year, seventh grade, eighth grade, I graduated from Kahakuloa in eighth grade. But then when I went to St. Anthony School I stuck back to one grade. I stayed one year over there,

man my mother took me out and one other sister, me and my sister was staying with my aunty and we went to Iao School. So, I graduated from Iao School in 1948 and then my mother took me out from school before I go to Baldwin School, I had to go work because we had big family, yeah. And then you know at that time the money was bad yeah.
KK- How much was in your graduating class?
KC- Uh, Iao School? Probably about 100 I think.
KK- Oh wow, big.
KC- Yeah, yeah. So, then I stayed home about '48-'49 I worked, the kind stuff before we used to do, I used to work the kind yard man, yard boy so I was working for one Japanese family. I think their last name was Yatsui or something. So I work yard boy, ah only weekends maybe four hours, get paid 50 cents and hour. So I make four five dollars you know. About three quarter, three dollars go for my mother and one dollar go for me.
KK- What did you buy then for a dollar.
KC- Oh, see then you can go show(movies) for 10 cents and then you buy candy and gum for about 1 cent or nickel.
KK- Was the Hawaiian money still around at that time in '48, '49,'50?
KC- Um, no I don't remember.
KK- Kalakaua coins or things like that?
KC- Yeah, no, no we hardly use that. But anyway then I went work after that I work for the bowling alley, Wailuku Bowling Alley.
KK- What they give you 60 cents?
KC- We got paid I think 35 cents a game or something, you know.
KK- Oh, thirty five cents a frame.
KC- Yeah a frame.
KT- So you used to go put up the pin?
KC- Yeah, yeah the old style we used to set pins with hands, eh.
KK- Yeah we had that on Kauai.
KC- Yeah oh, oh. Then, I never had car so I used to get the bike, bicycle you know. Put little flashlight on the handlebar and then I used to use that for go work uh, bowling alley. Come home at uh, they close about midnight. I used to come home with the bike all the way from Wailuku to Waiehu.
KK- Wow.
KC- I mean them days no more no hale   and they no bother.
KK- Dark yeah, was dark too.
KC- Oh was dark, oh I remember the lower uh, Waiehu Beach Road coming from Sack N Save used to be all Kiawe trees over there.
KK- You had to go underneath.
KC- And had that old narrow, I think only two lane, eh. Yeah. And then I work, I work for the bowling alley, uh, I think till 1950. I think so. Then from there I….you remember Sandy Bell?
KK- Oh yeah, yeah.
KC- Sandy Bell.
KK- He went crash at the uh…..
C-That one, no was the brother George Bell.
KK- George Bell the one with the bus. Sandy went um..
KC- Sandy died, uh….
KK- With the cement truck.

KT- Sandy Bell was musician.
KC- Yeah, yeah, yeah, yeah.
KK- He went get in one accident yeah him?
KC- Oh, I don't know I was staying Honolulu that time. But, he and I worked for the Hinode Soda Works up at Main Street.
KK- The rice company, Hinode?
KC- Yeah used to be one Hinode Soda Works on uh, I think they used to be a little bit above somewhere around uh, oh where they get that Koa apartments now.
KK- Oh, yeah, yeah, yeah.
KC- Yeah, well that used to be the Soda Works. That was owned by Fred Yokayama. Fred Yokayama was from the Federate from the 442, eh. So me and Sandy Bell worked for the Soda Works until, I worked till '53, 1953. And then just when the Korean War was ended I volunteered for the Marines.
KK- Oh, the Marines, and where did you go Korea?
KC- I was in Japan, yeah we were standing in Japan with the Third Marine Division.
KK- Where in Koska?
KC- We was in Gifu.
KK- Gifu, oh Gifu City.
KC- Yeah Gifu City, oh you remember? You know that place?
KK- Me and Kumu went go Japan.
KC- Yeah Gifu City? Get one army base over there. That's where I was.
KT- How old were you then?
KC- I was twenty…..I was twenty.
KK- At that time they give you the army blanket jacket yeah? The military, the kind uh, the jacket the things look like one almost army blanket yeah.
KC- Oh, yeah, yeah, yeah the wool kind.
KK- The wool kind, yeah.
KC- I get my picture over here on this.
KK- Where? Wow.
KT- Who caught those turtle back?
KC- Me.
KT- Where did you catch it?
KC- In Waianae, Nanikuli. I was staying Nanakuli.
KT- Oh. How did you catch it?
KC- The um, I don't know. We was camping at Nanakuli we call it Kahe Point and we was camping with uh….
KK- Oh you was handsome bugga when you was young.
KT- So you were at Kahe Point.
KC- Yeah we was at Kahe Point camping one weekend and there was a, yeah…..
KK- You get uh, bars over here, what the bars all about?
KC- Uh, this is uh, yeah the infantry but I was motor transport. Yeah I was the third, you know truck driver.
KK- For the military.
KC- Yeah, for the military.
KK- My uncle was in the military. My uncle Jojo Kua from Kauai.
KC- Oh yeah. Oh, oh, oh.

KK- What about the Korean War?
KC- Yeah we went over there, uh, I end up in Japan in '54 so we was standing by in case that war broke out we live the First Marine Division, yeah.
KK- That's uh, that's 9 years after Pearl Harbor.
KC- Yeah, yeah, yeah, yeah.
KK- '45 yeah, or '47, 1941?
KC- Which one?
KK- Pearl Harbor. Pearl Harbor 1941, yeah? You guys was in Korea 11 years yeah, 11 years later. '41 was the bomb yeah. The war went on to '45 when we went throw the atom bomb on them.
KC- Uh, I think was '45.
KK- '45 yeah? Nine years later you guys was over there.
KC- That's when we went over there, yeah.
KK- That's pretty intense. Some of the Japanese, they never like Samurai you guys?
KC- I don't know, when I was in Gifu, I mean we never had no, no.
KK- Gifo was old city anyway.
KC- Yeah, was old city before. We was stationed over there with the Third Marine Division and we just, we missed the China War. We was supposed to go into China when the France was fighting. You know when France was losing the battle at Jenjenpo or something like that. We was for go, that was '54. We got all ready, we was supposed to go over and help.
KK- What year you came out of the military?
KC- Fifty six.
KK- Came back Maui?
KC- Then came back Maui.
KK- And when you came back Maui, where you went stay? From the beginning you was like Pulehuiki, Kahakuloa, Waihe'e, Waiehu.
KC- Then I went in the service.
KK- And then after service where you came back?
KC- Then I, '56 I came back, came back Maui. I went back to high school, yeah because I never go high school before. I don't know. Well, actually how I end up in the Marine Corps., remember six of us Maui boys? You remember Ralph English?
KK- English?
KC- The English family from one of the boys, Ralph.
KK- Who's that the….
KC- Uh, no the singer was the uh….
KT- Myrna.
KK- Myrna, champagne lady?
KC- Yeah, yeah, yeah. So anyway, six of us guys was walking in Wailuku Town. And where the, you know where the road go from Main Street up you turn left go Lahaina? Get the big building over there now, that big business over there now, right on the corner. Well, used to be the recruiting station over there so the recruiting station had uh, I think was the Army, Air Force, Marine and Navy.
KK- Right there.
KC- Right there, three things in one building. So, six of us guys we was walking up. So I was about 20 years old, the rest of the boys they was younger than me and plus they all went to high school. Me the only one never did go to high school because my mom pulled me out from Iao

School, yeah. So we walked by there so one of the boy says, “oh, gee uh what you guys like do, like join the service?” Uh, we all skinny oh, eh I was about 130 lbs. So, “ah what we going join the service? Oh, I don’t know.” But you get Army, Air Force, Marine and Navy da kine, which one you guys join? Oh, we go junk and po then. So, one of the boys went junk and po and end up right by the Marine da kine. So, oh we gotta join the Marine’s then. That’s what the agreement was yeah, junk and a po. So all six of us guys we walk inside the office and the haole Srgt., he was the recruiter. “Good morning” he said, “good morning. What can I do for you boys?” “Uh, Sir, we like join the Marine Corps.” And the Sergeant he tell us, “good, good come in, come in. Man, we love boys like you. So, ok, ah we go. Come, we going give you a test.” And the test was the kind easy kind you know the kind putting blocks together. So you know the boys they know how to do it.. Me, I only from Iao School, so took the test everything the other boys they pass with flying colors. Me I just barely make ‘em by one point. I think was, I think was 60 for pass and I had only about 50 or 59. Oh, ok. That was on Monday, Wednesday say come on report back here we going ship you folks to Tripler take the physical. So we went to Tripler take the physical and, and worse I had one lame foot from Kahakuloa School. I got hurt playing baseball in Kahakuloa when I was about 12 or 13 years old. Stick went through my foot from the bottom to the top. So we went to Tripler they pass me. They pass me. I was walking they pass me. So, pass the test physical everything, come back Maui. Come back Maui report back to the, that weekend they said Sunday report back we going ship you folks to Pearl Harbor and get ready for go San Diego. The thing move so fast so I told my mother, you see my mother and I she pulled me back from the Ho'opi'i family, I wasn’t happy because my, my, I take care Walter as if that was my real father. You know because most of my life was with Walter. So, I was kinda mad so I just want to get out from the family and go on, yeah. So I told my mom, “oh mom, I joined the Marine Corps. I leaving the following weekend go Pearl Harbor and wait for the ship coming and go to San Diego.” My mother tell “oh boy no don’t go, don’t leave us because we need your help.” I tell my mom I’m going.
KT- How old was she then?
KC- Oh, my mother was uh, I think she was in her 40’s.
KK- You got one picture of him, Kumu?
KT- Yep. So you didn’t finish telling me the story on how you get, all three you caught ‘em one time?
KC- No, no, no. The two smaller one’s as was, my friend caught ‘em but they was going throw the shell away. I tell ‘ah I take ‘em home. But the bigger one we was down at Kahe Point, we was camping. You know diving when I was staying Waianae before I move over here I had about 5 or 6 local boys we all dive for tako & fish. So, one weekend we was down at Kahe and was on one Christmas weekend. The water was rough and this boy he came from Maui, Kawai family Larry Kawai, I dunno if you know the Kawai family from Kailua. So, we was drinking and we had all our diving gear you know. So we seen this turtle coming up. Was one big turtle was about 200 something pounds you know, we was all feeling good. This boy Kawai from Maui he had a 30 odd six. So we watch this turtle going up and down, up and down you know. Was good about ah, I think about hundred yards out and the sea was rough and that was a winter month. Water was dirty. So the boy tell, “ah, what folks like chance ‘em?” Tell him I don’t know go ahead but if you go you gotta go pick that turtle up. So ok we gotta see what timing the turtle come up ah, ok. So we see ‘um coming up. “ok, here come, here come. Boom.” The head went, the head went flying but we catch ‘em. So, eh now everybody look at everybody say, “hey now we gotta go out go pick ‘em up.” And never had the turtle rules that time, never have

the da kine so ok. But we was all feeling good so the guy was something. Oh, ok braddah we gotta go get ‘em. No sense we shoot ‘em and then let ‘em go so, ah ok. Feeling good. Jump in the water with our fin and goggle. Me and him we swim oh geez, almost hundred yards out finally we look under water we see the blood yeah, but green yeah. The blood turn green. We look ,we look oh and there so we went down about twenty feet. So me and him went up with one side me one side we come up. Whoa two guys coming inside one arm like that. Like about, we brought ‘em on shore and we had to hurry up because ‘eh come on get going because shark bum by they might come around yeah. Ah, we put the turtle on the rock like that take ‘em up by the camp put ‘em on the table. Now who going kill ‘em? And this boy he, the Kawai boy he said, “oh I like turtle but if I kill ‘em…” But if he kill ‘em he no can eat. Somebody gotta kill ‘em so and me I don’t know how to kill turtle.
KK- You gotta stay away from the front, the two front yeah.
KC- My wife, she the one went kill ‘em.
KK- Oh yeah, no way!
KT- She was over there?
KC- Yeah.
KK- How long you married to her now?
KC- Ah, I married in ’84 I think so, yeah we married yeah. So she the one went clean the turtle everything.
KK- And what’s her maiden name?
KC- Uh, Au. Au, from Kahuku.
KK- Kahuku. And she went clean ‘em? She know how for clean ‘em?
KC- Oh yeah, she the one. She was brought up the kind life I was brought up too. The parent, the father, Au, Hawaiian ‘eh. Hawaiian Chinese. The father too was rough with the kids yeah. They survive by the old style yeah. So she killed, she killed chickens, she killed ducks, she killed turtle.
KT- You married a good wife then.
KC- Oh, yeah, yeah, yeah.
KK- She kill the pig too?
KC- Oh, yeah. This girl for make loco clean in the house, yeah. Make na'au, She no scared.
KT- So, um. The area of Wailea and Honua'ula before all you can remember is going down there for fishing.
KC- Yeah. And then I remember I used to go at my Uncle Charlie’s place. I remember when I was a young boy used to visit him. And his house was a old house, yeah. It was sitting on the shoreline and I remember we used to look from the kitchen, you know he had the old style kind you know, used to open. From the kitchen we look straight down in the ocean. But where and I don’t know what part.
KT- What was his last name?
KC- Kanoho.
KT- Oh, ok.
KC- He’s buried at that uh, that Hawaiian Church in Makena. You look at the, get his name, Charlie Kanoho.
KT- So the house was close to the ocean.
KC- I remember the house was close to the ocean.
KT- But those were fun days, yeah?

KC- Oh, that was fun days, and in that days I mean you never…hotel's now only Kiawe trees. So I remember we used to from Kahakuloa we all with all the fish we get in Kahakuloa we go Makena you know. So I remember we used to all dirt road before, all Kiawe trees no have the no hotel's nothing.
KT- So you bring your fish back home?
KC- Oh yeah, we bring back home.
KT- You soak 'em with the salt over there on the beach?
KC- Yeah.
KT- Used to have salt ponds, yeah over there.
KC- I remember when I was young, Walter before like you know in old kind days you know, they throw powder eh? Dynamite.
KT- So he used to dynamite over there?
KC- Yeah I used to go with him. Even in Kahakuloa.
KK- Short stick.
KC- Yeah, short stick, yeah. One time, one time I remember back in Kahakuloa back in the '30's I think up to 38-39 never have road go from Kahakuloa village to Lahaina. No road, nothing. And we used to, we had horse and the road used to go from Kahakuloa beach to the back road and that's it. Turn around come back. So I remember I used to go with uh, I was closer to Walter Hoopii than his boys but his oldest boy Walter Jr. Hoopii was about 4 years younger than me. So, I was mostly with the old man, Walter Hoopii. So I remember he used to go throw powder, and I go bag boy for him, eh. Whoa, I tell you one time you throw and pau go home.
KK- What kind fish was different fish in Makena and Kahakuloa? Had different fish?
KC- I don't know but the, the type or what you know. But I remember them days before, whoa the fishing Kahakuloa, Moe run. In fact, Moe, I remember when I used to be small kid Kahakuloa, the shore line. All that Kahukuloa area from the Kahkuloa point from there maybe all the way to, almost to Kaupuna, Makalele Point.
KK- All in the white water.
KC- Yeah was stomping ground when I was small. I used to hike all them mountains in Kahakuloa, you know the ridge. That red hill, I used to go look for our, sometime our horse always run away, back in the days before. Had all kind wild cows, eh. And our horse run around, so our horse every now and then kihele, so when I pau school from Kahakuloa School you know only 12, 13 years old, Walter said "whoa Stanley, you go look for the horse, the horse ran away again." All pau, I had to go up all the way in the mountain go look.
KK- That time everybody in Kahakuloa speak Hawaiian?
KC- Yeah.
KK- You speak Hawaiian?
KC- Well, when my aunty was, when stay with my aunty, she talk mostly Hawaiian. You know and I was picking up Hawaiian and sing Hawaiian songs. You know with Frank Ho'opi'i Sr. was leaving, he was the teacher of Kahakuloa School, and um….he was a principle. So I remember we was going up Kahakuloa School with Moke them, Moke Kaaa, the Kekaula's…
KK-- Joe's daughter just came back said he had a party and his birthday was just Saturday.
KC- Oh yeah.
KT- So, you came this side.
KC- Yeah, came back Maui. I went back to Baldwin High School twenty four years old. Twenty four years old, but you know I had paid $110 a month from the GI so might as well

make use of the money. So they paid $100, so I went back to Baldwin High School uh, '56,'57 to '58. I felt kinda real shame because all the kids I went look like one grandpa to them so I quit. I went to 10th grade, I quit. I moved to Honolulu in '58 and then in '58 that's when Honolulu was, the construction was booming, the H-1, H-2, H-3. Ala Moana Shopping Center we went build that. The Blaisdell Center all those days was the big contractor before, they had all the jobs, we built that. The airport, the old airport, used to be closer to Lagoon Drive. The whole airport the Hawaiian the they move 'em till now. WE built that and all the runways so, mostly all that houses that you see up at uh….
KK- Halawa.
KC- Halawa at uh Waleiki Ridge, Wailua Ridge, up Hawaii Kai. Pearl City, Pearl Ridge way up, yeah we built that.
KK- That's small subdivision compared to today now.
KC- Ha?
KK- Small yeah, compared to today?
KC- So my last job was the H-3 tunnel.
KK- Across the Pali.
KC- Yeah, that we worked on that town. Our company, trucking company, I was working for trucking company. We built the road from Halawa going up to the valley to the H-3 that's when they had all that uh, Hawaiian plants. So we went through that valley, oh that valley all that valley, it's a beautiful valley.
KK- Nice and green.
KC- Nice and green and it's just like you're going to Hana. Plus you can see we went to that valley we seen all that terraces.
KK- Oh the taro.
KC- Yeah, I mean beautiful valley.
KK- You used to grow the lo'i papa?
KC- Uh, in Kahakuloa, no. In Wainae yeah, my wife had a small little lo'i but I mostly for laulau yeah. But in Kahakuloa, all them living you know Moke Kaha them Samuel Kaha, Kekona family, Nakoa family. So in Kahakuloa uh, our place on our side, we never had lo'i, Walter's side. But I always go over to the makai side go help.
KK- Walter is Makai yeah?
KC- Yeah. But I remember Kahakuloa oh, before used to come you look down used to be just like had nothing but taro patch. So, I don't know what happened after our generation. Only stay only houses now. But before I remember we used to go from Waihe'e River all the way to Kahakuloa Village, every spin that you go only water come down. Today I go back Kahakuloa I look, very seldom you see any water in the stream. In Kahakuloa, that bridge where the kids swim in, I remember before when I was young we used to go swim over there. Me, Moke them, Daniel and Saul we used to swim by the bridge. And I tell my family, my friends, "our day's we used to swim from the ocean, the river, from there to the bridge you pick up opa'i and o'opu. Now no more."
KK- What about the Pulehuiki side you see the water come from the mountain go down.
KC- Oh, no, no, no.
KK- Never see? Had Koa tress before over there?
KC- Had plenty Panini.
KK- Panini, oh Panini.
KC- Yeah, from uh, Pulehuiki all mauka side was all Panini.

KT- What about uh…
KC- Below side, Makai side the Kula Highway, the old Kula Highway used to be pineapple.
KT- Oh that's what I was going to ask. What about sugar cane?
KC- No had no sugar cane up there.
KT- Oh, most pineapple.
KC- Yeah, mostly pineapple.
KK- What about, never had sweet potato up the mountain before? People was growing sweet potato like Makena side or Kula side?
KC- No I no remember Makena side yeah.
KK- Well, we appreciate the time. Thank you so much.

Interview: Kevin Mahealani Kai'okamalie

By Keli'i Tau'ä/ Kimokeo Kapahulehua

KT- Keli'i Tau'ä
KK- Kimokeo Kapahulehua
KMK- Consultant

KT- So, Mahealani, your full name?
KMK- Kevin Mahealani Kai'okamalie.
KT- Where were you raised?
KMK- Um, I was born in Keokea, raised in Honua'ula and various other places on Maui.
KT- For all the Kupuna we talk to, not too many are familiar with Honua'ula because the name wasn't used before. Compared to, you're in fact, out of the nine Kupuna we talked to already, only you use the name due to the fact that you were born and raised there.
KMK- Hmm.
KT- What about your Ohana, your family, did they use that name?
KMK- Yeah used extensively in my family.
KT- So, can you give outside of your family name, some other families that did they live there around there with you? Who are some of your relatives that could have grown up over there? Any at all?
KMK- Many, yeah.
KT- Like who?
KMK- Well, my father was a Kai'okamalie, the Kai'okamalie's were here long before the sugar, long before the white man. We can trace our, my father's side, you know family tree genealogy whatever you want to call it, at least seven generations in that one particular area. Honua'ula which encompasses Keokea to Kanaio and all the ahupua'a's in between which is Paiahu, Papa'anui and so on. But I, and my mother was a Purdy so along with the Purdy's came other names.
KMK- This is my great grandfather, yeah.
KT- Wow. So the entire family were cowboys?
KMK- Generationally I guess you could say that there were members of my father's family and my mother's family also they chose other professions. Such as back spin, working for the mill, going where the money was at the time, yeah. At the turn of the century.
KT- What mill are you talking about?

KMK- Pardon?
KT- What mill are you talking about?
KMK- Uh, at that time I believe HC&S, Pu'unene.
KT- Where was it located?
KMK- Pu'unene and Sprecklesville.
KT- Was there a mill in Ulupalakua?
KMK- Yes. The history thereof, which I'm semi familiar with, since I lived in the mill at one time or resided in the mill.
KT- But you never see it actively being used?
KMK- No. That was way before my time, way before my father's time. Probably before my grandfather's time, so I don't know any family member's have anything to do with the mill. Probably sold 'em by then because of it's prevalence in the area.
KT- So did you folks own land in Honua'ula?
KMK- Ah, yes my family still does. .
KT- Um, now and before, how did they use the land? Ranching, farming, anything….
KMK- Oh, to my knowledge yeah some farming, ranching also. Yeah, my father raised cattle, my grandfather raised their own cattle aside from the ranch. Yes, farming definitely there's evidence of that.
KT- I don't know if you recall the first time I ever met you?
KMK- I think Kahikinui I bet.
KT- Yes, yes, so that leads us to having a great desire to talk story with you. You're a man of the aina and the la'au, the kanu. Of utmost importance we wanted to hear from you on the plants you're familiar with in the ahupua'a of Honua'ula and the plants there.
KMK- is there a specific ahupua'a that, that you're looking into?
KT- Well, our assignment is Honua'ula but…
KMK- Ah, we no more enough time for talk about all the plant of Honua'ula.
KT- Right, so the one's that you are most familiar, the one's that might be endangered that this company should really consider looking at to see what kind of preservation they needed.
KMK- That would, oh boy. Honua'ula is, in my opinion, one of the larger moku's around Maui and well, I shouldn't say that. It was one of the most undisturbed moku's on the island of Maui and it would take some kind of a classification in breaking down the lands in an effort to understand it's biological significance, importance, it's value. So that would encompass the low lands so on and so forth.
KT- So the moku in general, is there…
KMK- Probably there is more endangered species than any other one particular land track that I'm familiar with.
KT- Really? More than Kanaio, Ulupalakua?
KMK- Kanaio is a part of Honua'ula.
KT- Oh, ok. It's the same passion you and I talked about when we were walking Kahikinui and so forth.
KMK- Yeah you know, Kahikinui, well Kahikinui is Kahikinui.
KT- Right. Honua'ula, yep.
KMK- Kahikinui is something else. Biologically it's probably one of the most restorable land tracks probably in the entire state. It harbors a lot, Kahikinui. Honua'ula, Honua'ula on the other hand has been more utilized by modern man, thus creating probably the innovation of a lot of it's resources but there's still a lot of microhabitats here and there. Botanically, ethno-botanically.

KT- How young were you to realize that it was important, or very important to learn about native species, our plants?
KMK- Twelve, thirteen, eleven, twelve, thirteen, somewhere around there.
KT- Somebody turn you on or just you?
KMK- Um, I guess my eldest brother sorta brought up the fact that my family was knowledgeable in, members of our family in the past, was very knowledgeable about Hawaii's natural history thus creating an interest in me at that age and at that time. I think we were hunting and when he shared this knowledge of our Kupuna.
KT- So as a young boy, what kind of hunting were you doing?
KMK- At that time goats. There was a lot of goats everywhere at that time.
KT- With guns or with bow and arrows?
KMK- Ah, both. I think I had a rifle and at that, on that day, and I think my brother was carrying a bow.
KT- No deer at that time?
KMK- Uh, I wasn't familiar….this wasn't, yeah this was in the seventies so the deer wasn't as prevalent as it is now. I mean even in the late sixties, there's very little evidence of uh, I mean of course the deer was here for fourteen years already. In 1969 was introduced in '59, Mayor Pueokahi, on Maui. So took a while for them to become prevalent probably not until the eighties, you know.
KT- If you can recall now, some people might be reading this document, or listening to this. If we put it on audio, who have no inkling of the lifestyle of a young Hawaiian man on the aina, would it be possible for you to be out there with your brother's or yourself, or maybe your brother because you mentioned it. Or your father and you folks walking on the land, hunting and while you're walking, dad or brother says, "Oh look at that plant." Or, "Look at that plant." Is that how you pretty much learned that because while you were, you just walked it and you saw it and they talked about it.
KMK- Yeah, pretty much. I guess I remember you know, my eldest brother, my father died when I was young. So my eldest brother pointed out something, um I can't remember what it was at this time but, yeah, eventually I became very interested in the plants of Hawaii in an effort again to identify with who I was or who I am still.
KT- For young people it's challenging to get turned on to plants cause plants no talk back, they don't..
KMK- Yeah, I noticed.
KT- There's not a two way communication that human beings tend to draw towards. So, so, I'm trying to get into what was the communication with you? What did you hear, see, feel, touch?
KMK- All of that. I heard, I saw and I felt something.
KT- Describe, describe that.
KMK- Oh, just when I'm…
KT- Take a plant.
KMK- I mean, I don't know, you know growing up, you know there were people paddling canoe, there were you know, there were other Hawaiian's dancing hula. Um, when I was growing up there was no Hawaiian speaking Olelo Hawaii but I remember, you know, extensively paddling canoe and dancing hula and that was the two Hawaiian activities. And though I appreciated those acts of Hawaiianess I was, I was….
KT- You weren't drawn to it?

KMK- Um, I was but yet felt there was more. You know at the time growing up as a child in the seventies, um this the only Hawaiian things that you were exposed to; paddling canoe and dancing the hula.
KT- Yup.
KMK- You know, and I knew there had to be something more. Um, and then there was a lot of talk about the (farmer) mahi'ai, you know and taro. And then both, you gotta manage our land, our aina. I went look, wait a minute. I only see X amount of Kalo on this land, you know what is the rest of it made up of? And thus that peaked my curiosity I think trying to identify with this word called Hawaiian and being Hawaiian because I wasn't being, I probably was. You know being raised Hawaiian but just didn't know it at the time because we take all that we have and grow up with as youths, probably take it for granted. You know and probably don't appreciate it until we start to, our minds start to, you know not wander but our minds start to think about who we are and what we are and where we going be, you know in this thing called life. And for me that was around the ages between eleven and thirteen when I started to think about things on my own without being guided. So, you know and walking through places you know, such as Makena um lower Kanaio, you know with my fishing net, I can remember that not going to school. You know cutting out of school just to go throw net. I remember leaving bottles of water, and was glass bottles, back then shoyu bottles, filling 'em up with water leaving 'em here and there. You know one day just tripping around knowing that we going come back to this place. Or the next day, you know to fish or whatever, depending on what we were doing if we could get a ride that far. You know, we 'eh go fill up bottles with water, you know. But yeah, through walking the land, starting to notice you know the changes in vegetation, the more….. the less people you saw, the more vegetation there was so it started to peak my curiosity, you know and fishing the lowlands and hunting the Maui 'äina and the mauka lands, um you know you notice things like this once a man or a person I should say, starts to think about you know him or herself. You know as a human being, you start to develop interests in life and for me that began between the ages of 11 and 13. But I found time to come to what we called is the city at that time we make mischief too but you know, I never forgot our roots and then later on took it to another level as far as interests were concerned. I lost interest, it became my responsibility, or I felt it to be my responsibility to understand all there is to know about Hawaii's natural history, including it's scientific significance in the populace. I think it's an important part, a very important part of our culture. Probably the most important part of our culture aside from your 'ōlelo because in my heart I believe, you know the simple fact that over ninety percent of the time things in Hawaii are endemic, meaning found no where else in the world. It is my opinion that it is Hawaii's natural history, or it's biology that redefine the Polynesian and made him a Hawaiian so that's just my personal opinion. Others see differently, some others feel nothing when it comes to Hawaii's biology. Feel nothing, know nothing, and choose to know nothing. But it's, I feel it's changing, especially in the last ten, twelve, fifteen years. Unreal, I could count on half a hand the amount of native Hawaiians that knew more than three native Hawaiian plants. Now, now it's countless the amount of native Hawaiians that have, you know that are now interested.
KT- You have pioneered the area and that's what I was going to lead towards. In your opinion, outside of you, on this island, who are the more knowledgeable Kupuna, Makua, down the spectrum of really know about, you know the natural history, you know the plant.

KMK- Interesting question because um, you know at the time when I desired to understand more about Hawaii's natural history or it's biology, um I found that there was no Hawaiian's that I could turn to.
KT- No one right, no one.
KMK- Yeah, there was no one, at that time. At that single…
KT- On this island?
KMK- Yeah, on this island. Um, and then later I, you know not that much later I met a man named Rene Silva. After going to, after visiting some agencies, you know with my curiosity of things that I wasn't familiar with; um some individuals referred me to Rene Silva. I don't know why, they just noticed I was Hawaiian, I guess. And every time I walked into an agency, be it the Department of Land and Natural Resources, uh The Department of Agriculture, they you know, they found it quite peculiar that you know, here was this twenty something male Hawaiian interested in things that most twenty something people period were not interested in. Um, and it peaked their interest, I don't know, sometimes fear I guess. Sometimes I would come straight out of the mountain and I, you know, hadn't showered for four or five days, you know, at a time. And I don't know if you seen a man who came out of the mountain after four or five days, he sometimes look pretty scary! So, at times you know with experiencing anxiety, you know in an effort to understand what I had in my hand or had collected. I would go into the mountain for days at a time for the specific purpose to just collect vouches of things that I wasn't familiar with.
KT- Like, as an example…
KMK- Like, as an example?
KT- One excursion, you came back, what was in your hands?
KMK- What was in my hands? Oh, the list is endless but I remember one trip that I took and went into a few gulches in the Kahikinui area and let's see, one, two, three, three of the plants that I had collected had not been seen in decades. And in one case they thought to have been extirpated, at least from the island of Maui, a Hawaiian fern that doesn't have a Hawaiian name. Well, not doesn't have, we don't know the Hawaiian name anymore, that's how rare it is, that plant's the Molokai named after the island of Molokai which is the only place they thought had to have existed at that time. Um, referred to by Hawaiians to the entire genus. Um, a lot of the species in the family were referred to as Ha or Haha hadn't been seen in a couple decades, I guess. a native tree fern, not be confused with the hapu because this fern actually grew on a tree. And the one that I collected was growing on a Koa tree. Um, I knew by it's looks that it was a Waiwaiole but it looked different from the one I seen growing on the ground. The one that was growing in this tree, definitely was different. In my opinion in speciation, uh probably the genera was the same, which it was but I knew it was a different species from that, from the common Waiwaiole I see growing on the ground. So, I collected that. Um, those are the three of note on one particular trip but you know, I'd gather all kinds of stuff like Maua and various species of um even whoa there was even a curious Akala that I collected. Come to find out it was a rare variety of Akala. You know I noticed there was some physical differences in it's appearance and so I collected it and I believe it was Fern Duvall that I first ran into. He's an ornithologist with the State of Hawaii, or at that time he was a ornithologist, I don't know what he does now, something different. But anyway, he said, "wow, this is…" ah I can't remember at that time, I have it written down, though. I haven't been doing well in the last couple years, physically so I'm a little rusty.

KT- So, Mahealani, you had looked in books about these plants before you went. So when you went and you looked, you compared what you saw in books and pictures and then realized then that was the kind of plant that you just referred to.
KMK- Yeah, yeah. Well, you not used to being able to identify families and genera, yeah. Definitely, but then it comes down, come in, I think five categories in a family you have a genus, you have a species, you have a sub species, and then you have varieties. So, so the first two parts were somewhat visible, you know right off the bat, you know. The family and genus, but oh boy, when you get into species, sub species and varieties, it's a very, very interesting world. And the great part about these scientific classifications is the ancient Hawaiian's did it too. You know they have more names for Ohi'a's then science does. You know, so they noticed, they noticed these slight or miniscule differences in these plants that grew in Papa'anui from the one that grew in Kanaio, from the one that grew in Hawai'i, from the one that grew in , from the one that grew in Kanahena. You know, despite it being the same plant, it had differences and the ancient Hawaiian noticed these differences. And when I found that out, I went like, "Wow!" You know, we are as brilliant now and yesterday as the scientists' think they are today. Or claim that they are today by, you know the only difference is we didn't have the means to document it in writing. Only in 'ōlelo and unfortunately through the genocidal acts of a foreign country, that knowledge was lost.
KT- And, are you, you went through the different ili's, or lele's, or moku's where each of the plant was located. Can you give name of the one that was at Makena and Kanaio because you trace a genealogical sequence of these plants were the same but little different. Maybe in color, maybe in size, maybe what was hanging on it. Like for example as you pointed out; Ohi'a, a wide perspective of Ohi'a pua ahihi was generic to Makiki on Oahu but still a lehua. And right up in Ulupalakua they had, right in front of the store was Lehua Melemele or they might have had another name. So, are you, did you make the comparison as such that the one you found in Ulupalakua had a name and you went to Kanaio, had the other name?
KMK- Um, unfortunately in most instances um, in most instances, not all in most instances those differences were recognized only in scientific terms and not in 'ōlelo. But, um I've tried to come up with some Hawaiian terminology for plant differences and I'm finding it quite difficult with the exception of the, the Ohi'a. You know the many names for the Ohi'a, Lehua Mamo, Lehua Ke'oke'o. Um, Ohi'a Ha just some differentiating in color and some differation in their actual physical appearance. Oh, you know Maile is a good one, you know there's the mountain, there's two mountain Maile, you know one is called Maile, one is called Maile Lauli'i which is a tiny leaf now, not a small leaf. Maile, but an actual tiny leaf, you know Maile so that's one example. Like I said unfortunately, you know the changes that took place you know, particularly in the last hundred years. You know, which in the millennium of time, is a very, very short time. Very short, it's a snap of a finger, a hundred years. It's amazing the knowledge that, that was, I hate to say lost.
KT- Not lost.
KMK- You know it's not lost, you know that's the wrong term.
KT- It's there for people like you and others you might have privy to groom. I'm only saying this from personal experience from where I was and where I am. By having people say, "oh, no it's not there, it's lost" and then diving into it and getting it. So, it's there but it's going to come to people like you and others, those that you train and so forth. Because they'll bring in a different spirit and they'll be able to connect to that spirit.

KMK- I agree, and I agree and it's no longer a hope because it's already happening, you know. Um, you know fortunately people like Rene Silva that have been able to influence the Makua to, to at least have a common knowledge of Hawaii's botanical treasures. Maui is a botanical treasure and I see it every day now, you know, driving through neighborhoods. You know it's not something I saw as a youth, or even as a young adult. Native Hawaiian plants being grown by everyday native Hawaiians, even non-Hawaiians. And you see it in people's yard's now, you know, Hawaiian plants. It's about time. I remember a conversation that I was having with Arthur Mederios.
KT- Now here's another individual.
KMK- We have, I was, I think in my early twenties when I met him. He actually flied me down. I was on my motorbike at that time. But anyway, I became friends with Arthur Mederios after a first confrontational meeting, I think. You know being a Hawaiian from Honua'ula and you know, my family, you know coming from the Big Island and moving from the Kipahulu area until finally settling in Ulupalakua. Um, you know, I grew up in a manner that you were supposed to be responsible, you know as a native Hawaiian. As a male in particular, you know, that was influenced partly by my eldest brother, by my uncles. You know how to be, and thus, I developed a personality. And out of that personality was born an attitude, you know I saw mistreating the land. And unfortunately those people were of a different shade of skin from me. So there I developed a, and when somebody of a different shade of skin possess more knowledge than you do and is checking upon your backyard, I going take offense! You know I started to hear about this guy named Art Mederios. Everywhere I turned because of my interest in Hawaii's natural history, particularly in Honua'ula and Kahikinui. Apparently when I was walking around in the one area this guy named Art Mederios is walking around in another area.
KT- But close by.
KMK- But close by, I never met him so, um…. So I guess there was this brief one or two year period where he and I kept hearing about one another and you know they're saying, "eh, there's this Hawaiian guy." I said, "what?" "You know there's this young Hawaiian guy I mean, you know that we haven't seen in a long time." So I guess that was what he had heard about me and every time I ask someone that I thought had vast knowledge or broader knowledge of Hawaii's native plants than I did, his name kept popping up. Whether it was Richard Nakagawa or Rene Souza, or Bob Hobdy, or who was at the nature conservancy at that time, more haoles but yeah Mark Deflin he say hey, I go anywhere. Because you know, I don't consider myself to be a prejudice but since so great wherever I can gain knowledge of things Hawaiian, not just plants, I going ask. Regardless and I going, you know, you gotta have a degree of respect for these non-Hawaiian's that treasure our culture, that respect our culture. Unfortunately, most of them don't, you know, the vast. But you know to those native Hawaiians that were very helpful in helping me, you know, God bless them because I wouldn't have been able to do the work with the youth of Hawaii. With the youth of Maui, you know that I did without their respect for our culture because they're instantly, you know, boom, they dig in my background. They just said, "wow, you're a native Hawaiian who care, unbelievable, you know. Here we are to help you." So, I guess they were frustrated as I was at that time that there were no native Hawaiian's actively pursuing ways to preserve this very vital part of our culture.
KT- As far as you know Rene is not Hawaiian?
KMK- He is Hawaiian.
KT- Yeah, he is because he is Lopaka Aiwohi's uncle.
KMK- Yes he is.

KT- Yup. So, you got all this knowledge growing up but you were collecting that knowledge through brother and dad unbeknownst that this was valuable information.
KMK- Valuable, I don't know valuable. Cause I don't know. I think that's an understatement.
KT- That's why we're here talking because we put, we try to define value, you just spoke it in terms of now all these, pardon me, outsiders who come and build, see the value of native plants in their back yard. That's the value. What native plant's does for our aina, that's the value. Because native plants that can survive on our aina, makes the aina ulu or grow. If you bring in as we know, all these other species that become endangerous to the environment, it wipes out the whole community of plants and eventually us as an example. Like the Miconia can be very destructive so native plants, knowledge of it, valuable. From my eyes.
KMK- Invaluable. Um, response to that, yeah you know, as strong as some people, I don't know. I just chose. I believe all native Hawaiian's growing up at the time I did, had difficulty identifying what being a native Hawaiian was. I was interested in all kinds of things but I kept noticing this pull, and I believe that pull was spiritual. I believe it has something to do with the fact that my father loved and respected. It was a difficult time, the cowboy time, especially with the great cowboys, and I consider my father my grandfather to be great cowboys. Cowboys not supposed to go play with plants. (laughing) You know the wahine's went go play with plants but you know the stories I hear from Dr. Fleming's daughter and my aunt's.
KT- Who was... Who was your aunt?
KMK- Oh, Vivian, Dolly Kai'okamalie, my father's younger sister. She's the only one in our family that actually had first hand account of the love that my father and my grandfather had for native plants. Not aloud but.
KT- She's still living?
KMK- Yeah she's still living.
KT- That's who we gotta get to.
KMK- Okay. But yeah, she was, I was already head, you know up to my nose in, for lack of a better term, loving the 'äina already when she shared her stories with me. Of course I knew my grandfather because the scientist had already told me about my grandfather. Wow! You know, everywhere I would go they would ask.
KT- Oh my gosh, Mahealani! Your grandfather is in the books that I have been reading. I only see his name now. I can bring you references. That's the man.
KMK- Everywhere I would go they would ask me the question, 'Who is William Kai'okamalie to you?' and I says, 'My father.' And they would look at me like I'm lying and I remember one person saying, 'Oh, you're too young.' It might have been Dr. Lyons from, not Dr. Lyons, not Machelic, that was the shell guy. Oh, God, I remember Par telling me that they arrested this guy in Hawaii for trespassing and he died a few years back and I met him like three times. But I remember him asking me who William Kai'okamalie was. He was the botanist at Lyons Arboretum, damn he's one of my hero's and I can't remember his name right now. But anyway, he had asked me and I told him he was my father and he looked at me and he said, 'You're too young.' You know, real stand offish like, don't lie to me, kinda. The way of speaking to me he said, 'You're too young.' I said, 'Oh, my grandfather's name was also Kai'okamalie.' And he looked at me. I had just given a talk, in fact, on Kahikinui on the area at a conservation conference and he looked at me and there was a tear that started coming down this man's eyes. You know that was the most touching experience but everywhere I would go, oh God, Dr.Lameru, very, very interesting man. I didn't know him very well but during the times that I had the privilege to be in his presence was, it's unbelievable. You know when, you know us

native Hawaiian's we all love our culture, we all love who we are. We all now have a profound respect for who we are, you know this sense of being proud of who we are. But to see non-Hawaiians, you know to have that same passion, whoa, it's an incredible thing. You know, and it cause me to have a more profound respect for other cultures as opposed to just diving into ours. I read a lot about the Mayan's and various other Indian cultures but the Mayan's in particular peaked my interest because they were ahead of their time. It was an incredible thing. You know, I likened the way….boy you know, we have over two thousand names flowering plants in Hawaii. Our culture, our culture now, is less than two thousand years old. (laughing) That's an incredible feat in my opinion to give names to over two thousand species and varieties of flowering plants, ferns and grasses. Boy were you, that's the amazing thing I recognize you know, in my personal pursuit to understand hopefully all I can, or all there is about Hawaii's natural history, about it's botanical treasures, from the Hawaiian perspective and from a scientific perspective is. You know that's gotta be one of the wonders of the world, you know, the fact that we went name over two thousand plants, being one of the youngest cultures in the world. You know, a mere sixteen hundred years old, you know the Hawaiian, the native Hawaiian. The biological significance of where we are in relationship to the development of a culture in a mere fourteen or fifteen hundred years before Captain Cook came and developing a cultural system of living, breathing, surviving. You know I think it was an incredible thing and everything you look at, you know, our culture involves a plant or more. Everything, from the hula; there's twelve hula plants. From building a canoe; from the hull to the, from one end to the other of a wa'a. You know, one plant of another, one tree or another, you know was implemented. You know everything we did, you know every day survival depended on our surroundings. And the fact again that over ninety percent of the flowering plants in Hawaii are endemic, boy. To me it is the most vital part of our culture, aside from our ability to communicate with one another is our plants. And here in the new millennium… Honestly I never thought, the way I was going, I never thought my body was going to survive this long, and I'm a young man. It's just I dove hard and I feel very fortunate to be alive, actually despite being in my early forties. I don't know, I feel lucky to be alive to see, not the renaissance, but that's the wrong word. The revolving of the native Hawaiian and the acknowledgement of our plants, in my lifetime is a blessing. I remember trying to impose upon other native Hawaiian's how important the plants are. They acknowledge that, yet desired not to know anything more than that. And now today, these young Hawaiians, and you especially these young Hawaiians, the University of Hawaii studying to become land managers in an effort to manage our resources. Boom! It just happened man, in like fifteen years, in like twelve or fifteen years. From not even being acknowledged as a vital, vital meaning present day, part of our culture. All we know was maile, go get a maile go dance the hula. You know we get bougainvillea's and plumeria's on our po'o, that's always the wrong plants. But more and more I feel very blessed because I thought this day would never come, not in my lifetime. You know, even native Hawaiians would recognize how vital our non managed lands are, for lack of a better term. Kalo, the hula and the canoe paddling, people acknowledge the fact that these resources are still all around us, you know. I don't care where you are on the island of Maui, you park someplace. I don't care where you are, within five miles, within a five mile radius of any point on the island of Maui, I can take you to an endangered species. Any point, any point on this island, I can take you to an endangered species. In other words, present day, it's a part of our future. It's not a part of our past, brah, it's a part of our future and we should be doing everything we can to preserve every ounce. Not just because you know, get ilima lands on West Maui we going denude all the ilima

lands despite it's commonality in the biological community. That doesn't make it ok to destroy it. To build, you know, public's it's inevitable. Inevitable, what is inevitability? You know when you're dealing with the people's and it's not just about plants, the things I do with my life, in my life in the community. You know, it' isn't just about plants, it isn't just about a family thing, it's about all of us. I believe this desire is an unselfish one and those people that surround me, or I've surrounded myself with, you know we just want to be able to preserve it long enough for the next generation of native Hawaiians, or whomever, to come up with better solutions. Because modern day man brings with him the ability to wipe out everything that defines people of culture, yeah so all people of culture we need to. Not just native Hawaiian's but all people of culture. Americans, they have no culture, so they can't, they don't get it. They can't fathom the significance and the importance of one plant. I would stand in front of that dozer for one plant because it's not about one plant. If there's only one population, there's another population of Maheapilo down the road braddah. But we're not talking about that population of Maheapilo's down the road, we're talking about this one. That's just me, you know. I live in a development, you know I exist in a development, you know with my sore back I have right now and right now all I have is my books and my field notes for now, until I, I hope I become healthy again. But that's how important it is, the native plants of Maui, the native plants of Hawaii. It defines us as a peoples.
KT- In your neighborhood of Honua'ula, if you can recall when you were growing up, the most significant plants that were there when you were growing up that you've seen and that you'd like to see forever that you don't see too many other places but it's there. Especially in the area we're talking about.
KMK- Yeah, you know, the funniest thing is um, just in my lifetime things have changed. Land has evolved into something that is, something very un-Hawaiian. The pasture lands, just in my short lifetime, I've seen tracts of land, I mean the Uluhe plant, when I was ten years old, through the Kahikinui forest was incredible. Now you cannot find Uluhe, it's a very common fern, very, very. The most common fern, Uluhe. If you drive around east Maui, on the windward side of east Maui, man I remember Kahikinui, man. Gee, I couldn't make my way through it, it would terrify me to see Uluhe because I knew I had to get from point A to point B. The only way to point B was through the Uluhe. Now you cannot find Uluhe on the ridges, only in the gulches. So, just in my short lifetime... So you know that's one because I was terrified, I was petrified of the conditions because I was too small, other plants of interest of course.
KT- What wiped them out? And now that you say, I can see it in my mind's eye,
KMK- Yeah, well the introduction of ungulates, you know way back when from Vancouver's time, you know, all the way up to the present and the management and or the lack thereof of, of these ungulates or these hoofed animals is what's cause the denudation of habitat. Yeah, pigs, goats, in particular, pigs and goats in particular. Um, and of course cattle. Us descendants from the Paniolo we like to think that they were always managed but till this very day we still have wild holoholoa(animals) on the island of Maui. And when I say wild, yeah. If you stumble upon one, you know, you may get hurt.
KT- Yep.
KMK- If they see you from afar, they will run. But if you stumble upon one of these animals, and I speak from personal experience, dodging, you know, dodging a twelve hundred pound hoofed animal behind the, wasn't a tree, oh boy. You know, a twelve hundred pound animal in the forest, uneven terrain, he has the advantage. So, till today we still have these hoofed animals. Hopefully they're more managed. You know there are spikes in their population growth and

right now we're experiencing a spike. Nearly a two thousand one. Five, six in particular the pigs and goats. You know we've noticed a spike in their population growth, despite it being that, I don't know, some say it's because other lands are being more managed today. We're seeing spikes in other areas. So if that's the case, then it's a good thing, but other significant plants was the Mamane tree growing up. Um, I remember the Oheohina, there's an Ohimauka and an Oheohina, Ohimakai. But they were statues' trees, I remember, so yeah, there wasn't that much because they was used for the Ohia. You know and my father's later day life the mamane firewood, you know for make imu. You know most people think Kiawe was always here. Kiawe is an introduction. It's an interesting story. They say the father or the grandfather or the great-grandfather of all the Kiawe trees in the State of Hawaii, well, what some people refer to as the State of Hawaii, comes from that one tree in Thompson Square in Oahu.
KT- Wow.
KMK- I find that story too interesting to not believe because it's an example of how non-native plants, when arriving here without their natural enemies to keep them in balance can do. You look much of the kiawe on our leeward east Maui, it's kiawe. I mean if you ever have an opportunity to take a helicopter ride from Kahului Airport going Mauka, above Omaopio, or getting into the Omaopio and the Pulehu area, going straight across to Makena, the dominant species is Kiawe. The dominant.
KT- Tree, yeah.
KMK- Yeah, you know, biology. You know seems monotypic, when you get into the microhabitats and then you start to see the Wiliwili lands with the Keahi trees and the Lama trees and the tiny plants like the Nehe and all that stuff. But just like the people of Hawaii.
KT- All those plants you just mentioned are all found in Honua'ula?
KMK- Yeah. Yeah.
KKMK- Yes, all of them. The Keahi, the Lama, Iliahi and I can go on and on right off the top of my head I can probably name fifty trees, just trees that existed in Honua'ula.
KT- But they're overrun by Kiawe.
KMK- They're dominated by Kiawe.
KT- Yup.
KMK- And it's up to us, you know, it's up to us. I think, you know for me personally, much of the battle, much of the battle in this….I wouldn't say gone, I just not healthy, that's all. Fortunately, you know throught working with people like Rene Silva, Anna Palamino, Art Mederios was able to, oh boy that's the man, have been able to influence the significance and the importance of Hawaii's native plants. You know, introducing them back to the native Hawaiian. It's encouraging to see keiki blurting out names of Hawaiian plants. Unreal! It's a great thing.
KT- Where did you see that?
KMK- Um, where did, right while being employed on the Ranch and welcoming Maui's youth to come and see native Hawaiian plants. That's remarkable to see that how much percentage of these young Hawaiian kids already knew. Yeah, and being involved in other facets of the Hawaiian culture, just going on ecno hikes, I guess. I hate to use the archaeological. Just going up on looking for cultural sites, you know, with groups of people and seeing their kids. 'Oh, Papa look, Akoko. Oh, Papa look, the Ilima. Oh, Papa Amai'opio . You know, and you didn't see that just ten years, twelve years ago, never. You would never see that so, in a short amount of time, for some reason, you know, like I said earlier. I thought this day would never come. I used to cry in the mountain. I'm a big boy, I used to cry in the mountain. You know, when are we going to get it? I remember trying to solicit funding from the United States Fish and Wildlife

Service and taking them on a field trip in Kahikinui and despite them willing to give the funding, they weren't getting it. You know, it wasn't about the money, the field trip wasn't about the money, it was a portion of the field trip. The purpose of the field trip was to show them and inform them that there are native Hawaiian's out there that cared. Whose sole life passion was to hold on, to preserve these very, very rare habitats. The habitats in particular more so than the individual species, what was happening to our native eco systems. The habitat destruction caused the dissipation in speciation or biodiversity and I knew it was so important. I don't care if you get one hundred endangered species. If you don't have a habitat for those endangered species to exist in, you have no plant. That plant will cease to exist, inevitably. Maybe not today, maybe not tomorrow, maybe not next week, inevitably it will die. The purpose of the field trip was to inform them that there a group of, at least one group, of native Hawaiians that got it, that knew it. But, come to find out, they're the one's that didn't get it. You know, it was the experts. And their frivolous mannerisms, you know, in a very spiritual place, you know. I remember it was around Thanksgiving because they were talking about turkey and sh** and I couldn't help but walk off from the loop and… What gulch was it? I think it was an off gulch. Was it Kamaole? Must have been Kamaole, I remember going into Kamaole Gulch and just visualizing the faces of my eldest brother, my father and this vision I have of Akua. I was saying 'Bless them.' You know, I was angry, so angry I wanted cry. So angry I did cry. I don't know, it's hard to find anger and hate when you're in such a spiritual place. And I saw that and that moment changed me forever as a person. You know, I not going lie. I grew up angry. Very angry. Um, but that moment with the non- Hawaiian, the Hawaiian and the scientist, you know, in a very spiritual place, it changed my life forever. At first I was angry. I had visions in my mind of beating them right then and there. You know, visions, actual visions of beating 'em and I walked off. I realized they was funding for us, in these people that I wanted to beat. And after walking into Kamaole Gulch I realized, wow, you cannot blame somebody. You know there are other facets of life that I'm ignorant in, you know, so forgive them for their ignorance. For they not know who or what we are. I thought they would. They were the one's actually pushing for the funding; all we had to do was come up with the plan and another plan to execute the plan. You know, that's all we had to do. And in our minds at the time, you know, it was the activities. Management activities were fairly simple. Very, very difficult but in theory, simple. It changed my entire life right there. Right then and there I knew how important it was to get out and share whatever knowledge I had with whoever would listen. That one moment changed my life and that's what begun this process of physically, actually going out. You know at the time I didn't know how to do it, going out and soliciting groups of people to come to my backyard and share with them. You know, I look at that mountain as a part of me. In particular the leeward side because it's been so, what's that term? Not ignored.

KT- Passed over. Passed over.

KMK- Yeah, they say that land was destroyed you know. So they were telling me in the early days, you know, when I was going asking, you know. Just naively walking into agencies saying, 'You think you guys get some money so we can protect this stuff?' No, that's not the place to spend money at the time. Restoration was not, was not in anybody's vocabulary. You know at that time was a funny thing. 'Restoration? No we don't have money for restoration. We live in the real world.' You know that twelve, fifteen year journey, these last twelve of fifteen years was an incredible one. All kinds of money going into every island on the leeward side, you know today. And it's just, I like to believe despite….there are other projects going on, you know, on the Big Island. But nothing like what was happening here on Maui. You know the

support of the community at whole. Even the non-Hawaiian community, we have work parties, work days. More non-Hawaiian's than Hawaiian's showed up for these work parties. And these work parties consisted of humping Keawe posts over lava fields, you know, to go protect individual populations of things we felt important. Never mind what science says. This is what we viewed to be important. Science not going help us. We went out and we raised our own money to buy fencing material to protect our cultural resources from further denudation by animals and loss of habitat. And now you go, you know despite it being small areas, you should see it from an airplane now. Last time I flew to the Big Island, I was flying back, you could see the work. You could actually physically see from the air, you know, the work that's been done in the last fifteen years. And I like to think it's happening on all the Hawaiian Islands because of what took place here on Maui. And that's how special we are on Maui. And that's how special undeveloped places, such as Honua'ula, Kahikinui, Kaupo are. Very, very vital to the survival of our culture and us as a people's.

KT- We've been spending a lot of time on plants. But in terms of cultural significance in Honua'ula, what areas or, items, or sites, are very valuable to you?

KMK- The funny part is, we were just working in a corral couple months back. Same corral, same proximity. Same corral that my father worked in, that my grandfather worked in, my great grandfather worked in. I know this because I have actual pictures of this actual corral that my father worked in, my grandfather worked in and my great grandfather worked in. Just a couple months ago, literally in tact. Wendell Wong looks down from his horse and goes, "Hey, what is this?" (laughing) The Ulumaika right there. Hunting…Oh, where was this place, Kanaena. We call it Kauai pasture. We was hunting this place called Kanaena. Walked over this stone wall to go retrieve one deer. Go down, cut the deer, walking 'em back up, climbing over the same stone wall, the exact same place. In the wall lies a poi pounder and this is just nine months ago, one year ago. Cultural significance? Hmm…cultural significance, culturally.

KT- They all are one.

KMK- Yeah, you know, culturally, you know, period. Places like Honua'ula, you know in my opinion, gotta stop already. You know I've seen plans to develop much of what's left of Makena. I've seen plans drawn up by the land owner's. Three of 'em. This was by accident. You know, I don't know. Development, in my opinion, should be concentrated in areas where we're not going futher in desecration of our culture. In the tracks of land, you know, open to such things. You know if it's inevitable, you know, get cane fields that's all being, you know. But places like Honua'ula. You know despite it being extensively. You know, the cultural significance of land such as Honua'ula, Kahikinui and Kaupo. There's not many places where you can just walk and see… I don't want to say the past, because people say the past is the past. That's not what I said, that's in the past. Seeing me, seeing who I am, you know. And that identification is very important to my future, I feel, because it defines who I am. Integrity, you know, as man. I see hard work in the cultural side. Ask anybody's working, they going tell you that's one of the hardest people I've ever been around. See, it's not just our past, it defines who we are. And you know, define our future as a people. That's how important places like Honua'ula is for our keiki. There's places like Honua'ula, Kahikinui and Kaupo that's still harbor our history. Our natural history. Our cultural history. Those places should be preserved inevitably, for that simple reason. Because these are the last Hawaiian places, Honua'ula, Kahikinui, Kaupo. In my opinion the most, again I don't like this term, for the lack of a better term, these three moku, in my opinion, are the most culturally significant. Culturally valuable. And it's not just because of the cultural sites that exist there but the botanical treasures. And it

separated us, the plants separated us and it allowed us to have a culture. It's the plants in my opinion. Again, you know, we're trying to talk about culture but that is the culture. The plants, it is the most vital part of our culture. It defined us, it separated us. Not just the miles of separation between continents or other land masses.
KT- I must tell you Mahealani that this information is very valuable. You present cherishable memories of Honua'ula because you present detail information. So very valuable, this information that hopefully people that we're doing this for will really look at your words. Really, seriously what they're proposal. That's why Kimokeo and I go at this with passion because we're collecting vital data to assist in the preservation as much as we can.
KMK- Yeah, there's no, I mean, lot of things have been documented. I mean places like Honua'ula, I mean just…. If you were to be dropped, you know aerially, anywhere in Honua'ula, it's a hop, skip and a jump to the nearest cultural site or something significant. Siginificant in Hawaii. Literally anywhere in Honua'ula, Kahikinui and Kaupo a cultural site, a rare plant or significant plant. It doesn't have to be rare, you know, a plant significant to our culture, a cultural site. I mean the fact that we're finding Ulumaika in one cattle pen that's been used for at least four generations, for at least four generations, Ulumaika stay popping out of the ground! You know, slingstone, brah, slingstones was another, in this corral. Thousands, and thousands, and thousands of head of cattle were processed through this pen, brah, and we're still finding. I know 'cause we're finding part of our culture. You know, it doesn't seem like much but try think of that one. One cattle pen, brah. Imagine what's outside of that cattle pen in these less disturbed tracks of land, Ulumaika. I mean finding one poi pounder in the year 2004 or 2005 in one stone wall, that's cool brah. That's cool. Most people may not be able to appreciate little things like this. You might have to be Hawaiian to have that appreciation.
KT- And then like you said, even now, some non-Hawaiian's have a greater appreciation than Hawaiian's for those kinds of finds. Those who have been schooled in the importance of our culture.
KMK- Yeah people, fortunately, people are people. I don't know. We, yeah. A lot of non-Hawaiian's out there that actually deserve to be respected and appreciated. You know, that brings us back to a whole nother….
KT- But I've been keeping you here sitting in this position, I know it's uncomfortable. So, you want to say any last words in respect to this?
KMK- Um, no, just again to reiterate how significant. I don't care if the property is dominated in the Kiawe trees. You know, the fact that they, certain lands in Honua'ula are dominated by Kiawe trees, you know. It doesn't take a whole lot of effort. All you need to do is look around and you going see. You going see the Native Hawaiian right there. You know, whether it be in a cultural site, a plant, a heiau. Yeah, you know, places like Honua'ula, Kahikinui, Kaupo, again should be taken out of the development realm. Just because it's the last Hawaiian places on the island of Maui, in my opinion. Whatever development is there hey, you know, it's there. But enough already. I'm not against development. No, I am against development but now they put up all these buzz words now: culturally, sensitively, ah. I don't know, I don't know what that means. Developing it, there is no sensitivity in that. You know? Just, just think again, look again. And you know when it comes to places like Honua'ula, Kaupo and Kahikinui, we need a place to take our kids to show 'em our culture. Gotta draw one line somewhere, take it's time. Not here, there. This here, ppffhh. You know we deserve it as a peoples, so. Nothing like da kine brah, being on the land and talking about that land. Boy I miss the mountain.
KT- So the real dilemma is how do we do it.

KMK- Yeah it is. Oh boy, that's why I went change jobs, to hopefully become a part of a change.

Interview: Randsom Piltz

By Keli'i Tau'ä & Kimokeo Kapahulehua
February 15, 2006

Interviewers= KT/KK
Randsom Piltz=RP

KK: One thing we all enjoy is being Hawaiian. I can look back at Haleakala this morning and say, "if this is what I live for. If this is what I see everyday, I enjoy Maui."
C: Yeah. And this is why… I was on a one year appointment with a Land Use commission.
KK: I remember that.
C: Yeah. It was only a one year appointment. It's just finishing up in June and the Governor asked if I would stay on another four years. You know there's a lot of things that happen in our community that can be good. But it has to be good things that's going to be worthwhile. And you know, we have developer's coming in that are sincere and there's others that came by a long time ago that just came in and took off. Didn't do anything for us. I think the new developers that come today know that they can't just walk in and collect and walk out. So those that are here to stay and do something will have to be part of this community.
KK: We agree.
C: Yeah.
KT: So, can we start with your official name?
C: It's Randsom Arthur Kahawenui Piltz. Kahawenui was my mother's maiden name, so I took that as my Hawaiian name.
KT: Maui boy?
C: Born and raised here in Maui. My mom and her family have roots down into Makena and Kihei. I lived here all the way through my senior year in high school when I went to Kamehameha high school. And after that I went to the University of Dayton in Dayton, Ohio.

After finishing college, I worked for the Montgomery County Sheriff's office for about four and a half years. Then worked with General Electric Company for six and a half years. I was a sales engineer for them and during that period of time my dad wanted me to come back to Maui because he was looking to retire. And I wasn't really sure if I wanted to come back because when I look back it didn't look like they had too many opportunities. But, being that I was from Maui and I had some young children. So my wife and I decided to come back to Maui and relocate. But prior to coming back I went to work with a contractor in Dayton. An electrical contractor. To see if I even wanted to be a contractor. So I found out it's like dealing with people, you know? So I came back and got involved with Piltz Electric. That was in September of 1973. So here I am.
KT: How many children?
C: I have two. My son's 37 and he's got his electrical engineering degree and out working for an electrical engineer in Honolulu, hoping to come back very soon. And my daughter's 34, Michelle. She works for me as an estimator, has been for 10 years.
KT: What was your field of study at Dayton?
C: I was in business management. What took me to the University of Dayton was an athletic scholarship, so I played football there and then had a try out with the Buffalo Bills. Didn't make it. Came back and went to work. I lived totally in Dayton for 17 years. So I know what it's like to live in the Mainland. My wife still has family back in Ohio and in Arizona.
KT: When were you born?
C: I was born in February 20th, 1939 at Maui Lani Hospital in Wailuku.
KT: So you're 66?
C: I'll be 67 on Monday.
KT: Wow. Congratulations for living that long.
[laughter]
KK: Maui Lani Hospital in Wailuku is that the Wailuku Medical building?
C: No. Right now that's the Hale Mah'aolu… No, not mah'aolu… Hale Makua.
KT: Oh, Hale Makua.
C: That's the site of the old Maui Lani Hospital. Right next to Saint Anthony. And we lived in Wailuku on Vineyard street and our office when I came back in 1973, our office was located right there on the corner of Church and Vineyard. Which was only blocks away from where we lived. We now have our office building on Central Avenue. And we've gone from an Electrical Contracting company having almost 30 electricians to now we've downsized and that's where we are now. Downsized to about 8 electricians. Comfortable.
KT: So do you see yourself as a Kupuna today?
C: Well [laughs] a lot of times when you think about Kupuna you think about old age and I guess when you're 67 you can be. But I think mainly when you're called a Kupuna it's because you've retained knowledge from the past. I think that's what a real Kupuna is.
KT: Boyd Kanae addressed me as, "Hey Kupuna." And I said, "Boyd, I'm not Kupuna… you Kupuna. You are my Kupuna." He said, "What do you mean?" I said, "Number one, you got more puna, and when you've got more puna that puts you Kupuna. And number two, you start behaving like a Kupuna." [laughs] But Moloka'i people have a classification for two types of Kupuna. Kupuna who have paid attention to the cycle of life and have picked up all this cultural knowledge. Or have contributed to their life and their community. And there's others who are kupuna by age. But basically have just gone through life without looking at what's happening around. So, it's just a title that Kimokeo and I know that you have contributed, as you were

saying you were in politics before. Would you like to touch upon that a little bit so we can segue into the subject we want to talk about more.
C: The first involvement I had went back to Dayton, Ohio. I had a college professor who was running for State House. That was the first involvement I had, walking around and canvassing the neighborhoods. And that's about all of the involvement back in Ohio. But when I came back, I found that a lot of people were involved. My dad had been involved with a campaign with Frank Fossey. And then I was asked to get involved in Frank's campaign. So I did. That was in, I think, 1978, when I was asked to be the campaign chair for Frank here on Maui. I did that and gained a lot of experience, got to know a lot of people. Even though Frank didn't win that election, in '82 Frank asked me to be involved in his campaign even further and I became his candidate for Lt. Governor. And again, spreading the wealth of information throughout the state, meeting a lot of people in that campaign. And since then I've been involved with the others... Alan Arakawa when he ran for counsel. Alan Arakawa when he ran for Mayor. Kimo Apana when he ran for mayor, the most recent one. And we've gotten to know a lot of people here. A lot of people who have roots here. People who are concerned about what's happening on the island.
KT: So, by revealing who you serviced you're not really tied down to a party? Just looking to contribute to the best candidate?
C: Yeah, yeah, I've never been labeled, well, I've been labeled… but I've always considered myself independent. And it didn't matter what party that person was involved with as long as I felt they would do a good job. That's who I would support.
KT: So presently you serving on the Land Commission?
C: Yeah, the State Land Use Commission. I was appointed by the Governor last March. And it was for one year term, although I was serving on an unexpired term. So, that was only one year. I have since applied for another full term of four years. These appointments have to be approved by the Senate.
11:04
KT- You mentioned that you had roots in Makena and you know Kimokeo and I are cultural assessor's for this new name they're using in the area of Wailea 670, now called Honoaula. What, can you talk story about what you know about it, growing up there, etc. etc.
RP- Well, you know when my mom was mainly, they lived mainly in Kihei. But their family was right down there in Makena, near the Makena Landing and involved with the Kukahiko's and, you know, John Kamaka, Johna and Kamaka Kukahiko. We relate back to the land's that they owned back there and a lot of it was right there at the Makena Landing. In fact, we have a gravesite near there where we now have the Kukahiko family built a beach home. And I was involved in trying to save that piece of property and making sure that we have this piece of property that will be there in perpetuity. We're finding it very difficult now because we had one piece of property that we had to sell because of taxes. And later on we had to sell another piece of property because of taxes. And there was one piece left there, right next to the grave, and with the money on the sales of those properties, we were able to build this home. And that's for family use. But the real problem that we're having now is that before we built a house the taxes were twelve thousand dollars a year. This year it's thirty two thousand dollars. Our interest for the property, what it was, two thousand dollars. This year it's eight thousand so we're looking just on those two items, taxes and interest, forty thousand dollars. For a Hawaiian family to try to retain beachfront property, you have to have an unlimited amount of funds, or have some way of making money. And it's very difficult. Most of the family member's that we have can't

afford to spend or help pay for this. So we have to go out and raise funds, one way or another, so that we can retain this in perpetuity. It's going to be difficult. And, but you know, that's just one piece of property. I know we had a piece of property that my mom and her sister's owned.
KK- Which property is that Randy?
RP- Well, this is right near the golf course and in fact is right where Everett Dowling is planning on putting a project there.
KK- Oh, by that hole by the ocean.
RP- Yeah, that hole right along the ocean by the par three. That piece of property used to belong to my grandfather. And when he ran for public office, he had to have money for campaigning. So, he went and borrowed four hundred dollars, from what my mom had told me, and he passed on. At the funeral the lender came and giving his condolences and everything, he said, "but your grandfather owes me money." And so she and her sister's signed over most of that property. One sister was underage so she wasn't able to convey that property so they retained like a thirty six thousand square foot piece over there. And in that piece of thirty six thousand square feet, um, it had written in the deed that there was three hundred sixty degree access to that piece of property. And eventually my mom retained ownership because of loans through other family member's and everything. So what happened, we had it and when I came here I knew we needed a place for us to conduct our business. So I suggested to my parents to sell it and we did. We sold it to the Seibu Company. They wanted to build a hotel there. Because of that we had a 1031 exchange for a piece of property in Makena at our office building.
KK- In Central Avenue?
RP- Yeah, right on. Seventy Central Avenue. Yeah, so that was useful as far as I can see. And that piece of property still hasn't been developed and that happened in 1975, I think. Seventy four was when we sold that piece of property and we've been in Wailuku since.
KK- One of the thing I told Kumu is that your family is the Kuakahiko family.
RP- Yes.
KK- You know what I mean? And that you guys are, that Papa Chang was making that house with you guys. You guys all were making houses.
RP- Right.
KK- I would see him everyday with Charlie them went down there.
RP- Right, it was a real big family project.
KK- Yeah so, can you explain us that family ties between Piltz and your mom and Kukahiko and Papa Chang and Wilma thing.
RP- Yeah, my, our relationship goes back where Eddie Chang's father and my mother were first cousins. They had the same grandma. And our grandma was related to the daughter of John and Kamaka Kukahiko. So, we're very close and David Keala's they're, they're part of the Kukahiko family. And John Wilmington was married to Annie Chang, which is Eddie's aunty. Yeah. And that's how we're related.
KK- The daughter had the home now in Wailuku.
RP- Right, up in Sand Hills.
KK- See, that property is for sale too.
RP- Yeah.
KK- You know what I mean, when Charlie was working on that house. Charlie when he came back from Kentucky, he came to Uncle _______ and wanted to learn more about canoes. Today he's one of the canoe builders on Maui.
RP- Yeah.

KK- Cause he's really good with his hands. Good wood work and everything else. Because we also talked to Papa Earl Kukahiko out in Lahaina for Kohoma Street. And so is he the….
RP- Earl?
KK- Yeah, so Papa Earl, now, is he the only one now Kukahiko name?
RP- Um, that I can recall now, yeah I think he is.
KK- So what about your young days? Did you spend time with your father down at Makena and your mom?
RP- Yeah, for the longest time during the war period, you know, it was very difficult to get down to that area because access to Makena and parts of Kihei was blocked off. If you recall right there by Ahana Road, well, they had right there they had a guard station so you couldn't go any further. Past there you had to go up Ulupalakua and if you were in good graces with Ulupalakua Ranch then you could get the keys and you could come on down and make your way down to the landing.
KK- Oh.
RP- Yeah because that was the only way to get down to Makena.
KK- When you say guard, what kind of guard was that?
RP- Well, they had a military guard.
KK- Yeah, because you know on Honoaula, what they call this project.
RP- Right.
KK- We find military helmets. And what his name, Tavares, but they know him as Sonny Vicks. What is Sonny's first name?
RP- Oh, shoot, I can't recall.
KK- But his name is Tavares, yeah.
RP- Right, yeah. We'd call him Sunny Vicks.
KK- You would call him Sunny Vicks because he was saying all the military made all those roads up there.
RP- Yeah, from right there at Kalama Park on down like Kamaole I, II & III. Those are all for the military, for their recreation. They had buildings that was on those beaches.
KK- Oh, so one of the old buildings where the county get now, where the police station is, is that the old military building.
RP- No, that was built later. But some of the old buildings were used where they went in there to change and everything. In fact my daughter and son own that piece of property up in Kula. And some of those old buildings were bought and moved up there. So then those were remodeled and put into a configuration. But I remember using those, they were pavilions, right, you could go in and change clothes. And so one beach, I can't remember, I think, Kamaole I, was for the officers. And then number II was for, or was just vice versa. Number III was for the officers. And then you had the ______ guys were one and two but those were all those places where there's kinda in. Along, right in front of, they used to have all the military houses, you know, barracks and all that kind of stuff.
KK- So you know that road that goes up from Kihei up to Ulupalakua up to Haleakala, was that all trails before?
RP- Well, a lot of it was trails with cattle making their way down. And then eventually Ulupalakua Ranch mad their roads. And then there's one road that goes pretty close to where Honoaula is and that was built by the military to get up to Kula. And it goes right up to the Fong Store. So there's a direct road that comes straight on down, right behind Fong Store. You can see that it's still there.

KK- Right behind Fong Store is where the Hawaiian Homestead.
RP- Right.
KK- So I came down, with my quad, and that road leads right down to Wailea.
RP- Yup. And that was all built by the military. In fact the road that they talk about, the old Makena Road that comes along the beach and comes right by our house and everything. A lot of those roads were built by the military and it was just so that they could get into the area and they can protect it. A lot of people don't recall, you know, like Kalama Park and all those sandy beaches all along had barricades so that landing craft couldn't come in. And there's a few of them sitting around. And it's a big piece of concrete that had steel railroad ties coming out of them. And they were close enough so that no landing craft could make it to the sandy beaches.
KK- Oh, I know when it gets really, really rough, south shores, right by Kamaole I on the left hand side, they have those cement spikes and all that iron's sticking out.
RP- Well, those spikes were actually a boat ramp that they had going out. That was a boat ramp for the landing there.
KK- Well, when it's really, really rough you can see all that.
RP- Yeah, it washes all up. Those are sticking straight up but the one's I'm talking about are kinda like they're concrete pyramids right. And then they have these things going up on an angle from each, and it was actually four sided, you know, kinda pyramid. And those were actually railroad ties that were sticking out. And they had it close enough so that landing crafts couldn't come through to the beaches.
KK- There's remnants of that down at Kealia Beach. There's two of them by the river mouth.
RP- Yeah.
KK- When we dive we can see them.
RP- Yeah. And some of the, back in the fifties, they used Wailea Beach and those beaches for landing exercises. Yeah, so some of the helmets and that kind of stuff can be, I think they can date those to those landings. Because I know we used to go down there and as little boys, and when they were doing the landings and the guys would just leave their sea rashes all over the place and we would have them, you know. And they would leave their helmets so we'd dress up with them.
KK- Your mom is from? Where is she born?
RP- She was born here in Maui and I believe she was born in Wailuku.
KK- Wailuku?
RP- Yeah. I'm trying to think back now. The property where the Tesoro Gas Station is.
KK- In Kihei?
RP- Yeah. That was Hawaiian Homestead land. And they had that Hawaiian Homestead land, right there. And was some, they had a ninety nine year lease. But then, when their parents died, there wasn't much going on in Kihei.
KK- Right.
RP- And so they, she and her sister's and everybody, moved to Wailuku. And my dad was, lived in Ulupalakua. He was born on Oahu and my grandfather was a sea Captain. And he came to Maui and after he met my grandmother in Oahu and they had children there and then they came to Maui. And she had land up in Kanaio. So, we still have, I still have some multiple claim pieces of property in Kanaio. And they're scattered all over the place and those were given to me but I don't, you know, I just pay the taxes on it.
KK- You have access to the area?
RP- Some of the pieces of property are right on the road going out to….

KT- Vacant then.
RP- Yep. Right on the road, right near the, some of it's right near the Kanaio Church.
KT- Mauka?
RP- Yeah. And then my aunt, my dad's sister's children, Dolly who works for Purdy Eardmen, she owns the old home site way up in Kanaio.
KK- Mauka Kanaio?
RP- Yeah, mauka. If you look from the road you can see a stand of old pine trees and that's where the old home site is. And so she owns that. My dad gave his sister his share of the property and so she owns that.
KK- And she still works for Ulupalakua Ranch?
RP- Yeah. My uncle worked for Ulupalakua Ranch and all my cousins.
KK- Who's that?
RP- Kai'aukamalie, William.
KK- How old is he?
RP- Well, he passed on a long time ago. Before I came back to Maui but Dolly still works there.
KK- And how old is Dolly?
RP- Dolly's gotta be mid seventies.
KK- Is she at the winery or she at the Ranch.
RP- She just worked for Purdy and she watches, she's the nanny for Sumner's children.
KK- Oh, wow.
RP- In fact, she was the nanny for Sumner when he was a little boy.
KK- You think it's possible for us to have a talk with her?
RP- Who Dolly? Oh yeah, sure.
KK- You give us her number and we can talk to her and you can give her a head's up. So she might, when you was young you know any of your father's or your mother's story about what they did as a child or up there what they were doing on the land before?
RP- Well, that see that was the connection because my dad lived up in Kanaio and my mom lived out in Kihei and there's some pictures where he's on the motorcycle. And he used to ride the motorcycle down to Kihei and visit my mom.
KK- Wow. What kind motorcycle is that?
RP- Uh, it looked like a Harley Davidson but I don't know.
KT- What year?
RP- I gotta go back and look at the pictures, it's real old. But that's how they…
KK- He'd come down from the mountain for go see your mom?
RP- Yeah from down there yeah, to see. And then, you know, they would have what they used to call concerts right when they would have Kane Kapila and everything. And my mom would go up there and they'd have dances, you know, and so that's how they got to meet each other. And my dad, well, he grew up in Kanaio and he and Willie Olsen. You know Dickie Olsen that owns that Light Electric? Yeah well, you know his dad used to live up there in Kanaio.
KK- Wow.
RP- And they used to take the donkey from Kanaio all the way to the Ulupalakua School.
KK- Ulupalakua School used to be by Keokea?
RP- No, no, no.
KT- No they had a school there.
RP- No, right near the winery. If you're going towards Hana, it's just past the winery on the right hand side. Yeah, just before you get to the Catholic church. And I have a piece of property

up there in Ulupalakua. And someday, when I first came back I was hoping I could build a house up there but there's no real access to it and no water. So, it's about three and half acres that belong to my mom and her sisters.
KK- No access to them?
RP- Actually there is now and of course now we're thinking about downsizing might be the time for me to do that. Go up there and do something with the piece of property.
KT- Can you spell your mom's last name?
RP- Yeah it's Hattie, H-A-T-T-I-E. And it's KahaawInui. K-A-H-A-A-W-I-N-U-I. Yeah, W-I-N-U-I. And my dad's name is Adolph. A-D-O-L-P-H.
KK- What his nationality?
RP- Well, his dad was German. He was a German sea captain. And he was married to Heoni, which was my grandmother. And she was Hawaiian. And she had some Chinese because her maiden name was Ako. Yup, so that's where she got the Chinese in there.
KT- Randsom there's a real important issue in, because you're young and you're 'eleu and you're akamai. That this area I want to bring you to the ford because in our interviews this is the dilemma of our people, and that is land taxes. And inasmuch as you're participating with the land commission. First, do you think that the Akaka Bill could contribute to making change so that we're not penalized to own our own land?
RP- Right now I don't see any provisions that make that possible.
KK- I no think so.
RP- I don't see that. But it doesn't mean it can't be done. It's a step forward. And the main thing is the recognition and getting this Bill in effect that we can move forward. Right now we have nothing, nothing.
KT- That's why from what I just heard you say, would you tend to agree that the Akaka Bill could be an issue to assist us in these kinds of things?
RP- Most definitely.
KT- Well, most Hawaiians, not most, but a lot of Hawaiians don't understand the importance of this Bill or something like it.
RP- Well, and this is what's too bad about something. So many times Hawaiians are their worst enemies. You know they're, somebody's moving forward and they said, 'ah, hupo. Dumb, that's dumb.' You know, it's like, 'no!' We've gotta move forward, we've gotta do things. You have to be innovative. And Hawaiians are putting down Hawaiians instead of, you never see that in the Orientals. But you do with us, you know, and I'm saying, 'Why?' And I have to move forward and I like to take as many people forward with me.
KT- So you're saying, and what Kimokeo and I are saying, a few handful of people. We need to hui together and make a strong statement in terms of what you just said.
RP- Yup.
KK- I think one of the things that I think, I don't know if he does, that we should get involved with is that the Hawaiian, that Chamber or Commerce.
RP- Right. I joined that, in fact they had a meeting yesterday, I couldn't make that but it's something that is bringing business people together now and saying how can we improve? This is something, you know it was necessary. They tried to, whoa, I gotta say fifteen years or so. They tried it and it kinda fell apart. But I think today people are saying wait a minute, it's a step forward. And let's get organized. And you look at the voting on OHA, you know, where now anybody who lives in Hawaii can vote. It's like, yeah, well you know. They're saying at Kamehameha you're separating people, you're segregating. No. When you look at the Indian's

and how they were able to operate and their efforts to get organized, they're there. You know, ok, we don't have tribes but you have people living from different areas. Makena being one. It was a big settlement down there. Uh, Eddie Chang's dad used to have a store down there, you know.
KT- Do you remember the name of the store?
RP- No I don't. No, but he had a store down there and being Chinese he was very prosperous.
KT- What was his merchandise?
RP- Well, it's everything you can think of. Kinda like the Hasegawa Store. You know, whatever you got, they had. Yes, everything.
KT- Food, lumber, everything needed to survive.
RP- Yes, everything yeah, right. And now today, you have homes there and that's ok.
KT- Are there any cultural sites you can remember that our Kupuna used to go towards, in the area?
RP- I don't recall any that my parents ever talked about in that particular area, especially in Honoaula. Most of it was in scrub land and the only time any of the land was being used, from what I understand, was when the military came in for their exercises. And that was later in the fifties.
KT- Randsom, just for your information, everyplace had cultural sites. The reason why there was a void there is because our people were putting emphasis on other things to survive. But today we can walk back there and see, oh my gosh, it was all there. So this is the exciting part that Kimokeo and I get to do is walk on it again.
RP- Well, you know one of the things too is that when, especially when my parents were growing up, my mom especially. And for myself too. It was not, it wasn't good to be Hawaiian. And even my one aunt was saying, 'Oh we have Norwegian in us.' You know, it's like because she wanted to be part of being haole. It's like, be proud of what you have and what you're background was. And going to Kamehameha you had to speak good English. Did they emphasize speaking Hawaiian? Very little, we sang. But that was it on Hawaii. My son speaks better Hawaiian than I do. I don't speak the language, he went to University of Hawaii and he took the language. In fact when my dad was here he came back from Straub, he had cancer and he was dying, he used to sit and talk with my dad in Hawaiian. And people would come to the driveway and hear the Hawaiian language being spoken and they thought there was some Kupuna's sitting there. It was my son speaking to my dad. And I couldn't do that.
KT- So, outside of the names you mentioned, are there any other names you can think of that were growing up over there? I interviewed the Akina's and they were another one of the Hawaiian's that made…
RP- Well, in Makena, especially is Eddie Chang. Have you talked to Eddie?
KK- No we gotta go talk to Papa.
RP- Eddie Chang lived there and they lived right above where we had our old house. They had their home there and they have some gravesites right there at their old home site. And so, Eddie lived there for many years. And the Lu'uwai's. You know, Bobby and his family. We're all related, we're all cousins.
KK- Which one moved off? One stay in Big Island now.
RP- Oh, yeah, Boogie. Boogie moved up there, yeah but Bobby's still here. And he retained the home down there at Makena landing. But, yeah, Dolly Kai'aokamalie is from Ulupalakua and then that's where we come from. And Makena was our tie.
KK- We gotta go see Dolly and Papa Chang.

RP- Yeah, see my mom used to, our grandfather he used to be, Jade Kimo Kahaawinui, was a licenser right. And he used to preach on Sunday's at Kealahou Church. And then he would go down to Makena Landing, I mean to the Keawala'i Church and preach over there.
KK- Oh, two churches. Like Papa Kukahiko's father.
RP- Papa Kukahiko then also did that because he was the minister.
KK- He went Honolua and Halelani.
RP- All the way down. And sometimes he would come all the way down to Makena and preach there. And then that's when my grandpa was just a licenser there. But when he couldn't make it, my grandpa would be the licenser. And so right at the front door of the Keawala'i Church, right on the right hand side. When you come out of the church, the right hand side that first grave, that's our grandmother.
KK- Oh, what the last name on top there? What's the last name on there?
RP- Uh, Kukahiko.
KT- Spell Dolly's last name.
RP- K-A-I-A-O-M-A-L-I-E.
KK- What is the first part.
KT- It's not the, Kevin's, you know Kevin from Ulupalakua that living next to you now?
RP- The young boy.
KK- Mahealani? That's his grandma, yeah?
RP- No, that's his aunty. His dad was William, William Jr.
KK- Right, right.
RP- His dad was William Jr. and they all worked for the Ranch.
KK- He no work for the Ranch now. He work for Betzel. Betzel hired bunch or botanist people to work up this side for do the….
RP- Kahakuloa.
KK- For do the native plants. And then West Land Maui, they hired a bunch of botanist's to do the native plants. So they're doing some good things to try to keep the native plants.
RP- Well, you know, and we're talking about the historical sites and everything. It's really a shame that we moved away from that. Because especially the fishing shrines that I've seen now. The one down that, the heia'u down at Paluwea and of course they have the one heia'u that's down there by Eddie's property. It's on Eddie's property right next to Hale O Makena. And those are the only one's that I'm aware of right now. But, you know, it's good that we can preserve some of those sites.
KK- We have an Archeological State Commission that goes out. All the people all gotta do that. But they have what they call significant and insignificant. And so we have a lot of significant sites, we just gotta be careful about the insignificant sites and do more research and study before we say it's not so significant. Because all the sites are and I think that's one of the most exciting things I do, is walk the land and find a lot of them.
RP- Well, you know of course a lot of things, the walls were built by the Ranch. You know, ranch hands and everything. And some are remnants of pens and sometimes they're mistaken as a historical site. It's like, well, you gotta be able to be able to signify which is which.
KK- Yeah, I think it's um, you have to see the walls that our Kupuna's built compared to what the ranchers built. But because of what you say, antidevelopment, so they use any significant thing to fight that situation. So they'll put the cattle wall in, they'll put the cattle bones in. They put all…
RP- Oh, that's terrible.

KK- I mean the site that you're looking at, we're talking about by your folks land, by where Dowling is. Kumu and I went there because they found a gravesite but everything around the gravesite was not so significant and they made like 85 findings, including bones from the cows, you know.
RP- Yeah, and my mom and her sisters had no idea that anything like that even occurred on that piece of property. It was just land there. There was sallow land that couldn't grow anything. And when you're talking about rocks coming from fences and walls that were made by the ranchers, this all came from Ulupalakua.
KK- This here, yeah?
RP- Yeah. Uh, a former employee of mine, Ron Jacintho, when he first started in his business he was doing moss rock. And he had the agreement that he would take some of the walls from the ranch and sell it and share with ranch. And this was a gift from Ron. He brought all the rock down.
KK- When you go to Maui Community College, all that Pohaku came from Wailea. You know, they went pick 'em up and bring 'em in to make the whole wall for Maui Community College.
RP- That's beautiful, yeah, this is beautiful. This was originally a fireplace that was only one sided when we bought the place. And we expanded the house out and we wanted to have a through thing and then we talked with several people about doing a two sided fireplace. They said, 'ah you can't do it.' We found a mason that was from Boston and brought him up here and he looked at it, 'yeah we can do it.' So that's what it is. It's the old one veneered on the other side and veneered with Pohaku from Ulupalakua.
KK- Oh I think that's like the way, like you was talking about us Hawaiian people. We gotta move forward and we gotta be innovative like these people. We gotta be creative.
RP- Yup.
KK- We cannot be stuck in the puka.
KT- If you were the ali'i of the land, what would you want to change to make it better for Maui, for Honoaula. You said you saw their plan, can you summarize, Randsom, once more. What was the overall plan?
RP- You know, I saw this when they brought it to, you know I was on the planning commission for five years. And when they first came to us and reviewed they told us of the original plans which was a lot bigger in size. Two golf courses and now it's downsized to one golf course and just home sites. Had I been the ruler of the land I would look and say this is good because it can provide. If you look at what the taxes you can get out of it. Most of these homes will be used for part time residents. They're less impact on the environment because they're not going to be here all the time. But it provides employment because somebody's gotta take care of the property while they're not here. And the taxes that's generated out of this is something that too many times those that do not want development come in and say, 'well it's no good, you're raping the land. We don't want you using up our resources.' On these type of developments you have to look further than what's going to be built. It's what they can produce to us that live here. We're requiring them to do affordable housing. We're requiring them to put in addition over roadways. But it gave the traffic that we have. All these things, as long as it's done properly.
KK- They gotta get their own water.
RP- Yeah. And they're not going to be an imposition. And that's why I'm saying, you know, they got all the utilities. When you keep saying, 'oh we don't want all these rich bastard's around.' baloney. This island cannot afford what the public demands. We cannot generate that much. And projects that come in with we've well thought out. We, it's good.

KK- I think if we look at the projects that they fulfill our community needs and don't make an impact, I think it's a plus for them and a plus for us.
RP- Yeah. Well, some of the things that's passed now and it's too late because they're talking about affordable housings that's owed from different projects. Well, was it our fault? No. I think it's those that were in government in our time that failed us.
KK- They had the power.
RP- They had the power to enforce those rules. Today now they're making it, they make it a standard.
KK- Well, and I think the community is taking more of an effort. Since when I came on Maui, I know that the community association wasn't so powerful. But I think when the community association was given authority of making their own plans, that we're going to use your plan, it became like possession. I think the thing grew from that.
RP- Yeah and I think our County government has taken the step forward in correcting itself. But it's not, no more building because here's one of the things that too many people failed to recall. If nobody else came to Maui to live or build, there's still going to be growth. Children are still going to be born. Children are going to graduate from High School. People are going to need jobs. And that's growth. And you have to provide for what's growing. And now with an influx of new people coming in, they've gotta pay their fair share.
KK- I think you make a good point, the children. Because when I first came, I knew of St. Anthony and Baldwin and Maui High and Lahainaluna. That's it. And now we get Seabury Hall, we get Kamehameha School, we get Kaahumanu Hou.
KT- King Kekaulike.
KK- King Kekaulike. So you get, let's say we have 15,000 students. That's 15,000 children like you just said. That's growth, without nobody coming.
RP- That's it. That's right.
KK- And those guys, all those 15,000 get new 15,000 because we still get the same kindergarten, the same first grade and so they get filled every year. In fact they get filled where we no have enough teachers.
RP- Exactly.
KK- So those guys come out like your son and my son and his son. They have their own ano. They have their own idea how they going run this island. So that's growth. We not going be sitting by them and saying, 'No,no. That's not what dad wants.' They're on their own. Like your son, yeah I said, 'Oh your son going come back?' You said, 'no my son is in Honolulu.' You know what I mean? And you just said, oh your daughter's going her own way. As much as he and I and you want our children over here by our side, you know we can. Like me I'm 58 and just now I noticed that, you know, none of my kids are really close to my side. But we talk, we hug, we party, you know, family parties. But none of them follow in our footsteps because they have their own ano.
RP- And the thing is, we have to be able to provide places for them to live. I'm fortunate that my parents left us property that we could give to them so they have a place. They can have a home. But there's too many that don't. And that's why Hawaiian Homes is necessary. And they have to have this land here, they need to make it more readily accessible.
KK- That's one of the things you're talking about move forward. When I involved with the plants and the land usage with Honoaula, one of the things I told those guys, is you guys gotta help Hawaiian Homes. Because if they no more enough water up there, we gotta get water to them.

RP- Yeah.
KK- And so these guys went down and see Michael Kane and say if we have water we'll bring water up for them go to you guys.
RP- But then see, there's a problem in that because there's only one community plan. And that's the Upcountry community plan that mentions that you're not allowed to take resources, water resources, from one area to the next. And you know, it works both ways. When this came to the planning commission, they were willing to negotiate with Ulupalakua Ranch to have some wells drilled up there and then water pumped down to the project. Good idea. Really good idea. Ulupalakua Ranch, because they would use all the water in this particular project, would prosper from it. Because they could use, instead of taking land from the County, they could use the water from their wells and be independent of the County water system. But then it was brought forth to us in the planning commission and the developers would say, 'oh you're not allowed to do that. You're taking water from one area and putting it into the other area. That's wrong' And I mentioned to the testifiers that I'm saying, 'Oh, then you're saying that if we have electricity that's generated in Kahului, we shouldn't send it to you. You should develop your own electricity in your area.' Does that make any sense? No.
KK- No.
RP- But those that don't want growth use that little piece in there and say this is what you have to do. Wrong, totally wrong.
KK- Well, so now these guys have found their own water. Yeah, they found their own water on their own property. And so they now doing that but even with that, Hawaiian Homes have land all the way on the bottom. So hopefully like you said, our community needs it maybe they can help the other homes that the County cannot help, you know what I mean? To get water to them.
RP- Well actually, when Norma was, Norma my wife, was on the Water Board, they made sure that the line was built to fee the Hawaiian Homestead Lands. And there was some funding problem, I forget who was in charge of Hawaiian Homelands then, came over and testified that if the County couldn't come up with their fair share that the funding for that water line for Hawaiian Homes would be lost. So Norma called some Council people to ask for additional funding and Board of Water Supply, at that time, was semi autonomous. So they were able to kick in, they needed about a million plus dollars, and the Council then at that particular time was able to give five hundred thousand. And the balance was funded within the Board of Water Supply. And that' how they got the line in.
KK- Well, we gotta thank her because that's the reason why Waihuli, Keokea has been all been able to get awarded the lots because there is the water and they can continue development with the roads, you know. The water was the key. So the whole place was just last June, was awarded undivided interest to everybody. And everybody will probably be on their property in 2010.
RP- That's good, yeah. She was key to making sure the State kept their funding here.
KT- So, Randsom the Hawaiian's that still own lands like you need to hui together to, to lobby to change those laws about taxes that are literally stealing the land from the people.
RP- Yeah, we've been talking, every time election comes around and we meet with politicians, I know my wife is very active talking to them about this tax problems. We should, you know there isn't that many pieces of property, that I know of, on waterfront in Makena. But our family, the Kukahiko family, which involves a hundred and thirty different family members.
KK- Probably only you guys left down there.
RP- Yeah. And thirty two thousand dollars we gotta pay in taxes.
KK- Uncle Bobby must be having the same problem.

RP- He does. He does, I don't know how much his was.
KK- I know, I know, you know Rojac he always helps us out to take the logs from the pier to the canoe celebration.
RP- Uh huh, right.
KK- And I know two of three years back he decided to move out of Makena because of what you just told me.
RP- The taxes.
KK- He was like, right by Makena, by the State area. Right in the cove there.
RP- The reserve there, yeah.
KK- He said he gotta sell because of that, the idea. So was like forty eight thousand ended up the whole thing, a year.
RP- Well, and this is why we're hoping to save this one piece of property in Makena for the family forever. But we gotta cough up forty thousand dollars this year? And next year? I don't know what it's going to be. And you know, you cant' have something for everybody to use and no income.
KT- You gotta aggressively lobby.
RP- Yup.
KT- The powers that be.
RP- Yeah.
KK- The system just takes such a time, yeah? Every lobby, every lobby session is like a ten year session for education and the way they get elected and voted is just tough for get things through.
RP- Well, it's right here, you know, these are our taxes that go to our County and that's where they're at.
KT- So, Randsom, before we forget, do you have any contact numbers I can put on here so we can follow up and track. You got Papa Chang?

End Recording

Start Recording
KT- So, do you know if the Nakoa's live down there too?
RP- I'm not aware that they lived down there, no. I know because of their family ties they owned property down there. But their grandpa Alfred gave away his piece that they owned. But, yeah, Eddie lived down there and the Luuwai's did and that was mainly after their dad built the beach house down there at the landing.
KK- Whoa he's got a lot of houses, Uncle Bobby, coming around him.
RP- Oh yeah, yeah, yeah.
KK- Whoa, right on the road.
RP- Right there, right above the gravesite, right there.
KK- Underneath the smallest house. (laughing) I drive down there for go down by the church and they're like, they're on the road.
RP- Yeah, coming around there.
KK- Amazing how we used to go there and it was only their house, yeah? And then who was that other guy, Don Martin, used to live over there.
RP- Yeah, they're all family, yeah. They're all married. They were married to Bobby's sister.
KK- Never had the parking lot or anything near the beach. Never have the bathroom and now you look from the ocean side.

RP- Well, and when you come around that turn on that hillside there, there's going to be about seven house lots that's going in over there.
KK- Where is that?
RP- You know you come up the landing by the, when you come down you can see the Luuwai house?
KK- On the left hand side?
RP- On the left hand side, right behind Jimmy Campbell's house.
KK- The dirt road?
RP- Yeah, the one that goes up. That was your old Ulupalakua Road right there.
KK- That used to go across.
RP- All the way across and straight up the mountain.
KK- That was the original one for come down.
RP- Yeah, right.
RP- I know we have some property in the Mo'omuku area.
KK- Oh, in the ahupua'a?
RP- Yeah.
KK- Mo'omuku, Mo'oloa and Mo'iki
RP- Yeah, it's a co-ownership between my mom and Ulupalakua Ranch, about forty eight acres. And you know, someday I'd like to settle on that. I want to do some trade with the Ranch someday. You know, so that maybe we could move something closer to Makena. Down the below that's closer to the road because that one has access right from the golf course, the Makena Golf Course, they used to have a road that went up to get cinders when they were building the golf course. And it goes right past that property. So when, if ever, they develop the area then I would have access to that property. But right now until something happens.
KK- Well, you know because of Lahaina Road that I talked to Haleakala Ranch and Ulupalakua Ranch to give us emergency exit. So, Sumner was okay about that, to do emergency only for go straight up, you know kinda thing. But they wanted somebody to get money to help pave the top because the top is rough, you know to get out. Because when this thing, the tsunami hit, one of my things was we gotta look how for get out of South Maui.
RP- Yeah.
KK- So there's a road from Haleakala Ranch and Ulupalakua Ranch and Hawaiian Homes can go up. So somebody gotta get on that plan.
RP- Well, I think, you know working with, you know at one time that road from Ulupalakua down to Makena was opened. And even though it was unpaved dirt road and the Ranch, all they asked for was that the County hold Ulupalakua Ranch harmless on insurance. And that never happened.
KK- Now it's hard to go make it happen because of the value of the land, it's so high.
RP- Well, yeah, that's not going to happen. And even at one time a lot of people had keys to the gates to get in and they'd go hunting and all that kind of stuff. But because of many abuses by some of those people, they'd make copies and give it to somebody else and then they destroy the land and injure the animals in the area. So they just stopped it.
KK- I think that's the biggest problem with all that land right down there now is abuse using. By the not only by the people over there but by people outside.
RP- Yeah, like the, even like the land that I have in Kanaio, I'm concerned about it because Ulupalakua Ranch used to be part of this multi ownership. And they gave up their ownership because of pot growers and everything in the area, and you know, we could be liable. Even

though it's not a big amount of property that I own, my name is on several pieces. I could be responsible for it because people are growing illegal drugs.
KK- Well, above Diamond Resort somebody ripped the gates out and drove four wheel drives and all kind of stuff, so now the hopeless had to be bouldered off. I think you'll see more and more of that kind of, people protecting their land who have money. People who don't have protected land, just wide open, you know. Too many people going in and out.
RP- Yes, well you know then they get hurt on the property and then they say, 'oh well I got hurt in your property.' You're the deep pockets. You know, pay me. Because of their stupidity? Hello.
KT- While you're sitting there can we take your picture?
RP- Sure.
KT- So the process we're following is, take this home, transcribe it. Come back to you, spelling and stuff and you can look over and then be part of the proposal that we gave Charlie James. Then we would submit to them.
KK- So where you guys going go now? You get plenty choices but where you really gonna go?
RP- I really don't want to move into another house. Probably do condominium. Try that for a while and maybe while we're trying that, do something with the property up in Ulupalakua. It's just below the Catholic Church. I got three and a half acres up there.
KK- Where the road go left on the Catholic Church?
RP- Well, you gotta, you have to go past the Catholic Church about a mile or so and then come back. Then come back, but at least now the road's there. Some of the people have built private roads so I can get access.
KK- Oh great. Okay.

Interview: Mildred Ann Wietecha

By Keli'i Tau'ä/ Kimokeo Kapahulehua
Interview in 12/05

KT- Keli'i Tau'ä
MW- Consultant

KT- So, I'm just going to ask you questions and just input whatever you can remember.
MW- Okay.
KT- There's a development company that's been trying to get permission from the County to develop the area that used to be called Wailea 670 but now is changed to Honua'ula. That covers the whole ahupua'a.
MW- What is ahupua'a?
KT- Ahupua'a is a word that describes a land area from mountain to ocean. That's the ancient method of land division. Like Kula is one ahupua'a. Lahaina, all of Lahaina from the Pali all the way to Honokahau is an ahupua'a. Then in-between those little names can either be called Ili and kuleana and bigger areas were referred to as moku and that's how our people referred to land divisions.
MW- Oh.
KT- So, Millie, give me your full name.
MW- Mildred Ann Wietecha.
KT- No Hawaiian name?
MW- No. Mom didn't give me a Hawaiian name. (laughs)
KT- So how old are you right now?
MW- Seventy seven.
KT- And will be seventy eight…?
MW- In June 2006.
KT- In June. Where were you born?
MW- Kihei.
KT- And lived all your life in…?
MW- In Kihei.
KT- So you've seen a lot of changes?

MW- Yes.
KT- Some good, some bad.
MW- Yes.
KT- More to come. So what area exactly were you born at? What street?
MW- I was born just about a block above here.
KT- What is the name now?
MW- Oh! Halelani.
KT- Halelani, so one block from here.
MW- One block and a half. You know where the garden, where they have that garden shop? In the back of there.
KT- Oh, ok. So that's where mom and dad lived.
KT- Your mother, you're maiden name was?
MW- My late mom's name was Violet Thompson. She was from Kula. You heard of the Thompson Ranch?
KT- Of course.
MW- Yeah, that was my mom's. It was her mom that owned the property.
KT- And your dad was?
MW- And my dad was Alec Akina.
KT- So dad passed away. When he passed away, how old was he?
MW- Eighty two.
KT- So you folks live a long life.
MW- Yeah, I guess so.
KT- And how many children were in the family.
MW- Eight.
KT- And how many are still living?
MW- Five.
KT- Who are they?
MW- Um, start from me. I'm the oldest now. And then my next sister is Peggy.
KT- Where does she live?
MW- She lives in Honolulu, in Wahiawa. And the next sister is Claria Gomez.
KT- Where does she live?
MW- Mililani Oahu. And the next sister is Etheleen, she lives in California. And the next is my youngest brother Douglas Akina.
KT- Who runs the bus business?
MW- Yes Akina Bus Service. Douglas runs the business.
KT- How old is he now?
MW- He's in his sixties… He was born in nineteen forty one. No, no, I'm sorry, forty two.
KT- Forty two, so he's sixty four years old. So, he still carry on going fishing like your dad.
MW- No, he's not fishing anymore. He doesn't have anymore nets and boats. He's just gave that up and he's concentrating on his bus business.
KT- But he goes just for pleasure and family?
MW- Yes, he has a boat that he goes out just, you know what they do. They hook it or whatever. Trolling and things like that.
KT- So what school did you go to?
MW- I went to Kihei School. Well first I started Wailuku Elementary when I was five years old.

KT- Why did you go so far? Because that was the only school?
MW- I don't know. No. There was Kihei School my mom wanted to put me in Wailuku school.
KT- All the kids?
MW- No. I was the only one that went there. Uh, two years I think I stayed there and then mom brought me back to Kihei.
KT- Before we continue before I forget, I want to get it right. Spell your last name now.
MW- W-i-e-t-e-MW- h-a.
KT- So you were the only one that went to Wailuku. So you were privileged then to go Wailuku.
MW- (laughs) Well, wait just a minute. After that my oldest brother went to St. Anthony. He's older than I and we're four years apart. It's him, me and then my other sister and then down the line.
KT- So all your brother sisters went to Baldwin? Or Maui High?
MW- No they went to St. Anthony. That brother went to St. Anthony and after I finished @ Kihei School. First I went to Wailuku and came back to Kihei. There was something about transportation that's why my mom put me there and then brought me back. Or something like that, I'm not too sure. And then I finished Kihei and went to Baldwin. She rather put me in St. Anthony. She took me there to take the test. I signed up and took the test and everything was all fine But she told me after, "Oh, I forgot to tell you. When you sign your application what religion did you put?" I said, "Mormon." So I didn't get in to St. Anthony. (laughs) She said, "Oh! I forgot to tell you to put Catholic!" (laughing)
KT- Did mom and dad speak Hawaiian?
MW- I used to hear them speak a little bit but not too much. I think they spoke Hawaiian when they didn't want us to understand.
KT- Yeah. But what nationality was your mother?
MW- She was half German. German, French German. And her mother was Chinese-Hawaiian. Her father was pure Chinese, her mother was pure Hawaiian. Her mother comes from royalty. My great great-grandmother.
KT- Where did she get Thompson from?
MW- My grandfather.
MW- Thompson was my mother's father. So, mom was Hawaiian, Chinese, German. Dad was Hawaiian.
KT- You remember the community going to the beach helping pull the net?
MW- Yes, oh yes.
KT- Tell us about it.
MW- Well, whenever we caught fish on the beaches we would all go down to help. When we were little we didn't do too much but play on the sand and everything and watch them pulling the nets. We would go over there but we couldn't pull the nets in. You know we pretend we can pull but we tried. And then when we got older my dad fished with the boats in deep sea. Because most of the fish was out there and then they used these nets that they put inside a regular net and that would, the fish would go through the eyes of the net. And they would pick it up and put it in a bag. Some kind of bag, net bags or whatever they called it. We girls never really went to do much fishing. We had to stay home and do our work at home getting things ready before the men ended fishing.. We had a cook and he did all the cooking to feed all the men.
KT- Who was part of dad's fishing crew?

MW- Oh, he had hired men that he paid and he built homes for them. You know like the plantation built homes. On our property there was like four to six separate units. They had a kitchen, living room, bedroom and the bathroom. During those days I remember everything was outside, you know, the outside bath. And we didn't have electricity at that time where we lived. We lived @ Kamaole, Kamaole I. And it wasn't till after the war that we got electricity. So we had gas lamps and the fishermen, the workers they all had that. When they weren't fishing they would be patching the nets and doing whatever things they had to do. And my dad also had a wood cutting business supplying the plantation with wood.
KT- Was that Kiawe wood?
MW- Yes Kiawe wood, I guess for charcoal. And they would cut it in cords and sell it to the plantation in cords. And then they would have to deliver it to certain homes, whoever needed it. And that was sort of a steady thing that was when they're not fishing he's doing that and the men would have that job to cut trees. They had a machine, a cutter that was a saw. A huge saw that would cut all this.
KT- Cut all the pieces.
MW- Yes, yes.
KT- Because this area was usually overgrown with Kiawe.
MW- Kiawe, yeah this whole area of Kihei was Kiawe trees.
KT- And during the years that you grew up over here, the weather today is just like how it used to be? Hot and dry.
MW- Yes, yes, hot dry rain. I remember it use to rain Thanksgiving and then around Christmas and January, yeah.
KT- When the weather changed?
MW- Right.
KT- So going back with that, did you follow any Hawaiian customs that you can remember because Hawaiians used to have the Fish God, The Ku'ula. Did they follow the moon calendar to go fishing?
MW- Don't know
MW- You know his mom, my dad's mom was the one that would help him. She was a strong Mormon and she, when we were little kids we grew up in both the Mormon Church & Catholic Churches. After we go Catholic Churches we'd have to go to the Mormon Church. We'd have to go to two. Because our grandfather was Catholic and our grandmother was Mormon.
KT- Who was grandpa?
MW- Auhana Akina. The street off south Kihei Road before Chang's bridge took the name Auhana.
KT- Oh, okay.
MW- So we all had to take care two churches. (laughter) So when I was eight years old I had to be baptized into the Mormon Church. So my grandmother was so strong I remember going to the Mormon Church across Kentucky Fried Chicken close to the Kihei Public Library down here. The tiny Church is still there.
KT- That small little Church on South Kihei Road?
MW- It was smaller.
KT- The teeny weenie church?
MW- Yeah, and it was even smaller those days. There wasn't very many people here, just the Akina's I guess. And she would be preaching the gospel. And so, I think she helped my dad

believe all whatever Hawaiian things. I know they believe in certain Hawaiian things but I don't know.
KT- Can you remember Hawaiian families still living around here?
MW- None of them that I remember when I was young. They're not living here anymore they're either all dead or all gone. Um they were much older than we were.
KT- Who were some of the popular names you can remember?
MW- There was the Hoopii's.
KT- Is that the same Hoopii's with Richard.
MW- That's what they said, I don't know. When I asked Hoala he said they're not related. I said, "why not? Same name." But I really, maybe he doesn't know that much about it. But I don't know. Because he said their name is Na-Hoopii. But I think if I remember correctly I heard someone say when they have this name "Na" it's um some kind of like respect or they're maybe in the upper class. I don't know, something like that. Like you would I suppose recognize say the President in the family kind of thing. That's what I thought they meant but I really didn't know for sure. Nobody really explained anything. But, they have Hoopii's in Kahakuloa and places like that. Whether we came from Kahakuloa or not I'm not sure, but I know there was a big family here, lived here.
KT- So, because you're saying you hardly know any Hawaiians living here anymore, do you feel like a stranger in your own land?
MW- (laughing) No, not really they were much older, like I said then we were. And then eventually either the younger children moved away. I know a lot of them went to Honolulu for jobs. They worked Young Brothers, you know the boats that go back and forth. The older people, the parents I remember them when they died and I was just a little kid. The Ho'opi'is live by the cove. The small little cove, when you're going to the cove this way looking at the water, they were on the left. That's where there's a hotel there now, that whole place used to belong to the Hoopii's.
KT- Keonolio's used to live down there?
MW- Aunty Helen, yes. Across the street a little further down that corner I think their son is still over there. I'm not sure, sold most of the property. He's the only one I think he's still there. Don't see him anymore but he was adopted. He was actually one of my cousin's son; Akina girl.
KT- So, as you were growing up, what were you doing for fun? What activities…
MW- Really we make our own fun.
KT- Yeah! That's what I mean. What was that, what was that about?
MW- Um, my sister and I we were like four years apart but we chase each other around the whole yard and things like that. We would go swimming and then we have our cousins that live up this way come down go swimming with us.
KT- So it's just family gathering's and stuff.
MW- Yeah. Oh, my dad had friends that whenever we had luau's all the friends would be invited that lived in Wailuku or Upcountry and wherever they came from.
KT- So your dad was very industrious.
MW- Yes, yeah.
KT- He worked hard.
MW- He worked hard, yes. Everyday there was some different thing to do, you know. There was never a dull moment. He was up early and he was gone. Besides that he had the school bus business.
KT- Which still continued.

MW- Yes, yes. And he bid with the High School to get the contract. When they built Baldwin High that's when I really remember him taking kids from Kihei to high school. It was just them, a small little station wagon. You know a little bigger than an SUV kind of thing, longer. I think it took about ten people I think, maybe a little bit more. I'm not too sure. You sat in this bench. Two benches, one there and here and then there's the driver and one passenger in front.
KT- So how many could fit in there?
MW- I think it was about ten I think. If you're big well, less. But most of them you know in those days nobody was really fat.
KT- That's good information, in the olden days children wasn't fat. Because you guys' had a lot of physical activities.
MW- Yes, I guess so.
KT- Very physical.
MW- I guess so. And we didn't have a store to be getting candies and drinking soda's or stuff like that, I guess that must be part of reason for not having to many obese people.
KT- What stores can you remember that was here?
MW- Right there and where Foodland is, used to have Tomokio Store.
KT- Tomokio.
MW- Yeah.
KT- What did they sell?
MW- Everything. All kinds of groceries.
KT- Groceries plus clothes, plus everything you needed.
MW- Not clothes.
KT- Just groceries.
MW- Yeah, our food.
KT- What other stores were here?
MW- There was a plantation store in Kihei. There they sold clothes, little bit, shirts I guess for men. I didn't notice any other clothes but they sold material.
KT- So as we look over here you can see the map showing Wailea and so forth coming down here. I'm running my hand Mauka of all the names on the map. Was this all covered with sugar?
MW- Oh, this is outside of Kihei, right? This is all Kihei.
KT- This is ocean, this is ocean. Here's Wailea.
MW- Oh, we're going that way.
KT- So, coming down yeah. Just coming down Makena, Kanaio on this side. So up in this area. Above where we're sitting now, was it all plantation?
MW- No. Plantation moved their houses in for, made houses for the workers.
KT- So was it pasture land? Because Kula area was all pasture land.
MW- Yeah, I guess. That was pasture land. And then they built houses for plantation people. There was like one, two, three, four rows of homes. You go right around that you can go in and out, you know what I mean, how the roads were. And the houses were two rows of houses then you go around. Then the next two rows, then the next two rows, I remember that.
KT- Who used to live in there?
MW- All the people who used to work for the plantation.
KT- Which was? Japanese, Chinese, Portuguese?
MW- Japanese, Filipinos, Portuguese. And the Portuguese family ran the store. The plantation store. The Kihei Plantation Store run by the Venturas.

KT- Why, were they the lunas, or the boss, of the plantation?
MW- No, I don't know what they were before. All I know is they were managers of the store, the Venturas.
KT- What plantation was that? Pu'unene?
MW- Lahaina now. The one here in Pu'unene, all same plantation. And the rest of the houses were all people who worked for the plantation that would commute into Puunene. At that time they didn't have the cane fields that they have now.
KT- Right.
MW- The cane field was that way or Upcountry or wherever. But not in Kihei and gradually after the war, the cane came in. That's why you see all the plant. Buildings, some buildings there that was from military who left it from WW II.
KT- Yeah.
MW- Yeah, that's why you see there it wasn't cane fields before then.
KT- Oh, yeah, yeah all the concrete buildings by the airport and so forth.
MW- Right, and Pu'unene was an airport. Hawaiian Airlines and Aloha Airlines landed there. I went to Honolulu one time from there when I was fourteen years old. My first trip to Honolulu. I had one month vacation my mom gave me. I had so much fun playing with all my different cousins.
KT- So, it was….but did it come all the way this side?
MW- The cane?
KT- Yeah.
MW- No.
KT- Where did it stop?
MW- Right there where it is now.
KT- Right before Honoapiilani Hwy coming up over there.
MW- Yep, yes.
KT- And then this side was cattle pastures.
MW- I think they still own, right. So sometimes till now I see cattle coming down.
KT- Right. If you had your way, what would you like to see happen to the community, the area where you were born?
MW- If I had my way….Um. I'm not too sure. I wish I had time to think about it. I'm not too sure, I don't mind this right now. I don't mind you know having homes and things like that and shopping centers. My dream was when I was a little girl I always said I wish I lived near a store. (laughing) I got my way!
KT- By the way, do you have children?
MW- Yes.
KT- How old are they? And how many?
MW- I have five. And my oldest was born in 1943.
KT- And they still live in Hawaii?
MW- She's in Washington State. And she got married and went away and then they come back and forth. And all her lives there and I just lost my grandson. Well, one year we make one year, this month. Oh, boy was it the other day was the one year anniversary of his death. Anurism, just like that.
KT- So, all your children live away?

MW- No, I have um. That's my oldest daughter. Second oldest daughter lives in Waihee married to Kenneth Kahalekai. And the next daughter is in Kihei married to Ben Archangel who is in Honolulu right now going through serious health testing.
KT- Your dad didn't encourage you folks to learn about your culture?
MW- No. My dad was the youngest. My dad's two brothers weren't like him. They just did their work, whatever they did and just stayed home. They did not broaden themselves to know people like my dad.
KT- They weren't entrepreneurs like your father.
MW- Yeah, that's right. My dad loved people, you know, and made a lot of friends.
KT- What were their names? What was names of your uncles?
MW- The oldest was Frank Akina who owned a construction company. John Akina had a fishing business and my dad was Alexander. Just those three boys.
KT- Your dad was growing up, when he was growing up, you folks weren't around when he lived on Kahoolawe.
MW- No.
KT- It was just during his young life that he spent there.
MW- Um, he didn't live there full on. He was born there, two of them. Him and uncle John was born on Kahoolawe. My grandmother lived here and when she was ready to give birth she got on a canoe and she paddled herself there and my grandfather delivered them. Grandpa was pure Chinese and Grandma was pure Hawaiian. Grandmother Hanna was sweet loving and religious. Grandfather gave land on South Kihei Road to Mormons and Catholics to build their Church. KT- Why is that?
MW- They just didn't want the land to go to any stranger, I guess. They were taught. My grandfather was taught by his grandfather, I suppose, on how to deliver a baby. And then he taught my dad when my brother was born. And after that my dad delivered all of us. Grandpa Auhana took care of Kalama Park.
KT- Your dad delivered everybody.
MW- Yeah. I remember when we were building the house, a new house in Kamaole I and we were going to move there from this place, we're going to move there. We were living @Kamaole I, my grandparents home. My dad inherited that when my grandmother died because my mom took care of her mother-in law, my grandmother. When she died, she willed the place to us at Kamaole I. It was an inn. And this other inn where my dad built his new home on 22 acres beach side. Oh, the highway yeah up to there. So, um she um got that property and then they built, they sold that other home. It was old already that my dad inherited and then they built on this property.
KT- Did your dad tell you folks how much it cost? How much he sold the property.
MW- Yeah, oh no I don't know. I didn't hear what he sold the property for, what he sold that for so many years ago. I don't know I think in them days, I suppose one thousand was big, big bucks. Maybe was one million. I don't know I'm not sure. So, no I never heard that. Because we were like about 7 years old. And I never heard anything. Um but I know how much a new home, I heard, after I got older was 3,500. They built their house.
KT- 3,500, how many bedrooms?
MW- Yes, we had three huge bedrooms, an office and a huge kitchen & dining room, living room, I dunno, everything was huge. And then it went into a huge shape in the back. The front was straight, the back was a huge shape, and then we had a huge patio outside, open patio with

the hau tree's for shade. And then you go down the step and a building as huge as this. Something bigger than this.
KT- Hau trees for shade? They made the hau trees…
MW- Hau trees. One on each end of the patio and they came together. I think he trimmed, you know, to keep it up there. Yeah, hau trees.
KT- Well at least you can remember that.
MW- Yeah, and then we had, oh always people coming in. Always entertaining, so my mom didn't want people in the old house anymore. The house was too small. The dining room was too small. So my dad built this huge dining room bigger than this. Probably go out room from there to here I think. Where there was everything in there. Uh, large tables, there was, you know there was chairs like this from people who sit and when TV came my dad got a black & white TV.
KT- Everybody else, then everybody start's coming up.
MW- Everybody came to our house to watch TV. (laughing)
KT- So, what you're saying is you folks had a fun active life.
MW- We did, yes we did. Yeah. Every two years my dad bought a new car, a new sedan for the family. Two years go by & it's another new one. So when he goes out on the car, my sister Peggy and I would always go driving since our brother was always busy. We'd get on the trucks and we'd drive all around our yard, and so that's how we learned to drive. So when I went to get my license, I was about 17 years old. And when I went it was Texeira, this man that's the police officer, Texeira was giving license and he was very strict, he doesn't talk. He just point what he wants you to do. You go ahead, back up. You don't say a word, you just watch his finger. So when he got done we went up to Iao. Start car and start it up and go again. I did all that, couldn't believe it. And then when we got to the station he said, "Go in and get your license. I know you folks been driving. All you Akina's drive and you kids!" (laughing) Oh, that was so much. We driving this big, I don't know they're bigger than 2 ½ ton trucks with all this, we had this things on the side. I remember scraping off palm trees. You know the big tall palm trees…pine trees! Growing out on the side of the driveway. I remember scraping there. My sister was sitting on the side with me and going all over the yard. Go right around carefully. I think we better quit they're coming home pretty soon. Park the truck, my dad knew we was using it because he can see where it was parking. But he never said a word.
KT- Well, as long as you guys didn't get in trouble.
MW- Yeah we didn't get in any trouble. No trouble, we had nothing else to do. You know we were, we had lots of work. We had to clean our house, wash all the laundry. From when I was very young we learned all that, how to do.
KT- Take care of family stuff.
MW- Yeah, so when we had the chance we would always get into mischief. We had some busses, we used the bus sometimes, the smaller one, you know like the station wagon.
KT- So, you know on the starting of the first Akina bus transportation to the school. Did he have only one station wagon, or a couple?
MW- When he had to take high school, when the kids got old enough he had to go high school then he had another one for Wailuku high schools. One for Kihei school. Before, they had trains running from Wailuku to Hamäkuapoko.
KT- You don't know how many buses there are today? We gotta go up ask your brother.
MW- Oh, he's got huge busses! They're double the size of Robert's.
KT- Now?

MW- Yeah, they invited him to bid for contracts. I think because actually they supposed to have competition and Robert's didn't have competition I think that they don't like what he is doing.. So they call him he said, "I don't want to go in bus anymore." He didn't want to fight that thing with Robert's again. So he said, "No, go ahead and make a bid and you can you and I be united." He got it. So, he kept adding and plus he got Kamehameha School.
KT- Right, that's a big contract.
MW- Yeah, yeah. I don't know, he's got more busses than he ever had before. Running school buses. I think we used to have maybe 10-12 maybe at the most 15 buses. I think he said he's got what, 30 or 40. Now, there and
KT- Yeah, big guys. Wow. You can think of anything else you want to share about life in Kihei?
MW- We used to go that way where Wailea is now and pick beans during the summer. My dad used to pick up all this plantation kids early in the morning he'd go with his truck. The open truck with all the things on the side and the back for their safety and they all gave him their "pull" there pickings He took them down there or wherever there was a lot of beans. Like if they come here this week, maybe next week they have to go somewhere else. But I remember down that way @ Honua'ula always had no homes, only Kiawe trees. And it's were we used to go pick up beans for our pigs.
KT- So, dad raised pigs to eat.
MW- My mom. My mom loved to farm. She comes from the farming background, you know. I remember her having about twenty something pigs. They would all come in one time. Some funny she had a contract with someone, they brings this pig all white and black all around this portion of their bodies. And they're little piggies and as soon as they're six months old they come and take them away. I guess they go slaughter, maybe? And then they bring her another batch. About 20 pigs each time, somewhere like that. And we used to have to take beans for them and then she and my oldest brother would help her feeding the pigs. She loved farming. She was a farmer born in Kula.
KT- What else did you plant there?
MW- Then she raised them. Oh, yes she loved all her plants all around her house and then she grew hayden mangoes. Yeah so she'd have a, when they were all ready she'd pick em and then take em to the market. They were huge and beautiful color.
KT- Good taste.
MW- Yeah and the taste! Yeah.
KT- Yeah we only talked about your mother but now you tell me about your father but now you're revealing you're mother's side.
MW- Yeah my mom was a hard working woman. Always in pants and shirt. You see her in a dress only when she goes to church. Pants and shirt. And short haircut, real short like a man cut, you know. I can remember that. She died when she was 52 from cancer. Yeah, when she found out that she had cancer, she didn't say anything to anyone because they were building that second new home above.
KT- Above Kamaole.
MW- Oh, where Kamaole Beach Royale is. Just above, it's the same area, but above. They built up there and she was so happy and she planned this home, designed it way she wanted it. And when they gave her the keys, it was done, she went to the doctor. She knew something was wrong, and she knew about what it was, but she didn't think that it would be too late. So when she went it was too late. She flew to Honolulu where she stayed there six months getting

treatments everything. Then she came home, she had one month in her new home, and she came home she got on my dad's huge truck and went to Lahaina to see Fleming. Mr. Fleming there was giving her all these mangoes. She wanted more mangoes on her property. Mangoes and all kinds of goods. She brought em all home on this huge truck. And she planted about two, three weeks later she couldn't do anything. Then they took her to the hospital and couple weeks later she died. And you know when she died, I'll never forget, they called us, "come on up, come now because I think mom's going to go, they're going to pull out the plug." Because she was on the oxygen. All of us, my brother's all of us, went jump in her car. We had a Buick, she had a big Buick. We all jumped in her car and my other brother Don, the one that just passed away, was driving. He came from the mainland. He was living on the mainland and my sister. Both lived in the mainland, so they came home. Took up, we rushed up there and we stayed with her till she passed away. And as soon as they took the oxygen out, off of her, she said. The first time she talked she said, she smiled and she said, "oh, the grass is so green." No first, "The sky is so blue. And the grass is so green." And she passed away. Ah, I tell you we cried. Yeah, I'll never forget that.
KT- That's a beautiful story. Well like I told you, I knew your dad very well and we're going to do everything in my power to try to see if we can make copies of what I wrote about dad. I going, I think I going up…Send it and ask your brother if he can find some time for me to answer this.
MW- Yeah, maybe he has other memories, yeah.
KT- More detail in the fishing part, I'm sure he went with dad yeah?
MW- Cause he did, yeah. He did get all my brother's loved to go fishing, they all went.
KT- So, I'll go do that then.
MW- My oldest brother took over after my dad. My dad would go and help because he was the pilot, he'd fly for the fish spots, spotting fish.
KT- What was his name.
MW- Arnuby. Yeah, my grandmother, my dad's mother named him and she said she got that name from the bible. She was a very religious person.
KT- But dad used to fly too, huh?
MW- No, not himself. My brother did. My brother did the flying. He never, he was older already. And my brother was in his thirties.
KT- What about the one running the bus now?
MW- Douglas?
KT- He never used to fly?
MW- No. But he can fly, my brother taught him. He taught all of his brothers, when they fly with him. Sometimes he would tell everybody, "I think I'll buy me a plane so I can go flying all around this island." And then the second brother took over the fishing business after my brother died. Um, he died in an automobile accident, and then so the other brother took over and that one died in that crash. Yeah, plane crash but he didn't fly, somebody else did. Although he knew how to fly because every Thanksgiving, somehow Thanksgiving was his holiday. He loved Thanksgiving. So we celebrated with him at my brother's house, he lived up Kihei Heights, Douglas. And so we all went there and we had our own little party before Thanksgiving and everybody was singing after they had been drinking. You know we're going to sing and sing and then every other song, that brother, his middle name was Pali. Because my mom fell over the Pali when she was pregnant with him. And he was fine and she was fine and she gave birth that time when she was six months pregnant. The doctor was surprised they didn't know she was

pregnant. She was always skinny and tall and nobody knew. She was taller than us. I think my mom was about 5'5" my grandfather was 6'. Some of my uncles were short and tall. Either they were short or tall because my grandmother was very short. I never seen her, but I heard she was very short, the Chinese. Yeah, Hawaiians would be tall. I don't know how her mother was. We don't have any pictures, anything. But anyway um, he um used to like a song Akaka Falls and every time they would sing a song, as soon as, just before they end he would say "Akaka Falls." And then they singing the song Akaka Falls and would sing the song. And then he would say to wait a few minutes, he'll be back. He went to the airport, got on a plane and flew. Flew straight, came to the house and went around, show us that he can fly. He didn't have a license or anything but he flew. Yeah. I tell you my brother's were all talented. They had so much talent. Oldest brother can play any instrument you give him. He plays the piano and we had a piano in the house get on that piano and just whip it. Guitar, then all the harp. Any instrument, you gave him the sax, he play the sax. And he's so musical!
KT- Where do you think it came from?
MW- I really don't know.
KT- Mom and dad was?
MW- My mom wasn't, my dad was so. But I didn't see. My dad never played instrument. I never saw him playing the ukulele anything. Maybe he can but I never saw him play. But he could sing, you. He had a falsetto voice, he sang so high. He loved to sing all the slow songs. Alika when I was a little girl growing up he always sang all those songs. As you go then I can think. You know you forget the song's, I might hear it and say, "oh, that was my dad's song!" All the same songs he would sing all the time. Yeah, very musical. I used to love our luau's. They had so much food, and so much people there invited, you know.
KT- Was it an annual thing your dad used to do?
MW- Every Christmas we celebrated. And his brother's would celebrate the New Year's.
KT- Oh, so they took chances?
MW- They took, yeah, I guess maybe that's reason. But he always loved Christmas because my mom loved Christmas too so, for us, for us kids.
KT- So, what was included on the menu?
MW- It was always the Hawaiian food. Mom made the kulolo, she made it all. Kalua pig, loco, chicken and long rice. Lomi lomi salmon, opihi, sometimes Crab. I guess it depends on when they could get it or whatever. It wasn't the, I guess the main things was what I mentioned.
KT- Squid Luau.
MW- Loco? Squid Luau, and my mom used to be a good cook. She would make all this food.
KT- She would make it for lots of people?
MW- Yeah, she could cook.
KT- Lot of work.
MW- Yeah, where she learned it, maybe from my mother-in-law, I don't know I never did it. You know we were so young, how did we know we were going to lose our mother so early on. Then, so I learned something.
KT- So mom passed away at 53. How old were you then?
MW- Seventeen or eighteen.
KT- Teenager.
MW- Yeah, we were. At least I was every chance I get I go up there be with her.
KT- Where are they buried?

MW- Maui Memorial, both. And now our brother Don is there, my brother Pali is there, my oldest brother the military in Makawao. And I guess everybody else want to go to Maui Memorial.
KT- You know, I want to tell you what I'm going to do. We can go over it to make sure it's correct then I'll submit it.

Appendix L

Traffic Impact Analysis Report

TRAFFIC IMPACT ANALYSIS REPORT
HONUA'ULA
WAILEA, MAUI, HAWAII

FINAL

March 2, 2010

Prepared for:

Honua'ula Partners LLC
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TRAFFIC IMPACT ANALYSIS REPORT

HONUA'ULA

Wailea, Maui, Hawaii

FINAL

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March 2, 2010

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AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

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FINAL
TRAFFIC IMPACT ASSESSMENT REPORT
HONUAULA
Wailea, Maui, Hawaii

I. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi & Associates, Inc. (ATA) to evaluate the potential traffic impacts resulting from the proposed development of Honuaula (formally known as Wailea 670) in Wailea. Honuaula will be comprised of mixed uses, residential areas, neighborhood commercial areas, parks, bikeways, walkways and with an 18-hole golf course.

A. Location

Honuaula is situated on approximately 670 acres of land southeast of the Wailea Resort on Maui, which is more specifically identified as TMK: (2) 2-1-008:056 and 071. Neighboring communities include Maui Meadows to the north, Makena Resort to the southwest, and Wailea Resort to the west. Access to Honuaula is provided via the Piilani Highway/Wailea Ike Drive intersection to the north and via Kaukahi Drive to the west. Figure 1 shows the location of Honuaula.

B. Project Description

The original plan for Honuaula included more than 2,000 new single-family and multi-family residential units, two (2) 18-hole golf courses and a large commercial district. Honuaula has since been scaled down and modified. Honuaula currently proposes 1,150 new single-family and multi-family residential units (including 450 workforce affordable homes in compliance with Chapter 2.96

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WAILUKU, MAUI, HAWAII
HILO, HAWAII

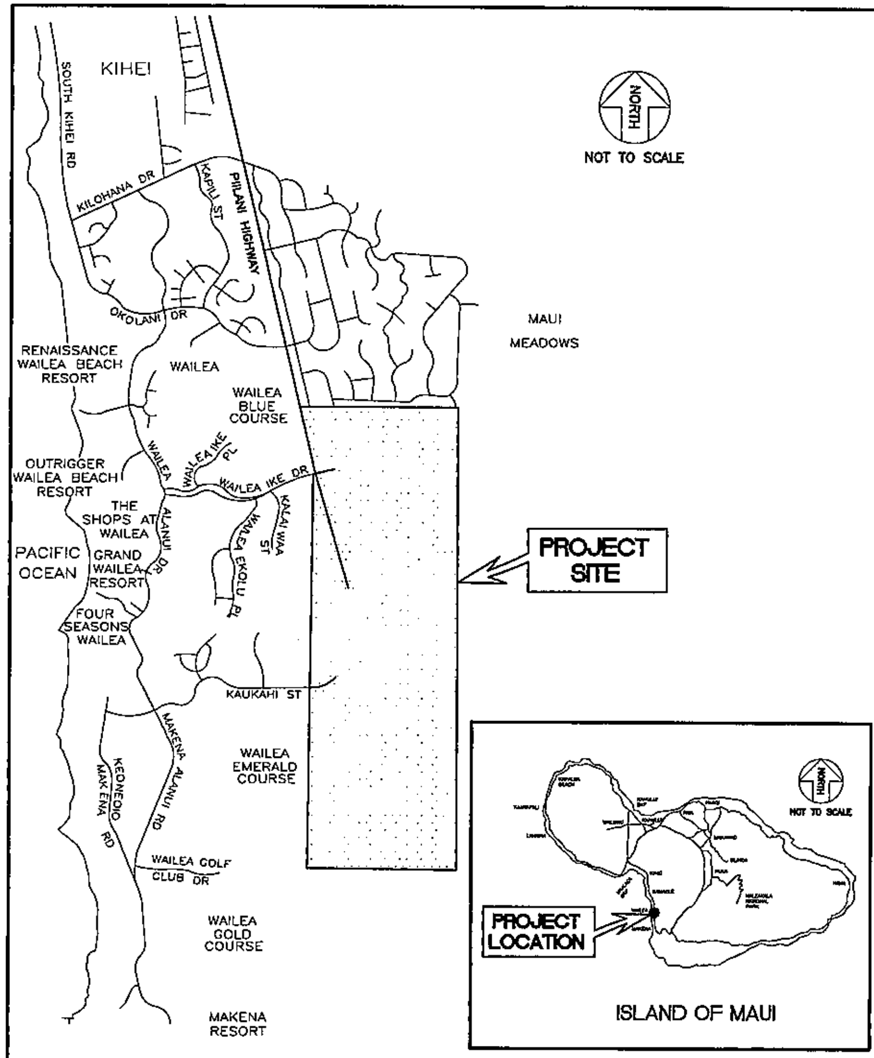
of the Maui County Code), an 18-hole private homeowner golf course and up to 100,000 square feet of commercial and office space.

For the purpose of this study, it is assumed that Honuaula will be constructed in three (3) phases as shown in Table 1. With Phase I of the Project, anticipated completion in Year 2016, the east leg of the Piilani Highway/Wailea Ike Drive intersection (forming a "tee"-intersection, with Piilani Highway being the stem of the tee) will be constructed and Kaukahi Street will be extended into the Project. Since Kaukahi Street is a private street, it is planned to be gated within the Project site to address the concerns of current owners along Kaukahi Street. With Phase II of the Project, anticipated completion in Year 2018, Piilani Highway will be extended beyond Kaukahi Street, forming the south leg of the Piilani Highway/Wailea Ike Drive intersection. Figure 2 shows the conceptual site plan for the Honuaula land uses.

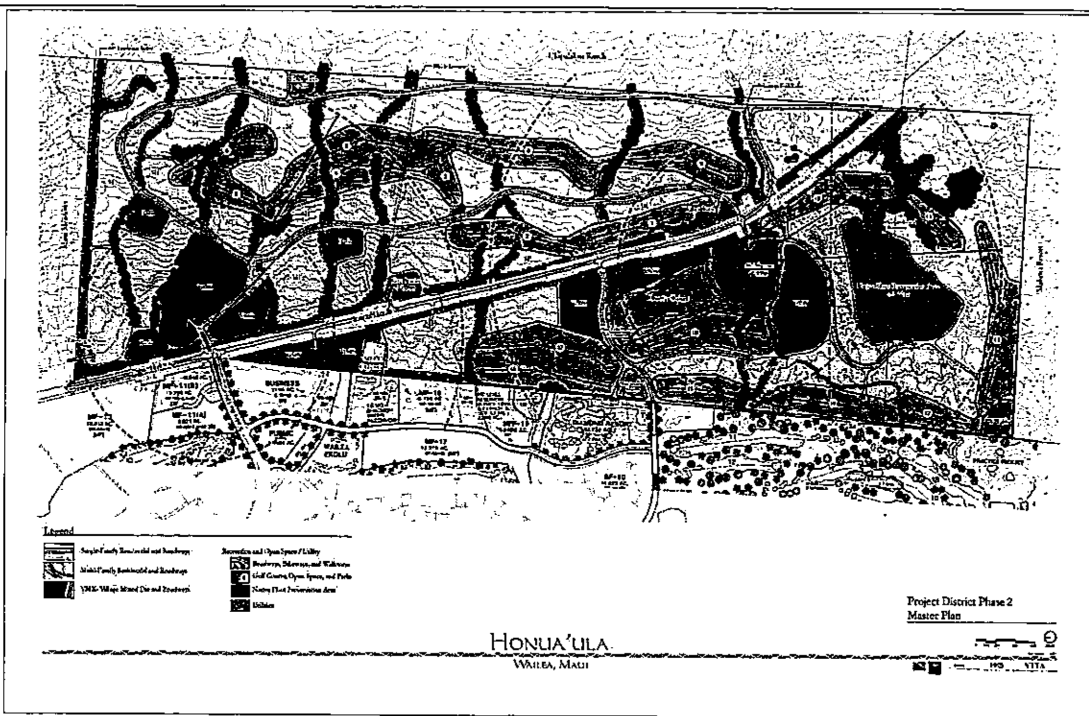
C. Study Methodology

This study will address the following:

1. Existing traffic operating conditions at key intersections within the study area.
2. Traffic Projections for Base Year 2016, 2018, and 2022 (without the project) including traffic generated by an annual defacto growth rate, consistent with the Maui Travel Demand Forecasting Model, and other known developments in the vicinity of the Project. These other known developments in consideration are projects that are currently under construction as well as known new/future developments that are expected to affect traffic demand and operations within the study area.
3. Identification of potential traffic conditions for the Base Year 2016, 2018, and 2022.
4. Trip generation and traffic conditions for the proposed Project.
5. Determination of the impact of Project-generated traffic.
6. Recommendations for roadway improvements or other mitigative measures, as appropriate, to reduce or eliminate the adverse impacts resulting from traffic generated by the Project.



HONUA'ULA | ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII | LOCATION MAP | FIGURE 1



HONUA'ULA | AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII | SITE PLAN | FIGURE 2

Table 1
Proposed Development for Honua'ula

Land Use	Units	Quantity
Year 2016		
VMX (Office Building)	SF GFA	26,000
VMX (Commercial)	SF GFA	74,000
MF Affordable	DU	75
MF Market Rate	DU	158
MF Townhouse	DU	40
SF Lots	DU	127
Year 2018		
MF Affordable	DU	200
MF Market Rate	DU	30
MF Townhouse	DU	60
SF Lots	DU	110
Year 2022		
MF Affordable	DU	175
MF Market Rate	DU	12
SF Lots	DU	163
TOTAL VMX (SF GFA)		**100,000**
TOTAL RESIDENTIAL (DU)		**1,150**

DU = Dwelling Units
SF = Single-Family
MF = Multi-Family
VMX = Village Mixed Use
SF GFA = Square Feet of Gross Floor Area

II. EXISTING CONDITIONS

A. Roadway System

The following are brief descriptions of the existing roadway network in the vicinity of the Project:

Piilani Highway - is generally a four-lane, undivided, north/south State arterial highway providing access to Kihei and Wailea from areas north of Kihei. Piilani Highway narrows to a two-lane highway at its intersection with Kilohana Drive/Mapu Place until its terminus at Wailea Ike Drive. Piilani Highway begins at its intersection with South/North Kihei Road and ends at its intersection with Wailea Ike Drive, with provisions to extend the highway further south. Left-turn storage lanes are generally provided at major intersections on Piilani Highway. The posted speed limit on Piilani Highway is generally 40 miles per hour (mph). The speed limit on Piilani Highway is 45 mph in the northbound direction from Wailea Ike Drive to Kilohana Drive; the southbound speed limit on this segment decreases from 45 mph to 25 mph as it approaches Wailea Ike Drive.

South Kihei Road - is an undivided, north/south County collector roadway that is generally parallel to Piilani Highway. South Kihei Road is a two-lane roadway in the vicinity of the study area. South Kihei Road provides local access to shopping centers and visitor accommodations along the Kihei coastline. The posted speed limit on South Kihei Road is generally 20 mph in the study area.

Kilohana Drive - is a two-lane, undivided, east/west roadway that connects South Kihei Road with Piilani Highway, intersecting Piilani Highway across Mapu Place, which provides the north access to Maui Meadows residential subdivision. The posted speed limit on Kilohana Drive is 25 mph.

Mapu Place – is a two-lane, undivided, east/west roadway that provides one (1) of two (2) access points from Piilani Highway, to Maui Meadows residential subdivision. The posted speed limit on Mapu Place is 25 mph.

Wailea Alanui Drive - is a four-lane, divided, north/south collector roadway between Kaukahi Street to the south and Okolani Drive to the north. North of Okolani Drive, Wailea Alanui Drive narrows to a two-lane, undivided, north/south County collector road to its intersection with Kilohana Drive. South of its

intersection with Kaukahi Street, Wailea Alanui Drive becomes Makena Alanui Road. The segment of Wailea Alanui Drive between Wailea Ike Drive and Kaukahi Street has a rolling profile and a meandering alignment. The segment of Wailea Alanui Drive north of Wailea Ike Drive has a less pronounced rolling profile and meandering alignment. The posted speed limit on Wailea Alanui Drive is 30 mph.

Okolani Drive - is a four-lane, divided, east/west roadway between South Kihei Road and Wailea Alanui Drive. Okolani Drive narrows to a two-lane undivided roadway east of Wailea Alanui Drive to its intersection with Piilani Highway directly across of Mikioi Place. The posted speed limit on Okolani Drive is 30 mph.

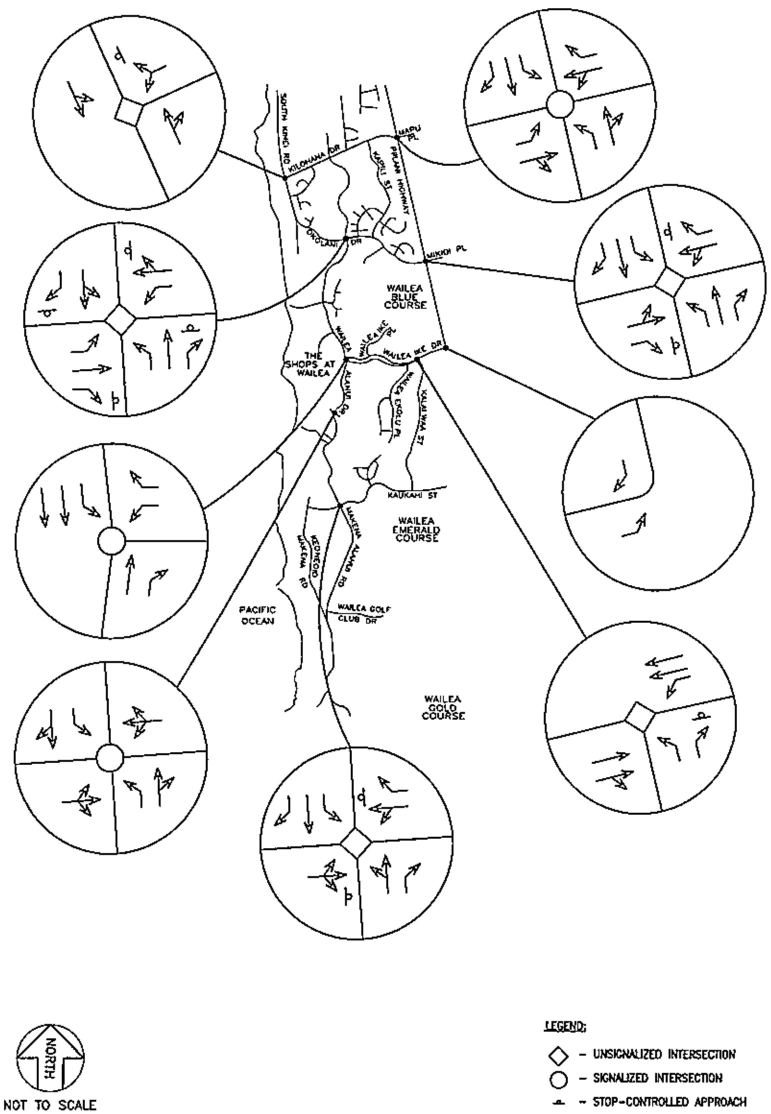
Mikioi Place – is a two-lane, undivided, east/west roadway that provides the southern access point from Piilani Highway, across Okolani Drive, to the Maui Meadows residential subdivision. The posted speed limit on Mikioi Place is 25 mph.

Wailea Ike Drive - is a four-lane, divided, east/west County collector roadway that narrows to a two-lane roadway just before its connection to Piilani Highway. Wailea Ike Drive is the main entrance to the Wailea Resort and connects Piilani Highway with Wailea Alanui Drive. Its vertical alignment is a relatively steep grade with a posted speed limit of 30 mph. Wailea Ike Drive, from its intersection with Wailea Ekolu Place to Wailea Alanui Drive, has a major drainage channel in its median area.

Kalai Waa Street - is a two-lane, undivided, north/south roadway between Kaukahi Street and Wailea Ike Drive. Stop signs are provided at its terminus with Wailea Ike Drive and at its terminus at Kaukauhi Street.

Kaukahi Street – is a two-lane, undivided, east/west roadway between Wailea Alanui Drive/Makena Alanui Road and Kalai Waa Street. Kaukahi Street intersects Wailea Alanui Drive/Makena Alanui Road on the west end and terminates at the Wailea Resort property line on the east end. The Project proposes to extend Kaukahi Street to intersect with the extended Piilani Highway. However, because Kaukahi Street is a private road, the extension of Kaukahi Street into the Project is planned to be a gated access to address the concerns of current owners along Kaukahi Street.

Figure 3 shows the existing roadway system and lane configuration at the study intersections.



LEGEND:
◇ - UNSIGNALIZED INTERSECTION
○ - SIGNALIZED INTERSECTION
- STOP-CONTROLLED APPROACH

HONUA'ULA	ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	EXISTING LANE CONFIGURATION	3

B. Existing Traffic Volumes

Based on the proximity to the project site, the following intersections are studied:

- Piilani Highway/Kilohana Drive/Mapu Place (Signalized)
- Piilani Highway/Okolani Drive/Mikioi Place (Unsignalized)
- Wailea Ike Drive/Kalai Waa Street (Unsignalized)
- Wailea Alanui Drive/Wailea Ike Drive (Signalized)
- Wailea Alanui Drive/Okolani Drive/South Kihei Road (Unsignalized)
- South Kihei Road/Kilohana Drive (Unsignalized)
- Wailea Alanui Drive/Grand Wailea Resort (Signalized)
- Wailea Alanui Drive/Kaukahi Street (Unsignalized)

The AM and PM Peak hour turning movement data utilized in this report were collected on Tuesday June 24, 2008 and Wednesday June 25, 2008. Based on traffic count data, the peak hours of traffic were determined to be from 7:00 AM to 8:00 AM and 4:00 PM to 5:00 PM on the weekdays. The traffic count data is provided in Appendix A.

Traffic count data was taken when public schools were in summer break session for the following reasons:

- Wailea is a resort community and caters to visitor traffic which is highest during the summer months.
- The nearest school to Wailea is located more than a mile north of the Piilani Highway/Kilohana Drive intersection.
- Existing peak hour volumes entering and exiting the Maui Meadows Subdivision (Piilani Highway/Kilohana Drive/Mapu Place and Piilani Highway/Okolani Drive/Mikioi Place intersections) during the AM peak hour of traffic were similar to the existing volumes obtained from the Traffic Impact Analysis Report for Wailea Resort 2005 Update (count data taken in October 2004). This comparison shows that for Maui Meadows, a local residential

subdivision with no recent expansion, traffic volumes are similar during the summer break session than the school session. The PM peak hour of traffic occurred after school hours.

C. Existing Traffic Conditions Analysis and Observations

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The Highway Capacity Manual – Special Report 209 (HCM), dated 2000, methods for calculating volume to capacity ratios, delays and corresponding Levels of Service were utilized in this study. LOS definitions for signalized intersections are provided in Appendix B.

Methodology

Analysis for the study intersections were performed using the traffic analysis software Synchro, which is able to prepare Highway Capacity Manual (HCM) reports. The reports contain quantitative delay results, as based on intersection lane geometry, signal timing, and hourly traffic volume. In addition, Synchro is able to estimate the queue lengths at the study intersections.

Field Observations

The general paths vehicles utilize when traveling between areas north of Wailea and south in Makena are Piilani Highway, Wailea Ike Drive, and Wailea Alanui Drive. Therefore, at the Wailea Alanui Drive/Wailea Ike Drive intersection, the turning movement volumes are the higher volumes.

During the AM peak hour of traffic, queuing was observed on the northbound through movement at the Piilani Highway/Kilohana Drive/Mapu Place intersection, however, all vehicles were able to clear the intersection within one (1) signal cycle length. During the PM peak hour of traffic, the northbound and southbound through movement volumes were noticeably higher than the AM Peak hour of traffic at the Piilani Highway/Kilohana Drive/Mapu Place intersection. The through traffic at this intersection was higher, but experienced little delay, with vehicles clearing the intersection within one (1) signal cycle length. The eastbound and westbound volumes at the Piilani Highway/Okolani

Drive/Mikioi Place intersection remained fairly low with no more than three (3) vehicles queued at the stop sign.

In its present configuration, the Wailea Alanui Drive/Wailea Ike Drive intersection operates well. The westbound left-turn queue varied from three (3) to eight (8) cars per cycle length, however all vehicles were able to clear the intersection during one (1) cycle length.

All other study intersections appeared to operate sufficiently during both the AM and PM peak hours of traffic.

Results of Intersection Analysis

The analysis and observations described below are based on prevailing conditions during the time at which the data was collected. Hereinafter, observations that are expressed as ongoing and current shall represent the conditions that prevailed at the time at which the data was collected.

Intersections along Piilani Highway

At the signalized intersection of Piilani Highway/Kilohana Drive/Mapu Place, all movements operate overall at LOS D or better during the AM and PM peak hours of traffic.

At the unsignalized intersection of Piilani Highway/Okolani Drive/Mikioi Place, the eastbound left-turn movement operates at LOS F during the PM peak hour of traffic due to minimal gaps in the northbound and southbound approaches. However, as a condition of the Kai Malu Development, a traffic signal is proposed at the Piilani Highway/Okolani Drive/Mikioi Place intersection to alleviate the eastbound left-turn delay. All other movements operate at LOS D or better during the AM and PM peak hours of traffic.

Wailea Ike Drive/Kalai Waa Street Intersection

The unsignalized intersection of Wailea Ike Drive/Kalai Waa Street experience an overall LOS C or better during the AM and PM peak hours of traffic.

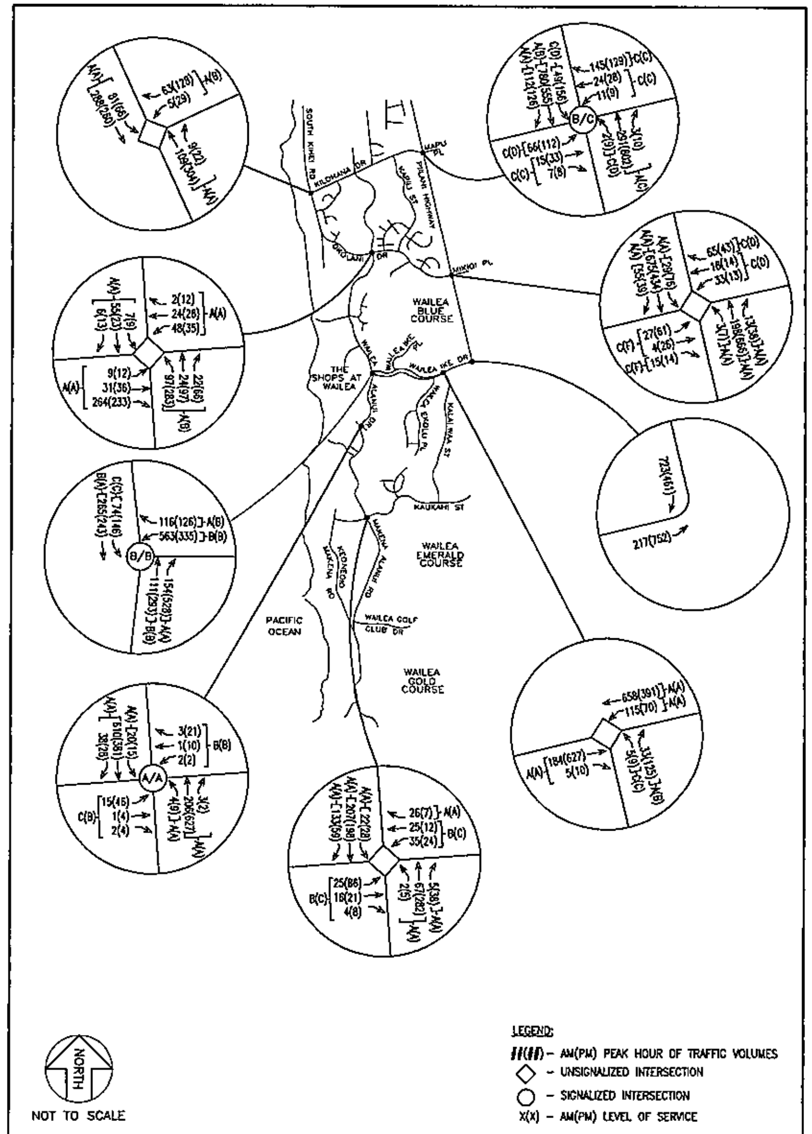
South Kihei Road/Kilohana Drive Intersection

The signalized intersection of South Kihei Road/Kilohana Drive experience an overall LOS B or better during the AM and PM peak hours of traffic.

Intersections Along Wailea Alanui Drive

All intersections along Wailea Alanui Drive operate at an overall LOS C or better during both the AM and PM peak hours of traffic.

Figure 4 shows the existing conditions traffic volumes and level of service and Appendix D shows the level of service summary table.



HONUA'ULA	ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS.SURVEYORS • HONOLULU,HAWAII	FIGURE
	EXISTING CONDITIONS TRAFFIC VOLUMES AND LEVEL OF SERVICE	4

III. BASE YEAR TRAFFIC CONDITIONS WITHOUT THE PROJECT

The Year 2016 was selected as the Base Year to reflect the completion year of Phase I of the Project. Year 2018 and 2022 will also be studied to reflect the completion years of Phase II and Phase III, respectively of the Project. Base Year 2016, 2018, and 2022 projections were formulated by applying a defacto growth rate and trips generated by other known developments, as described in the following sections.

A. Defacto Growth Rate

The growth rate of an area is the percentage by which an area will grow over a period of time. The Maui Travel Demand Forecasting Model was utilized to determine a defacto growth rate in the vicinity of the Project. In addition to Honuaula, Wailea Resort and Makena Resort are the main projects proposed in the Wailea/Makena area. Therefore, the data in the Maui Travel Demand Forecasting Model was adjusted to project growth excluding these three (3) projects. The results from the Maui Travel Demand Forecasting Model – consistent with the 2030 Maui County General Plan - show a defacto growth rate of approximately 0.5 percent per year. Therefore, a defacto growth rate of 4.0 percent for Year 2016, 5.1 percent for Year 2018, and 7.2 percent for Year 2022 were applied to existing traffic volumes.

B. Traffic Forecasts for Other Known Developments

Other known developments that are known to be constructed or completed by Years 2016, 2018, and 2022 are further described below. Peak hour vehicular trips were estimated by applying appropriate trip generation rates from the <u>Trip Generation, 8th Edition</u>, published by the Institute of Transportation Engineers (ITE) and the <u>Resort Residential Trip Generation Rate Development</u> prepared by Parsons Brinkerhoff Quade & Douglas, Inc. dated October 2, 2006 as accepted by the State of Hawaii Department of Transportation (SDOT), (herein after referred to as "PB resort rate"). Appendix F shows the PB resort rate report. Vehicular trips generated from the other known developments were distributed to the roadway network based on distribution obtained from the Maui Travel Demand Forecasting Model.

<u>Wailea Resort</u> is generally comprised of the area west of Piilani Highway, north of Makena Road, east of Makena Ala Nui Road and the Pacific

Ocean, and south of Kilohana Drive. Currently, Wailea Resort has constructed most of its parcels. Table 2 shows the proposed development on the remaining parcels of Wailea Resort.

Within the Wailea Resort, some individual parcels were under construction at the time of data collection or existing developments that are proposed to be renovated.

- Under construction were the Kai Malu (MF-8) and Wailea Gateway Projects. Since traffic studies for these Wailea Resort developments were completed, trip generation volumes and distribution were obtained from the <u>Traffic Impact Analysis Report for Wailea MF-8</u>, dated May 13, 2004 and the <u>Traffic Impact Analysis Report for Wailea Gateway</u>, dated March 6, 2006, both prepared by Phillip Rowell and Associates. Since the data collection efforts, both projects have been completed. Kai Malu (MF-8) is located south of Okolani Drive, east of Wailea Alanui Drive, and west of Piilani Highway, with access from Okolani Drive. Kai Malu (MF-8) proposed to construct 153 multi-family units. Wailea Gateway is located on the northwest corner of the Piilani Highway/Wailea Ike Drive intersection with access from Wailea Ike Drive. Wailea Gateway proposed to construct 32,000 square feet of commercial space to be utilized by businesses, restaurants, and retail shops.

- The existing Grand Wailea Resort proposes to renovate two (2) existing restaurants, construct 310 additional hotel rooms, an additional bar, a new cultural center and garden, and additional parking spaces by Year 2016. The Grand Wailea Resort is located south of the Shops at Wailea, east of the Pacific Ocean and west of Wailea Ala Nui Drive. Trip generation volumes and distribution were obtained from the <u>Traffic Impact Report for the Grand Wailea Resort Renovation</u>, dated January 2009, prepared by Wilson Okamoto Corporation.

- The 1 Resort & Residences (formerly Renaissance Wailea Resort) proposes to redevelop the existing 349 hotel units to provide 290 resort hotel units and 40 residential condominium/townhouse units by Year 2016. The 1 Resort & Residences is located north of Wailea Elua, east of the Pacific Ocean, south of Wailea Ekahi, and west of Wailea Alanui Drive. At the time of data collection, the former Renaissance Wailea Resort parcel remained vacant and therefore, trip generation volumes for the proposed redevelopment were obtained from the Traffic Impact Report 1 Resort & Residences, Wailea, dated March 2009, prepared by Wilson Okamoto Corporation. The existing Wailea Blue Golf Course, currently located off of Kaukahi Street, proposes to relocate the existing clubhouse, and provide approximately 8,000 square feet of commercial space, 10,000 square feet of office space, and 5,000 square feet of restaurant space by Year 2016. The Wailea Blue Golf Course clubhouse and additional commercial/office/restaurant space is proposed to be located at the southeast corner of the Wailea Alanui Drive/Wailea Ike Drive intersection, near the existing Matteo's Restaurant.

Makena Resort is comprised of the area east of the Pacific Ocean and south of Makena Road. Table 3 shows the proposed development for the Makena Resort.

Table 4 shows the Other Known Developments Land Uses and Trip Generation and Table 5 shows the Other Known Developments Trip Generation Rates. For the other known developments which utilized The ITE Trip Generation, 8th Edition and PB report rates.

C. **Planned Roadway Projects**

As a condition for the development of the Kai Malu Project (MF-8), Piilani Highway/Okolani Drive/Mikioi Place intersection will be signalized and the eastbound approach will be restriped to provide an exclusive left-turn lane and a shared through/right-turn lane. At the time of the data collection effort, the Kai Malu Project was under construction. Since then construction has been completed and some of the units have recently been occupied.

Table 2
Proposed Development on the Remaining Parcels of The Wailea Resort

Land Use	Units	Quantity
Year 2016		
SF-8 (SF Affordable Units)	DU	95
MF-6 (SF Lots)	DU	57
MF-10 (SF Lots)	DU	10
MF-10 (Condominiums)	DU	36
MF-10 (Grocery)	SF GFA	12,000
MF-10 (Retail)	SF GLA	30,850
MF-10 (Office)	SF GFA	12,200
MF-10 (Restaurant)	SF GFA	8,340
MF-16 (SF Units)	DU	18
MF-7 (MF Units)	DU	75
SF-S (SF Lots)	DU	38
SF-11 (SF Lots)	DU	16
MF-15 (MF Lots)	DU	72
MF-12/13/SF-7A (MF Units)	DU	300
MF-12/13/SF-7A (Hotel Rooms)	ROOMS	60
MF-12/13/SF-7A (Retail)	SF GLA	20,000
MF-9 Hoolei (MF Units)	DU	120
MF-8 Kai Malu (MF Units)	DU	153
Wailea Gateway (Specialty Retail)	SF GLA	32,000
Grand Wailea Resort Renovations	ROOMS	310
Wailea Blue Golf Club (Shopping Center)	SF GLA	23,000
Wailea Blue Golf Club (18-Hole Golf Course)	HOLES	18
1 Resort & Residences, Wailea (Hotel Rooms)	DU	290
1 Resort & Residences, Wailea (Condominiums)	DU	40
Year 2018		
Business I (MF Units)	DU	100
Business 2 (Storage)	SF GLA	50,000
Business 2 (Office)	SF GLA	40,000
[redacted]		

DU = Dwelling Units
SF = Single Family
MF = Multi Family
SF GFA = Square Feet of Gross Floor Area
SF GLA = Square Feet of Gross Leasable Area

Table 3
Proposed Development for Makena Resort

Land Use	Units	Quantity
Year 2016		
M-2/M-3 (SF Resort)	DU	28
M-4 (MF Resort)	DU	29
M-5 (MF Resort)	DU	110
M-7 (MF Resort)	DU	35
M-9 (MF Resort)	DU	10
M-12 (MF Resort)	DU	54
S-5 (SF Resort)	DU	1
S-6 (SF Resort)	DU	40
Hotel (MF Resort)	DU	44
Maluaka (SF Resort)	DU	13
Maluaka (MF Resort)	DU	2
H-2 (SF Resort)	DU	6
H-2 (MF Resort)	DU	28
Year 2018		
M-5 (MF Resort)	DU	22
M-6 (MF Resort)	DU	60
M-8 (MF Resort)	DU	12
M-9 (MF Resort)	DU	13
S-2 (SF Resort)	DU	17
S-4 (SF Resort)	DU	22
S-7 (SF Resort)	DU	4
Year 2022		
M-1 (SF Resort)	DU	9
M-6 (MF Resort)	DU	9
M-10 (MF Resort)	DU	31
M-11 (MF Resort)	DU	20
S-1 (SF Resort)	DU	90
S-3 (SF Resort)	DU	28
U-1 (SF Resort)	DU	113
TOTAL RESIDENTIAL (DU)		**850**

DU = Dwelling Units
SF = Single Family Homes
MF = Multi Family Homes

Table 4
Other Known Development's Land Uses and Trip Generation

	AM PEAK HOUR			PM PEAK HOUR		
	IN	OUT	TOTAL	IN	OUT	TOTAL
BASE YEAR 2016 WAILEA RESORT *						
SF-8	20	57	77	64	37	101
MF-6	13	37	50	41	23	64
MF-10	118	98	216	207	242	449
MF-16	6	17	23	15	8	23
MF-7	8	34	42	33	15	48
SF-S	10	27	37	28	16	44
SF-11	6	15	21	14	7	21
MF-15	7	33	40	31	15	46
MF-12/13/SF-7A	49	118	167	227	174	401
MF-9	11	49	60	47	23	70
Wailea Blue Golf Club	72	34	106	140	149	289
BASE YEAR 2016 MAKENA RESORT **						
M-2/M-3	8	5	13	7	6	13
M-4	3	4	7	4	6	10
M-5	10	15	25	18	20	38
M-7	4	4	8	5	7	12
M-9	2	1	3	1	3	4
M-12	5	7	12	9	10	19
S-5	1	0	1	1	0	1
S-6	12	7	19	10	9	19
Hotel	4	6	10	7	8	15
Maluaka	5	2	7	3	4	7
H-2	5	5	10	6	7	13
BASE YEAR 2016 TOTAL	**379**	**575**	**954**	**918**	**789**	**1707**
BASE YEAR 2018 WAILEA RESORT *						
Business I	9	43	52	41	20	61
Business 2	165	23	188	27	131	158
BASE YEAR 2018 MAKENA RESORT **						
M-5	2	3	5	3	5	8
M-6	6	8	14	10	11	21
M-8	2	1	3	2	3	5
M-9	2	1	3	2	3	5
S-2	5	3	8	4	4	8
S-4	7	4	11	6	5	11
S-7	2	0	2	1	1	2
BASE YEAR 2018 TOTAL	**200**	**86**	**286**	**96**	**183**	**279 5**
BASE YEAR 2022 MAKENA RESORT **						
M-1	3	2	5	3	2	5
M-6	1	1	2	1	3	4
M-10	3	4	7	5	6	11
M-11	2	3	5	3	4	7
S-1	25	17	42	21	21	42
S-3	8	5	13	7	6	13
U-1	31	21	52	26	26	52
BASE YEAR 2022 TOTAL	**73**	**53**	**126**	**66**	**68**	**134**

* Wailea Resort Trips generated by these developments were estimated by applying appropriate rates contained in the Institute of Transportation Engineers, Trip Generation, 8th Edition
** Makena Resort Trips generated by these developments were estimated by applying Parsons Brinckerhoff's 2006 single-family and multi-family resort residential trip rates.

Note: Does not include trips generated by Kai Malu Project (MF-8), Wailea Gateway, Grand Wailea Resort Renovations and 1 Resort & Residences, Wailea.

D. Base Year 2016 WITHOUT Project Traffic and Analysis

Since it is a condition of the Kai Malu Project (MF-8), it is assumed that the signalization and re-striping of the Pi'ilani Highway/Okolani Drive/Mikioi Place intersection will be completed by Year 2016. The following are conditions of the study intersections due to the defacto growth rate and other known developments.

Intersections along Piilani Highway (WITHOUT Project)

With a defacto growth rate of 0.5 percent per year along Piilani Highway and the other known developments in the vicinity of the Project, the Piilani Highway/Kilohana Drive/Mapu Place signalized intersection some individual movements will operate at LOS F and over capacity conditions during the AM and PM peak hours of traffic. Currently, Piilani Highway is a four-lane roadway and narrows to a two-lane roadway at the Piilani Highway/Kilohana Drive/Mapu Place intersection where it remains as a two-lane roadway to its terminus at Wailea Ike Drive.

The Piilani Highway/Okolani Drive/Mikioi Place, as a signalized intersection, southbound through movement will operate at LOS F and over capacity conditions during the AM peak hour of traffic. During the PM peak hour of traffic, the northbound through and southbound left-turn movements will operate at LOS F and over capacity conditions.

Therefore, with over capacity conditions at the Piilani Highway/Kilohana Drive/Mapu Place intersection and movements at the Piilani Highway/Okolani Drive/Mikioi Place intersection, it is recommended to widen Piilani Highway between its intersection with Kilohana Drive/Mapu Place and Wailea Ike Drive to a four-lane roadway. The following are the recommended lane configurations at each of the intersections:

Piilani Highway/Kilohana Drive/Mapu Place (signalized)

- Northbound and Southbound Approaches: Provide an exclusive left-turn lane (with a protected left-turn signal phase), two (2) exclusive through lanes, and an exclusive right-turn lane.

Table 5
Other Known Development's Trip Generation Rates

Land Use	Independent Variable (X)	Average Daily Weekday Rate	AM Peak Hour of Traffic		PM Peak Hour of Traffic	
			Rate	% Entering	Rate	% Entering
Single-Family Detached Housing (ITE Land Use 210)	DU	Ln(T) = 0.92Ln(X) + 2.71	T = 0.70(X) + 9.74	25%	Ln(T) = 0.90Ln(X) + 0.51	63%
Residential Condominium/Townhouse (ITE Land Use 230)	DU	Ln(T) = 0.87Ln(X) + 2.46	Ln(T) = 0.80Ln(X) + 0.26	61%	Ln(T) = 0.82Ln(X) + 0.32	67%
Supermarket (ITE Land Use 850)	1000 SF GFA	Ln(T) = 66.95Ln(X) + 1391.56	3.59	63%	10.5	51%
Retail (ITE Land Use 814)	1000 SF GFA	Ln(T) = 42.78Ln(X) + 37.66	Ln(T) = 4.91Ln(X) + 115.59	48%	Ln(T) = 2.40Ln(X) + 21.48	44%
General Office Building (ITE Land Use 710)	1000 SF GFA	Ln(T) = 0.77Ln(X) + 3.65	Ln(T) = 0.80Ln(X) + 1.55	88%	Ln(T) = 1.12Ln(X) + 78.81	17%
Restaurant (ITE Land Use 932)	1000 SF GFA	127.15	11.52	52%	11.15	59%
Shopping Center (ITE Land Use 820)	1000 SF GFA	Ln(T) = 0.65Ln(X) + 5.83	1.00	61%	Ln(T) = 0.67Ln(X) + 3.37	49%
Mini-Warehouse (ITE Land Use 151)	1000 SF GFA	Ln(T) = 1.01Ln(X) + 0.82	0.15	59%	Ln(T) = 1.02Ln(X) - 1.49	51%
Office Park (ITE Land Use 750)	1000 SF GFA	T = 10.42(X) + 409.04	T = 1.37(X) + 124.36	89%	T = 1.22(X) + 95.83	14%
Golf Course (ITE Land Use 430)	HOLES	35.74	2.23	79%	2.78	45%
Multi-Family Resort Residential * (PB Trip Generated Rate)	DU	N/A	0.22	40%	0.34	49%
Single-Family Resort Residential * (PB Trip Generated Rate)	DU	N/A	0.46	58%	0.46	50%

DU = Dwelling Units
SF GFA = Square Feet of Gross Floor Area
T = Number of Trip Ends
X = Independent Variable

Source: Institute of Transportation Engineers, Trip Generation, 8th Edition.

- Eastbound Approach: Remain as an exclusive left-turn lane and a shared through/right-turn lane (with a permissive signal phase).
- Westbound Approach: Provide an exclusive left-turn lane, an exclusive through lane and an exclusive right-turn lane (with a permissive signal phase).

Piilani Highway/Okolani Drive/Mikioi Place (signalized)

- Northbound and Southbound Approaches: Provide an exclusive left-turn lane (with a protected left-turn signal phase), an exclusive through lane, and a shared through/right-turn lane.
- Eastbound Approach: Provide an exclusive left-turn lane and a shared through/right-turn lane (with a permissive signal phase).
- Westbound Approach: Remain as a shared left-turn/through/right-turn lane (with a permissive signal phase).

Piilani Highway/Wailea Ike Drive (unsignalized)

- Southbound Approach: Remain as an exclusive free right-turn lane.
- Eastbound Approach: Remain as an exclusive free left-turn lane.
- Northbound and Westbound Approaches will only be constructed with the Project.

With the widening of Piilani Highway, the intersections of Piilani Highway/Kilohana Drive/Mapu Place and Piilani Highway/Okolani Drive/Mikioi Place will operate at LOS D or better during both the AM and PM peak hours of traffic.

Wailea Ike Drive/Kalai Waa Street Intersection (WITHOUT Project)

It is not uncommon, however, for a low volume side street, such as Kalai Waa Street, to experience long delays especially when trying to cross or execute a left-turn onto a high volume roadway, such as Wailea Ike Drive. At the Wailea Ike Drive/IKalai Waa Street intersection, it is projected that approximately 10 and 15 vehicles will utilize the northbound left-turn movement during the AM and PM

peak hours of traffic, respectively. Due to low traffic volumes on Kalai Waa Street, the projected traffic volumes at this intersection do not warrant the installation of a traffic signal system as presented in the Highway Capacity Manual (HCM).

South Kihei Road/Kilohana Drive Intersection (WITHOUT Project)

The South Kihei Road/Kilohana Drive intersection will continue to operate at LOS C or better during both the AM and PM peak hours of traffic.

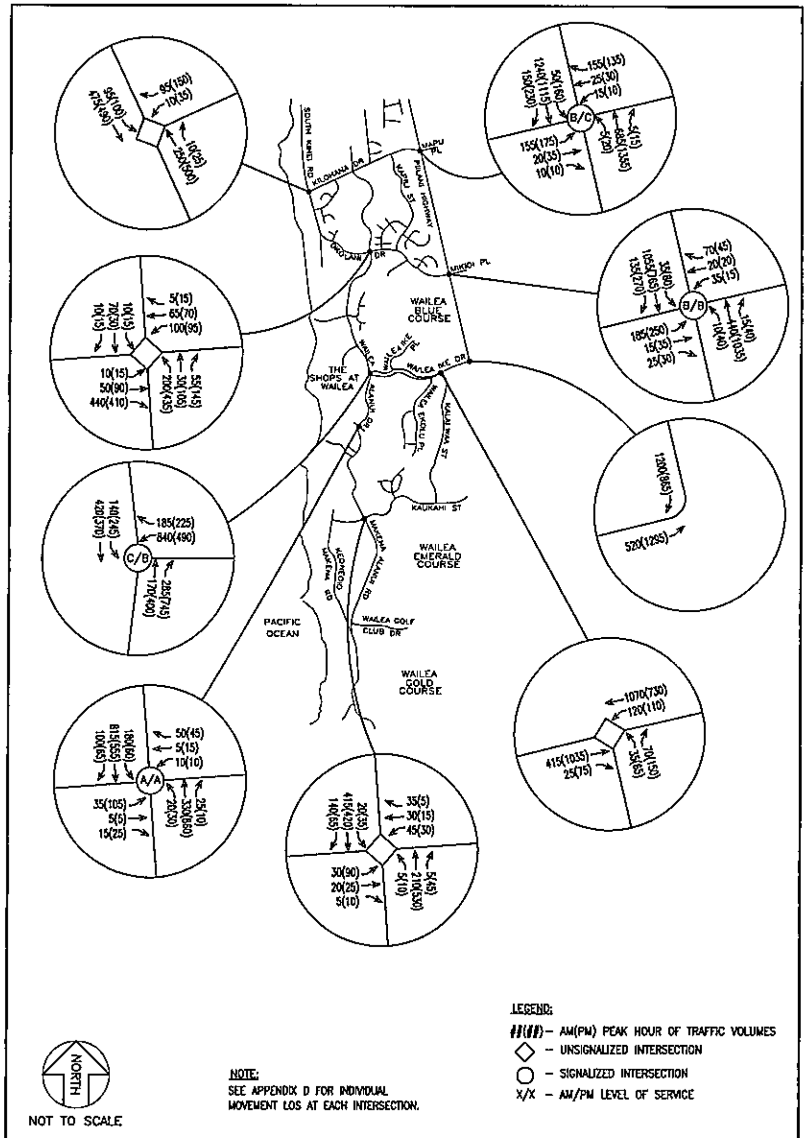
Intersections along Wailea Alanui Drive (WITHOUT Project)

During the PM peak hour of traffic, at the Wailea Alanui Drive/Kaukahi Street intersection, the eastbound shared left-turn/through/right-turn movement will operate at LOS F and the westbound left-turn/through movement will operate at LOS E due to minimal gaps in the northbound and southbound approaches. The eastbound left-turn movement is projected to generate approximately 90 vehicles, however, providing an eastbound left-turn lane will improve the movement by approximately 15 seconds (operate at LOS F) and allow the though and right-turn vehicles to proceed through the intersection (operate at LOS C). Therefore, it is recommended that the eastbound approach be restriped to provide an exclusive left-turn lane and a shared through/right-turn lane, and for alignment purposes, it is recommended that the westbound approach be restriped to also provide an exclusive left-turn lane and a shared through/right-turn lane. The westbound left-turn will operate at LOS E, however it is projected to generate a relatively low volume (approximately 30 vehicles). All other movements operate at LOS C or better PM peak hour of traffic. During the AM peak hours of traffic, all movements operate at LOS C or better.

The projected traffic volumes at the Wailea Alanui Drive/Kaukahi Street intersection do not warrant the installation of a traffic signal system.

All other intersections along Wailea Alanui Drive will continue to operate at LOS D or better during both the AM and PM peak hours of traffic.

Figure 5 shows the traffic volumes and LOS at the study intersections for Base Year 2016. Appendix D shows the level-of-service summary table at all the study intersections and Appendix E shows the recommended lane configuration.



HONUA'ULA | AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII | FIGURE 5

BASE YEAR 2016 TRAFFIC VOLUMES AND LEVEL OF SERVICE WITH MITIGATIVE MEASURES

E. **Base Year 2018 WITHOUT Project Traffic and Analysis**

It is assumed that mitigative measures recommended in Base Year 2016 have been completed by Base Year 2018.

Intersections along Piilani Highway (WITHOUT Project)

With improvements as recommended for Base Year 2016 completed, intersections along Piilani Highway will operate at LOS D or better during the AM and PM peak hours of traffic.

Wailea Ike Drive/Kalai Waa Street Intersection (WITHOUT Project)

The Wailea Ike Drive/Kalai Waa Street intersection northbound left-turn movement will operate at LOS F during the AM peak hour of traffic and will continue to operate at LOS F during the PM peak hour of traffic. With projected volumes at the intersection do not warrant a traffic signal system. All other movements will operate at LOS D or better during the AM and PM peak hours of traffic.

South Kihei Road/Kilohana Drive Intersection (WITHOUT Project)

The South Kihei Road/Kilohana Drive intersection will continue to operate at LOS C or better during both the AM and PM peak hours of traffic.

Intersections along Wailea Alanui Drive (WITHOUT Project)

The northbound left-turn movement at the all-way stop-controlled intersection of Wailea Alanui Drive/Okolani Drive will operate at LOS E during the PM peak hour of traffic. Much of the traffic traveling north on Wailea Alanui Drive headed toward Kihei utilize the northbound left-turn (220 and 485 vehicles during the AM and PM peak hours of traffic, respectively) at the Wailea Alanui Drive/Okolani Drive intersection to access South Kihei Road. In the opposing direction, much of the traffic utilizes the eastbound left-turn (485 and 435 vehicles during the AM and PM peak hours of traffic, respectively) at the Wailea Alanui Drive/Okolani Drive coming from South Kihei Road to access Wailea Alanui Drive. To mitigate the LOS E conditions on the northbound left-turn movement, a roundabout was studied since the projected volumes do not warrant a traffic signal system. However, in accordance with the Roundabouts: An Informational Guide, published by The U.S. Department of Transportation Federal Highway

Administration, dated June 2000, "It is generally not desirable to locate roundabouts in locations where grades through the intersection are greater than four percent." This is recommended due to the difficulty of vehicles entering the roundabout on the downslope to slow down or stop. In the opposing direction, on the upslope, there may be limited sight distance for vehicles entering the roundabout. Therefore, a roundabout is not recommended at the Wailea Alanui Drive/Okolani Drive intersection where the existing slopes along Okolani Drive appear to be greater than 4.0 percent. Projected volumes at the intersection do not warrant a traffic signal system. During the AM peak hour of traffic, all movements will continue to operate at LOS B or better.

The Wailea Alanui Drive/Kaukahi Street intersection eastbound left-turn movement will continue to operate at LOS F and the westbound left-turn movement will continue to operate at LOS E during the PM peak hour of traffic. With projected volumes at the intersection do not warrant a traffic signal system. During the AM peak hour of traffic, all movements will continue to operate at LOS C or better.

All other intersections along Wailea Alanui Drive will continue to operate at LOS D or better during the AM and PM peak hours of traffic.

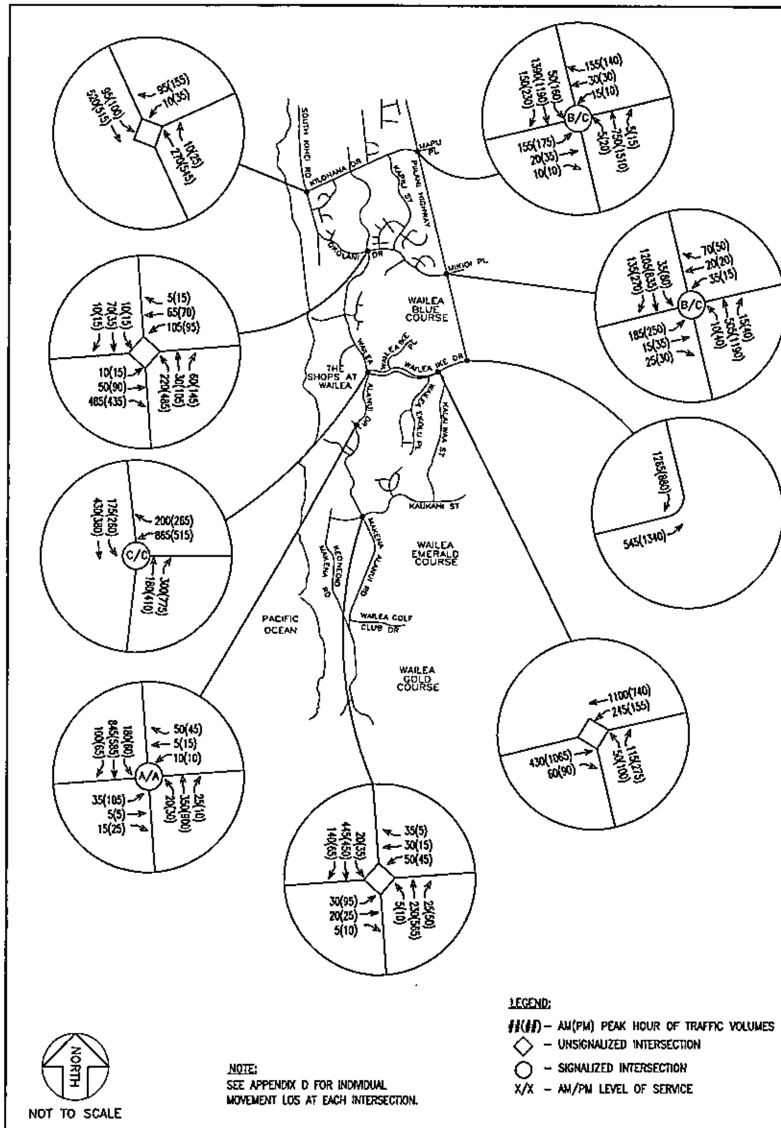
Figure 6 shows the traffic volumes and LOS at the study intersections for Base Year 2018. Appendix D shows the level-of-service table summary at all the study intersections and Appendix E shows the recommended lane configuration.

F. Base Year 2022 WITHOUT Project Traffic and Analysis

It is assumed that mitigative measures recommended in Base Year 2016 have been completed by Base Year 2022.

Intersections along Piilani Highway (WITHOUT Project)

With improvements as recommended for Base Year 2016 completed, intersections along Piilani Highway will continue to operate at LOS D or better during the AM and PM peak hours of traffic.



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BASE YEAR 2018 TRAFFIC VOLUMES AND LEVEL OF SERVICE WITH MITIGATIVE MEASURES

FIGURE 6

Wailea Ike Drive/Kalai Waa Street Intersection (WITHOUT Project)

The Wailea Ike Drive/Kalai Waa Street intersection northbound left-turn movement will continue to operate at LOS F during the AM and PM peak hours of traffic. Additionally, during the PM peak hour of traffic the northbound right-turn movement will operate at LOS E. With projected volumes at both intersections most likely will not warrant a traffic signal. All other movements will continue to operate at LOS D or better during the AM and PM peak hours of traffic.

South Kihei Road/Kilohana Drive Intersection (WITHOUT Project)

The South Kihei Road/Kilohana Drive intersection will continue to operate at LOS C or better during both the AM and PM peak hours of traffic.

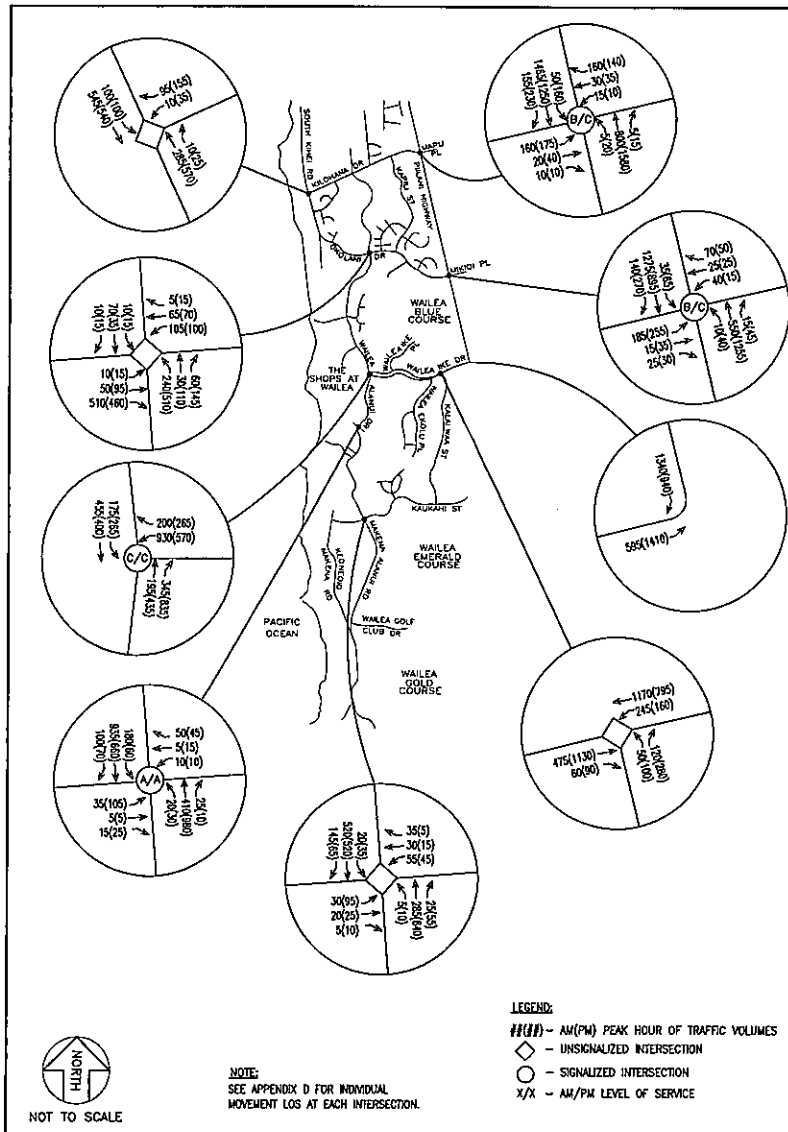
Intersections along Wailea Alanui Drive (WITHOUT Project)

The northbound left-turn movement at the intersection of Wailea Alanui Drive/Okolani Drive will operate at LOS F during the PM peak hour of traffic. However, as mentioned in Section III.E., a roundabout is not recommended at this intersection due to the slope along Okolani Drive. Projected volumes at this intersection most likely will not warrant a traffic signal system. During the AM peak hour of traffic, all movements will continue to operate at LOS B or better.

The Wailea Alanui Drive/Kaukahi Street intersection eastbound left-turn and the westbound left-turn movements will operate at LOS F during the PM peak hour of traffic. Projected volumes at the intersection most likely will not warrant a traffic signal. During the AM peak hour of traffic, all movements will operate at LOS D or better.

All other intersections along Wailea Alanui Drive will continue to operate at LOS D or better during the AM and PM peak hours of traffic.

Figure 7 shows the traffic volumes and LOS at the study intersections for Base Year 2022. Appendix D shows the level-of-service table summary at all the study intersections and Appendix E shows the recommended lane configuration.



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BASE YEAR 2022 TRAFFIC VOLUMES AND LEVEL OF SERVICE WITH MITIGATIVE MEASURES

FIGURE 7

IV. FUTURE YEAR TRAFFIC CONDITIONS WITH THE PROJECT

A. Trip Generation

Trip generation estimates the total number of trips produced by a given land use. Trip rates contained in the nationally published ITE, Trip Generation, 8th Edition were used to estimate the number of trips generated by the Project. Additionally, the Resort Residential Trip Generation Rate Development prepared by Parsons Brinkerhoff Quade & Douglas, Inc. dated October 2, 2006 as accepted by the SDOT, is utilized to estimate the number of trips generated by resort residential units. Table 5, as shown in the previous section, shows these trip generation rates and Table 6 shows the number of peak hour trips that are expected to be generated by the Project.

An estimation of the percentage of internal trip capture was obtained from the ITE Trip Generation Handbook, Second Edition, which was determined to be approximately 15 percent. The internal trip capture was only applied to the PM peak hour of traffic since commercial areas are typically closed during the AM peak hour of traffic. The 15 percent internal trip capture rate was applied to the number of residential trips and the result was applied to the commercial trips, in order to match the number of internal trips between the residential areas and commercial areas. Internal trips are assumed within the Project.

B. Trip Distribution

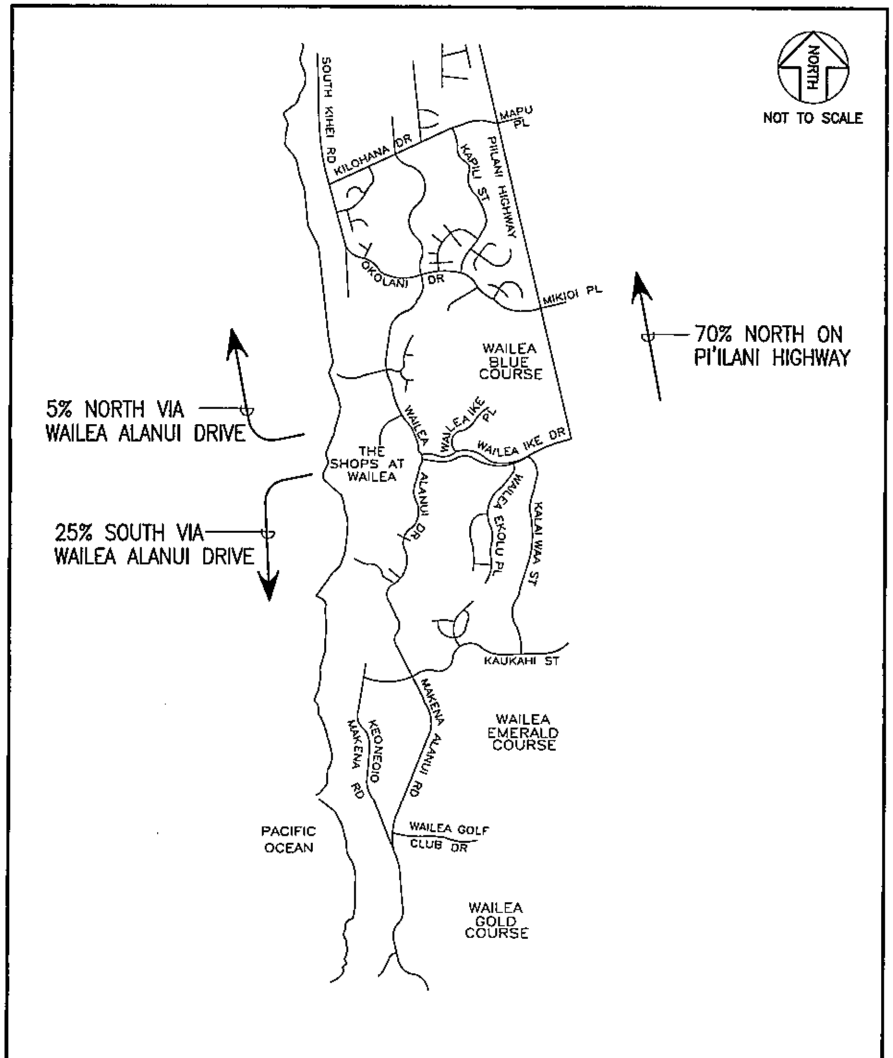
The Project generated trips were distributed based on the distribution utilized by the Maui Travel Demand Forecasting Model; Figure 8 shows the general distribution. Phase I of the Project proposes to construct the east leg of the Piilani Highway/Wailea Ike Drive intersection and Kaukahi Street will be extended into the Project. Since Kaukahi Street is a private street, it is planned to be gated within the Project site to address concerns of current owners along the street. Phase II of the Project proposes to extend Piilani Highway, forming the south leg of the Piilani Highway/Wailea Ike Drive intersection. Figures 9, 10, and 11 show the Project generated traffic volumes during Year 2016, 2018, and 2022, respectively.

Table 6
Project Generated Peak Hour Trips

LAND USE	ITE CODE #	Units	Quantity	Avg. Daily Trips	AM Peak Hour In	AM Peak Hour Out	AM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out	PM Peak Hour Total
YEAR 2016										
VMX (General Office Building)	720	SF GFA	26,000	940	57	7	64	19	89	108
VMX (Commercial)	820	SF GFA	74,000	4978	100	62	162	303	313	616
MF Affordable Housing	230	DU	75	501	8	34	42	33	15	48
MF Townhouse	230	DU	40	290	5	20	25	20	9	29
SF Detached Housing	PB	DU	127	N/A	35	24	59	30	29	59
MF Market Rate Villas	PB	DU	158	N/A	15	21	36	28	26	54
YEAR 2018										
SF Detached Housing	PB	DU	110	N/A	30	21	51	26	25	51
MF Market Rate Villas	PB	DU	30	N/A	3	4	7	6	5	11
MF Townhouse	230	DU	60	193	8	33	41	32	14	46
MF Affordable Housing	230	DU	200	570	18	86	104	82	39	121
YEAR 2022										
SF Detached Housing	PB	DU	163	N/A	44	31	75	38	37	75
MF Market Rate Villas	PB	DU	12	N/A	2	1	3	3	2	4
MF Affordable Housing	230	DU	175	1047	14	67	81	65	31	96
		TOTAL	100,000 SF GFA 1,150 DU		339	411	750	685	634	1318

DU = Dwelling Units
SF GFA = Square Feet of Gross Floor Area
SF = Single-Family
MF = Multi-Family
VMX = Village Mixed Use

Source: Institute of Transportation Engineers, Trip Generation, 8th Edition.
Parsons Brinckerhoff's 2006 single-family and multi-family resort residential trip rates.



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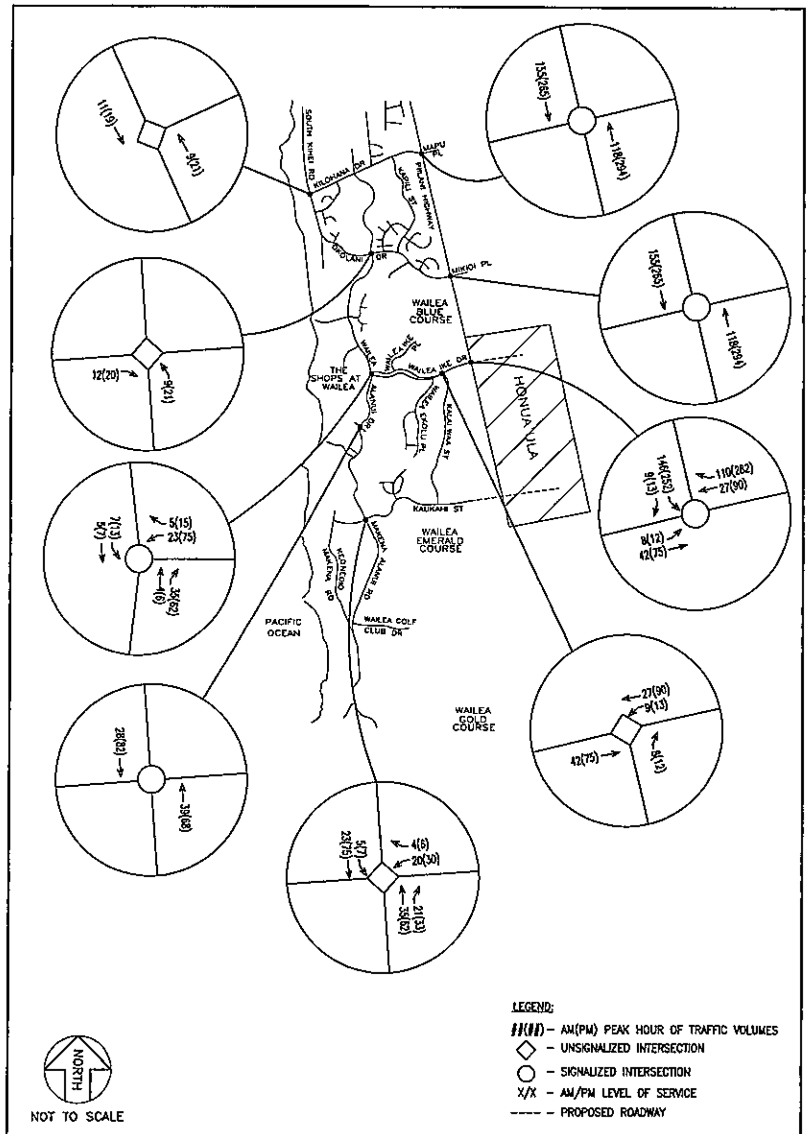
	GENERAL TRIP DISTRIBUTION PATTERN	8



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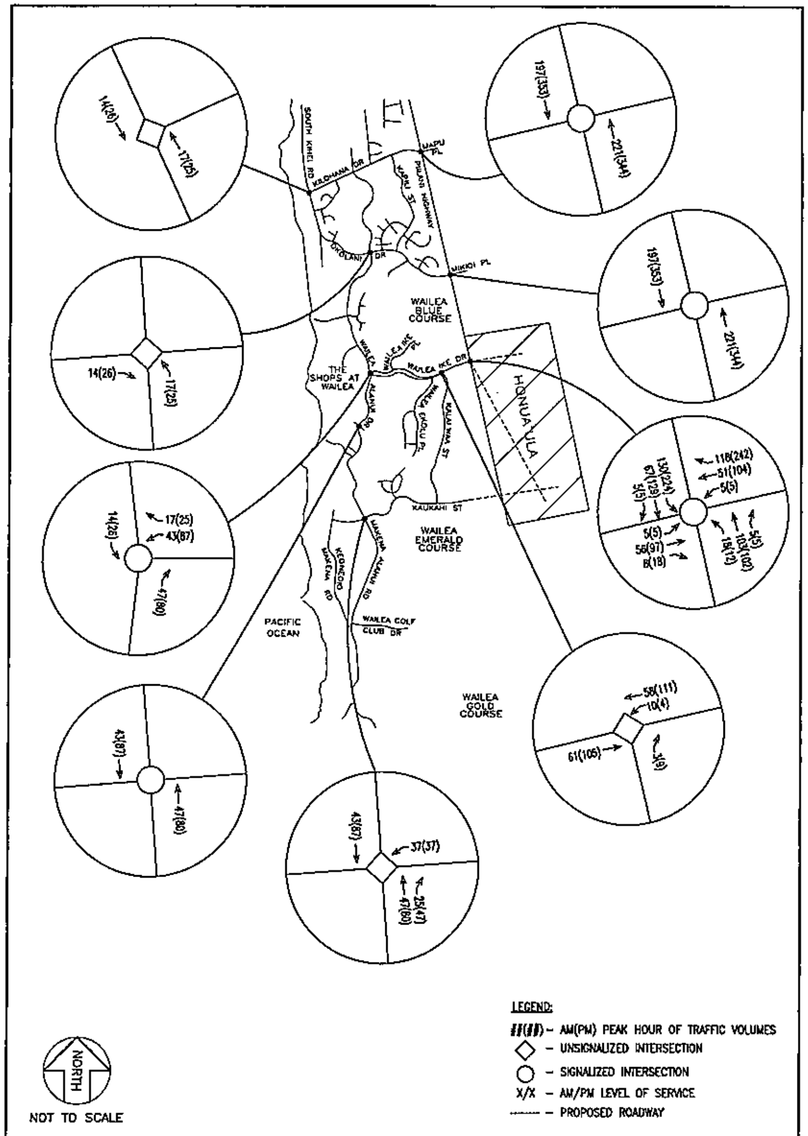
	YEAR 2016 PROJECT GENERATED TRAFFIC VOLUMES	9



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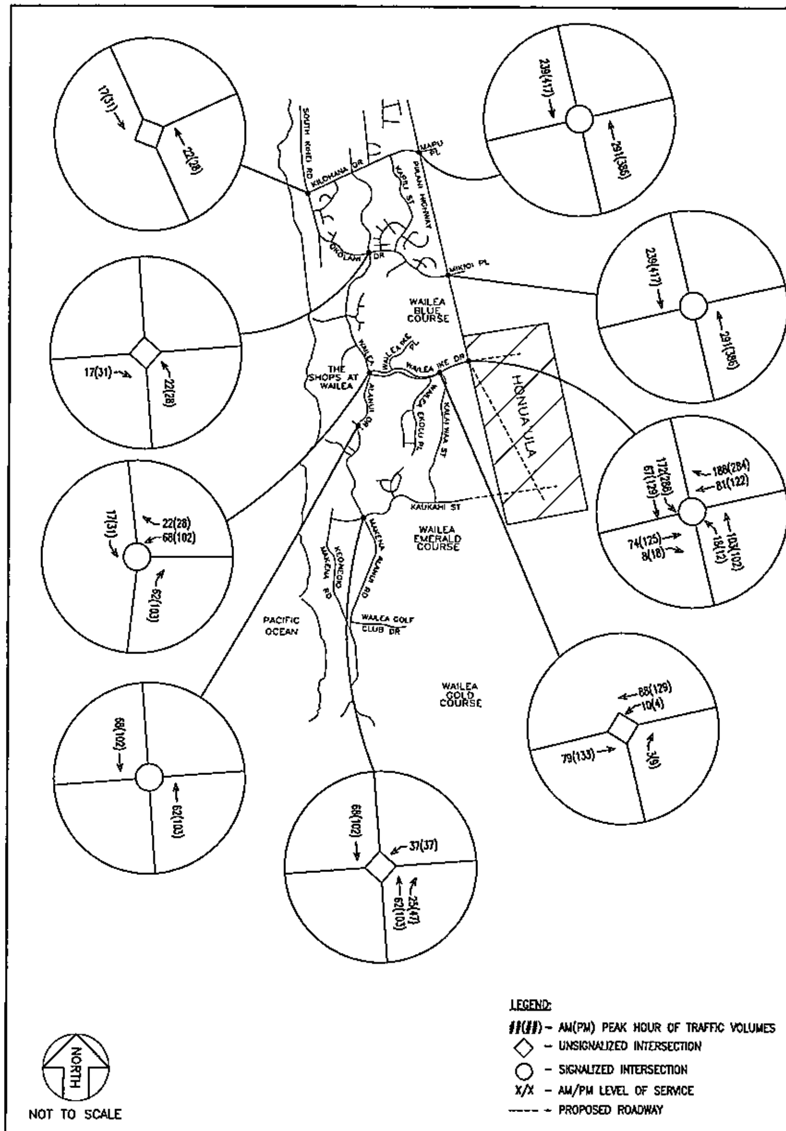
YEAR 2018 PROJECT GENERATED TRAFFIC VOLUMES

FIGURE 10



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YEAR 2022 PROJECT GENERATED TRAFFIC VOLUMES

FIGURE 11

C. Zoning Conditions for the Project

In accordance with the Zoning Conditions for the Project, the following roadway improvements will be implemented prior to construction or occupancy of the Project:

- Piilani Highway will be widened to four (4) lanes as recommended in Section III.D. of this report. The widening of Piilani Highway is required without the Project.
- As stated in the Zoning Conditions for the Project, *"Modify the Wailea Alanui Drive/Wailea Ike Drive intersection to add a signalized double right-turn movement from northbound to eastbound turning traffic and provide two left-turn lanes for southbound traffic from Wailea Ike Drive prior to occupancy of the first unit in Kihei-Makena Project District 9."*

Additionally, when warranted, a traffic signal system will be constructed at the Wailea Ike Drive/Kalai Waa Street and Wailea Alanui Drive/Kaukahi Street intersections in conjunction with the Makena Resort. Therefore, traffic signal warrants at the Wailea Ike Drive/Kalai Waa Street and Wailea Alanui Drive/Kaukahi Drive/Kaukahi Street intersections will be studied.

D. Future Year 2016 WITH Project Traffic and Analysis

Traffic generated by the Project was added to the Base Year 2016 traffic volumes to estimate traffic volumes for Future Year 2016 with the Project. The analysis of traffic conditions for Future Year 2016 assumed the mitigative measures recommended for Base Year 2016 and the Zoning Conditions for the Project to be implemented.

<u>Intersections along Piilani Highway (WITH Project)</u>

With completion of Phase I of the Project, the east leg of the Piilani Highway/Wailea Ike Drive intersection will be constructed forming a "tee"-intersection, with Piilani Highway being the stem of the tee. Due to a high southbound right-turn (1210 and 880 during the AM and PM peak hour of traffic, respectively) and eastbound left-turn (525 and 1305 during the AM and PM peak

hour of traffic, respectively) the following is recommended with Piilani Highway/Wailea Ike Drive intersection reconstructed to a "tee"-intersection:

- With projected traffic volumes, the intersection will warrant a traffic signal.
- Southbound approach: Provide an exclusive left-turn lane and an exclusive right-turn lane. Allow the Piilani Highway southbound right-turn to be a free turning movement by providing an exclusive westbound receiving lane on Wailea Ike Drive.
- Eastbound approach: Provide two (2) exclusive left-turn lanes (with a protected left-turn signal phase) and an exclusive through lane.
- Westbound Approach: Provide an exclusive through lane, and an exclusive right-turn lane.

With the lane configuration recommended above, the Piilani Highway/Wailea Ike Drive intersection will operate at LOS D or better during the AM and PM peak hours of traffic. All other intersections will continue to operate at LOS D or better during the AM and PM peak hours of traffic.

<u>Wailea Ike Drive/Kalai Waa Street Intersection (WITH Project)</u>

The Wailea Ike Drive/Kalai Waa Street intersection northbound left-turn movement will operate at LOS F during the AM and PM peak hours traffic. With projected volumes at both intersections most likely will not warrant a traffic signal. All other movements will operate at LOS D or better during the AM and PM peak hours of traffic.

<u>South Kihei Road/Kilohana Drive Intersection (WITH Project)</u>

The South Kihei Road/Kilohana Drive intersection will continue to operate at LOS C or better during both the AM and PM peak hours of traffic.

<u>Intersections along Wailea Alanui Drive (WITH Project)</u>

The Wailea Alanui Drive/Kaukahi Street intersection eastbound left-turn and the westbound left-turn movement will operate at LOS F during the PM peak hour of traffic. With projected volumes at the intersections most likely will not warrant a traffic signal. All other movements will operate at LOS D or better during the AM and PM peak hours of traffic.

All other intersections along Wailea Alanui Drive will continue to operate at LOS D or better during both the AM and PM peak hours of traffic.

Figure 12 shows the traffic volumes and LOS at the study intersections for Future Year 2016. Appendix D shows the level-of-service table summary at all the study intersections and Appendix E shows the recommended lane configuration.

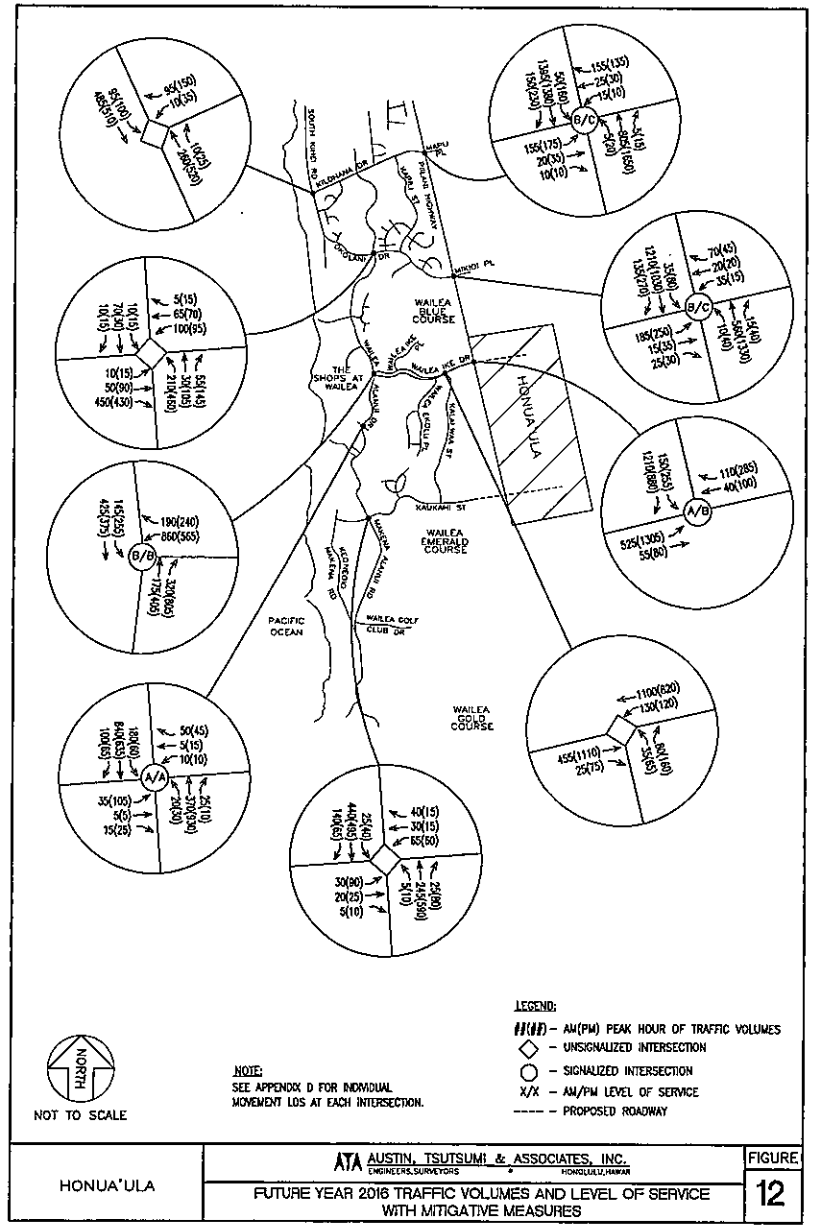
E. Future Year 2018 WITH Project Traffic and Analysis

Traffic generated by the Project was added to the Base Year 2018 traffic volumes to estimate traffic volumes for Future Year 2018 with the Project. The analysis of traffic conditions for Future Year 2018 assumed the mitigative measures recommended for Base Year 2016 and Future Year 2016 to be implemented.

Intersections along Piilani Highway (WITH Project)

The eastbound left-turn and southbound left-turn movements at the Piilani Highway/Kilohana Drive/Mapu Place intersection will operate at LOS E during the PM peak hour of traffic.

Providing additional capacity for the eastbound left-turn movement (double eastbound left-turn lanes) requires improvements to provide an exclusive westbound left-turn lane and a protected left-turn signal phase (8-phase signal cycle) for the eastbound and westbound left-turn movements. However, even if an additional signal phase is introduced, the eastbound approach will still continue to operate at LOS E conditions. If a split phase (6-signal phase) is provided for the eastbound and westbound approaches, the eastbound approach will still continue to operate at LOS E conditions.



The Piilani Highway/Kilohana Drive/Mapu Place intersection serves as the northern access point to the Maui Meadows subdivision which is comprised of single-family homes. As mentioned above, during the PM peak hour of traffic, the southbound left-turn movement will operate at LOS E conditions. By providing double southbound left-turn lanes, all movements will operate at LOS D or better during the PM peak hour of traffic. However, the Highway Capacity Manual (HCM) recommends that double left-turn lanes be provided where the left-turn volume exceeds 300 vehicles during the peak hour, and at the Piilani Highway/Kilohana Drive/Mapu Place intersection, only approximately 50 vehicles and 160 vehicles will utilize the southbound left-turn movement during the AM and PM peak hour of traffic, respectively. Additionally, some vehicles may opt to utilize the southbound left-turn at Piilani Highway/Okolani Drive/Mikioi Place intersection, rather than Piilani Highway/Kilohana Drive/Mapu Place, since it will also be signalized. Therefore, additional improvements are not recommended at the Piilani Highway/Kilohana Drive/Mapu Place intersection.

With completion of Phase II of the Project, Piilani Highway will be extended to intersect with an extension of Kaukahi Street, forming a cross intersection at its intersection with Wailea Ike Drive. With Piilani Highway/Wailea Ike Drive intersection reconstructed to a cross-intersection, the following are the recommended lane configuration and is in accordance with the Zoning Conditions for the Project:

- Northbound Approach: Provide an exclusive left-turn lane (with a protected left-turn signal phase), two (2) exclusive through lanes, and an exclusive right-turn lane.
- Southbound Approaches: Provide two (2) exclusive left-turn lanes (with a protected left-turn signal phase), an exclusive through lane, and an exclusive right-turn lane. Also, it is recommended that the Piilani Highway southbound right-turn to be a free turning movement by providing an exclusive westbound receiving lane on Wailea Ike Drive. It is projected that a higher volume will be utilizing the southbound left-turn movement (175 vehicles and 290 vehicles during the AM and PM peak hours of traffic, respectively)

as opposed to the southbound through movement (70 vehicles and 130 vehicles during the AM and PM peak hours of traffic, respectively) during the AM and PM peak hours of traffic due to the layout of the Honuaula Project. Additionally, the HCM recommends that double left-turn lanes be provided where the left-turn volume exceeds 300 vehicles during the peak hour
- Eastbound Approach: Provide two (2) exclusive left-turn lanes (with a protected left-turn signal phase) and a shared through/right-turn lane.
- Westbound Approach: Provide an exclusive left-turn lane (with a protected left-turn signal phase), an exclusive through lane, and an exclusive right-turn lane.

The Piilani Highway/Okolani Drive intersection will continue to operate at LOS D or better during the AM and PM peak hours of traffic.

<u>Wailea Ike Drive/Kalai Waa Street Intersection</u>

The Wailea Ike Drive/Kalai Waa Street intersection northbound left-turn movement will continue to operate at LOS F during the AM and PM peak hours of traffic. The northbound right-turn will operate at LOS E during the PM peak hour of traffic. With projected volumes at the intersection most likely will not warrant a traffic signal.

<u>South Kihei Road/Kilohana Drive Intersection</u>

The South Kihei Road/Kilohana Drive intersection will continue to operate at LOS C or better during both the AM and PM peak hours of traffic.

<u>Intersections along Wailea Alanui Drive</u>

The northbound left-turn movement at the intersection of Wailea Alanui Drive/Okolani Drive will continue to operate at LOS E during the PM peak hour of traffic. Projected volumes at this intersection most likely will not warrant a traffic signal system. During the AM peak hour of traffic, all movements will continue to operate at LOS D or better.

The Wailea Alanui Drive/Kaukahi Street intersection eastbound left-turn and the westbound left-turn movements will continue to operate at LOS F during the PM peak hour of traffic. With projected volumes at the intersection most likely will not warrant a traffic signal. During the AM peak hour of traffic, all other movements will continue to operate at LOS D or better.

All other intersections along Wailea Alanui Drive will continue to operate at LOS D or better during both the AM and PM peak hours of traffic.

Figure 13 shows the traffic volumes and LOS at the study intersections for Future Year 2018 with mitigative measures. Appendix D shows the level-of-service table summary at all the study intersections and Appendix E shows the recommended lane configuration.

F. Future Year 2022 WITH Project Traffic and Analysis

Traffic generated by the Project was added to the Base Year 2022 traffic volumes to estimate traffic volumes for Future Year 2022 with the Project. The analysis of traffic conditions for Future Year 2022 assumed the mitigative measures recommended for Base Year 2016 and Future Year 2016 and 2018 to be implemented.

Intersections along Piilani Highway

The eastbound left-turn and southbound left-turn movements at the Piilani Highway/Kilohana Drive/Mapu Place intersection will continue to operate at LOS E during the PM peak hour of traffic. However, all other movements will continue to operate at LOS D or better during the AM and PM peak hours of traffic.

All other intersections along Piilani Highway will continue to operate at LOS D or better during the AM and PM peak hours of traffic.

Wailea Ike Drive/Kalai Waa Street Intersection

The Wailea Ike Drive/Kalai Waa Street intersection northbound left-turn movement will continue to operate at LOS F during the AM and PM peak hours of traffic. The northbound right-turn will continue to operate at LOS F during the PM peak hour of traffic. However, projected volumes at the intersection most likely will not warrant a traffic signal. All other movements will continue to operate at LOS D or better during the AM and PM peak hours of traffic.

South Kihei Road/Kilohana Drive Intersection

The South Kihei Road/Kilohana Drive intersection will continue to operate at LOS C or better during both the AM and PM peak hours of traffic.

Intersections along Wailea Alanui Drive

The northbound left-turn movement at the intersection of Wailea Alanui Drive/Okolani Drive will continue to operate at LOS F during the PM peak hour of traffic. Projected volumes at this intersection most likely will not warrant a traffic signal system. During the AM peak hour of traffic, all movements will continue to operate at LOS D or better.

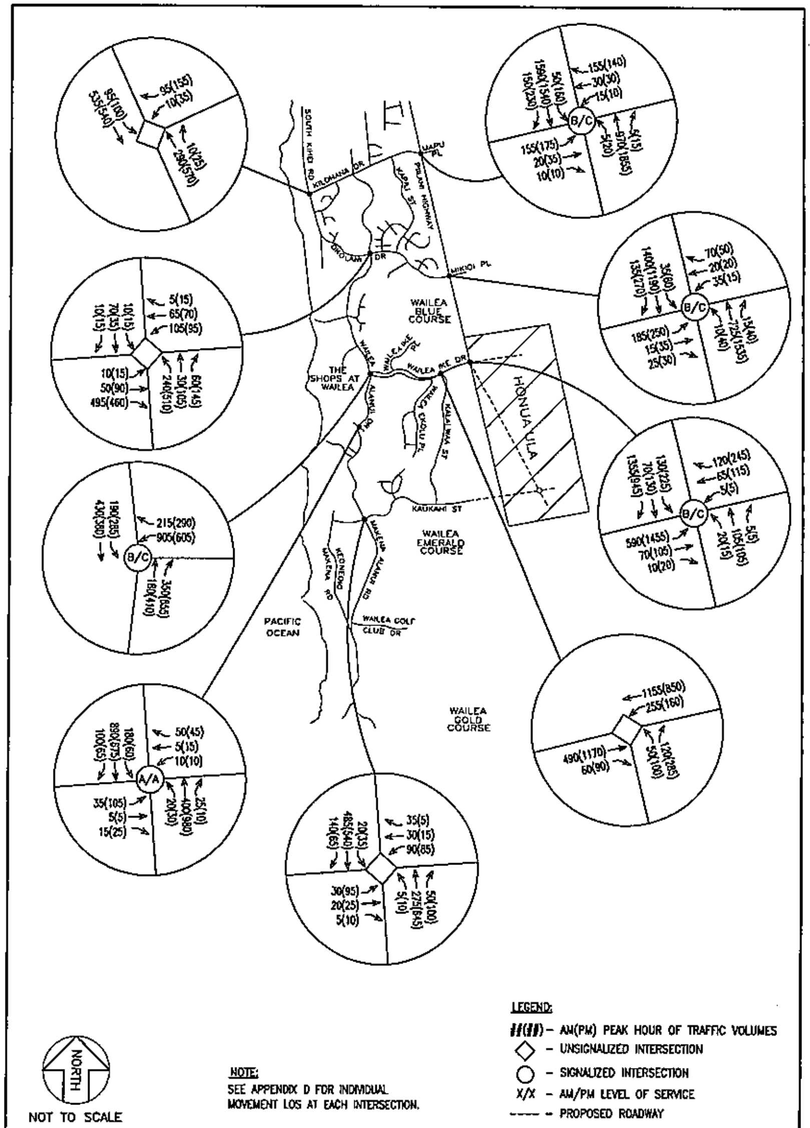
The Wailea Alanui Drive/Kaukahi Street intersection westbound left-turn and eastbound left-turn will continue to operate at LOS F and the eastbound through/right-turn will operate at LOS E during the PM peak hour of traffic. The eastbound left-turn movement will operate at LOS F during the AM peak hour of traffic. With projected traffic volumes, a traffic signal system will most likely be warranted. However, due to the current condition of the Makena Resort development it is unknown if the land use assumed in Section III.B. is accurate, therefore, a traffic signal warrant should be evaluated in the future as projects become developed. As a signalized intersection, the intersection will operate at LOS C or better during the AM and PM peak hours of traffic.

All other intersections along Wailea Alanui Drive will continue to operate at LOS D or better during the AM and PM peak hours of traffic.

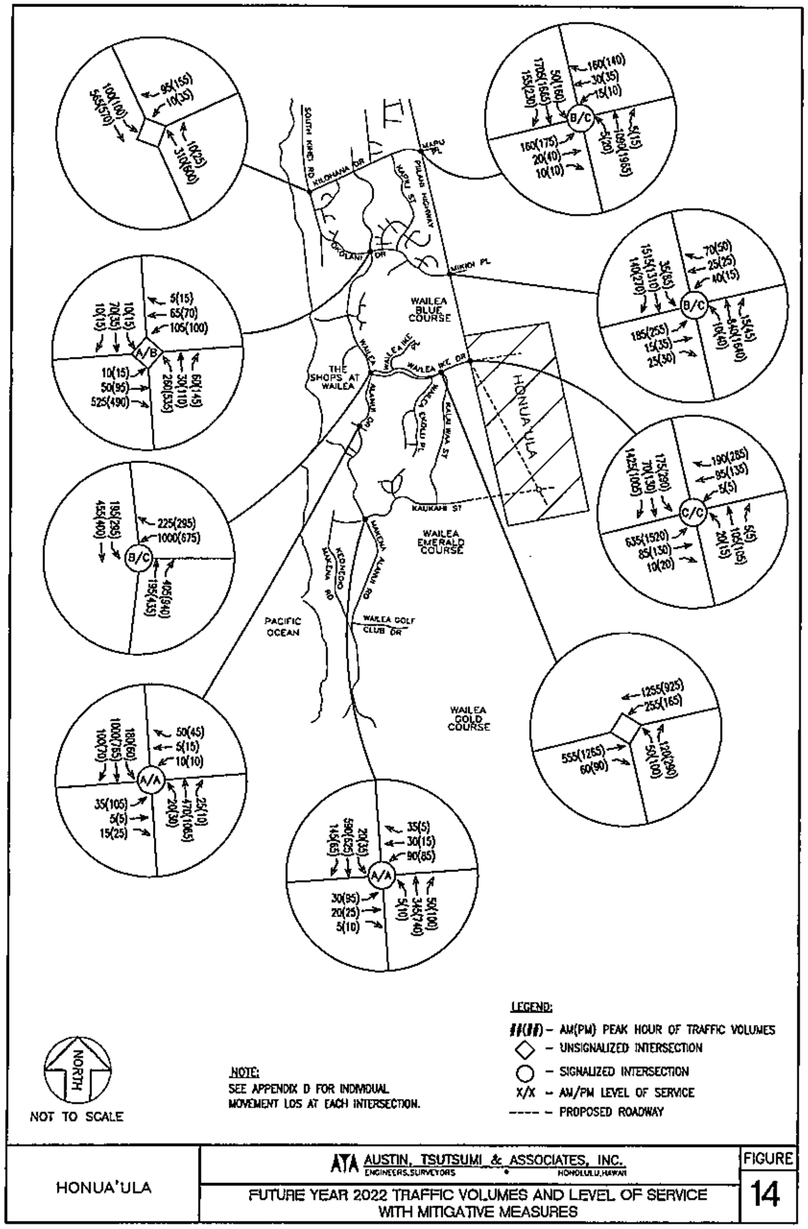
Figure 14 shows the traffic volumes and LOS at the study intersections for Future Year with mitigative measures. Appendix D shows the level-of-service table summary at all the study intersections and Appendix E shows the recommended lane configuration.

G. **Modern Roundabouts**

Due to zoning conditions and Special Management Area conditions, the Piilani Highway/Kilohana Drive/Mapu Place, Piilani Highway/Okolani Drive/Mikioi Place, Piilani Highway/Wailea Ike Drive intersections are conditioned to be signalized intersections. Additionally, at the Wailea Ike Drive/Kalai Waa Street and Wailea Alanui Drive/Kaukahi Street intersections are conditioned to be signalized intersections when warranted. Therefore, the option of modern roundabouts is not studied.



HONUA'ULA	ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	FUTURE YEAR 2018 TRAFFIC VOLUMES AND LEVEL OF SERVICE WITH MITIGATIVE MEASURES	13



V. PROPOSED PROJECT ACCESSES ALONG PIILANI HIGHWAY EXTENSION

A. Project Access Description

Phase II of the Project proposes to extend Piilani Highway further south. The Piilani Highway Extension will narrow to a two-lane roadway south of its intersection with Wailea Ike Drive and provide five (5) intersections to the Project. The following are the proposed intersections along the Piilani Highway Extension:

Piilani Highway Extension/North Access intersection is the first access south of the Piilani Highway/Wailea Ike Drive intersection. The Piilani Highway Extension/North Access forms a "tee"-intersection, with the North Access being the stem of the tee. The North Access is proposed to provide access to approximately 80 multi-family units located on the west side of the Piilani Highway Extension.

Piilani Highway Extension/Fire Station Driveway Intersection is the second access south of the Piilani Highway/Wailea Ike Drive intersection. The Piilani Highway Extension/Fire Station Driveway forms a "tee"-intersection, with the Fire Station Driveway being the stem of the tee. The Fire Station Driveway is proposed to provide access to the Fire Station only which is proposed to be located on the east side of the Piilani Highway Extension.

Piilani Highway Extension/Mid Access Intersection is the third access south of the Piilani Highway/Wailea Ike Drive intersection. The Piilani Highway Extension/Mid Access forms a "tee"-intersection, with the Mid Access being the stem of the tee. The Mid Access is proposed to provide access to approximately 68 multi-family units located on the west side of the Piilani Highway Extension.

Piilani Highway Extension/Kaukahi Drive Extension Intersection is the fourth access south of the Piilani Highway/Wailea Ike Drive intersection. The Piilani Highway Extension/Kaukahi Drive Extension forms a "tee"-intersection, with Kaukahi Drive Extension being the stem of the tee. The Kaukahi Street Extension will connect to the existing Kaukahi Street and provide access to the Project's residential units and golf clubhouse area.

Piilani Highway Extension/South Access Intersection is the fifth and last access south of the Piilani Highway/Wailea Ike Drive intersection. The Piilani Highway Extension/South Access forms a cross intersection. To the east, the South Access will provide a roadway connection, within the Project's development, to the east leg of the Piilani Highway/Wailea Ike Drive intersection. To the west, the South Access will provide access to the Project's multi-family housing, and golf clubhouse. To the south, the Piilani Highway Extension will provide a roadway connection within the Project's development along connecting to the east leg of the Piilani Highway/Wailea Ike Drive intersection.

B. Traffic Volumes and Analyses

The Project access intersections along the Piilani Highway Extension were studied as unsignalized intersections and as a roundabout. Table 7 shows the LOS at the Project access intersections as a single lane roundabout and with the following lane configuration as unsignalized intersections:

Piilani Highway Extension/North Access Intersection:

- Northbound Approach: Provide an exclusive left-turn lane and an exclusive through lane.
- Southbound Approach: Provide a shared through/right-turn lane.
- Eastbound Approach: Provide a shared left-turn/right-turn lane. The eastbound approach shall be the stop-controlled approach.

Piilani Highway Extension/Fire Station Driveway Intersection:

- Northbound Approach: Provide a shared through/right-turn lane.
- Southbound Approach: Provide an exclusive left-turn lane and an exclusive through lane.
- Westbound Approach: Provide a shared left-turn/right-turn lane. The westbound approach shall be the stop-controlled approach.

Piilani Highway Extension/Mid Access Intersection:

- Northbound Approach: Provide an exclusive left-turn lane and an exclusive through lane.

- Southbound Approach: Provide a shared through/right-turn lane.
- Eastbound Approach: Provide a shared left-turn/right-turn lane. The eastbound approach shall be the stop-controlled approach.

Piilani Highway Extension/Kaukahi Drive Extension:

- Northbound Approach: Provide an exclusive left-turn lane and an exclusive through lane.
- Southbound Approach: Provide a shared through/right-turn lane.
- Eastbound Approach: Provide a shared left-turn/right-turn lane. The eastbound approach shall be the stop-controlled approach.

Piilani Highway Extension/South Access:

- Northbound and Southbound Approach: Provide an exclusive left-turn lane and a shared through/right-turn lane.
- Eastbound and Westbound Approach: Provide a shared left-turn/through/right-turn lane. The westbound approach shall be the stop-controlled approach.

Analyses show that the intersections along the Piilani Highway Extension will operate at LOS A during the AM and PM peak hours of traffic as an unsignalized intersection and a single lane roundabout. Since the Piilani Highway Extension is a long stretch of roadway - with no traffic signals warranted at the proposed intersections - there is a possibility that speeding could occur. Therefore, single lane roundabouts were studied which are traffic calming devices, reducing the potential speeding of vehicles.

Figure 15 shows the Future Year 2022 proposed Project intersection traffic volumes and level of service.

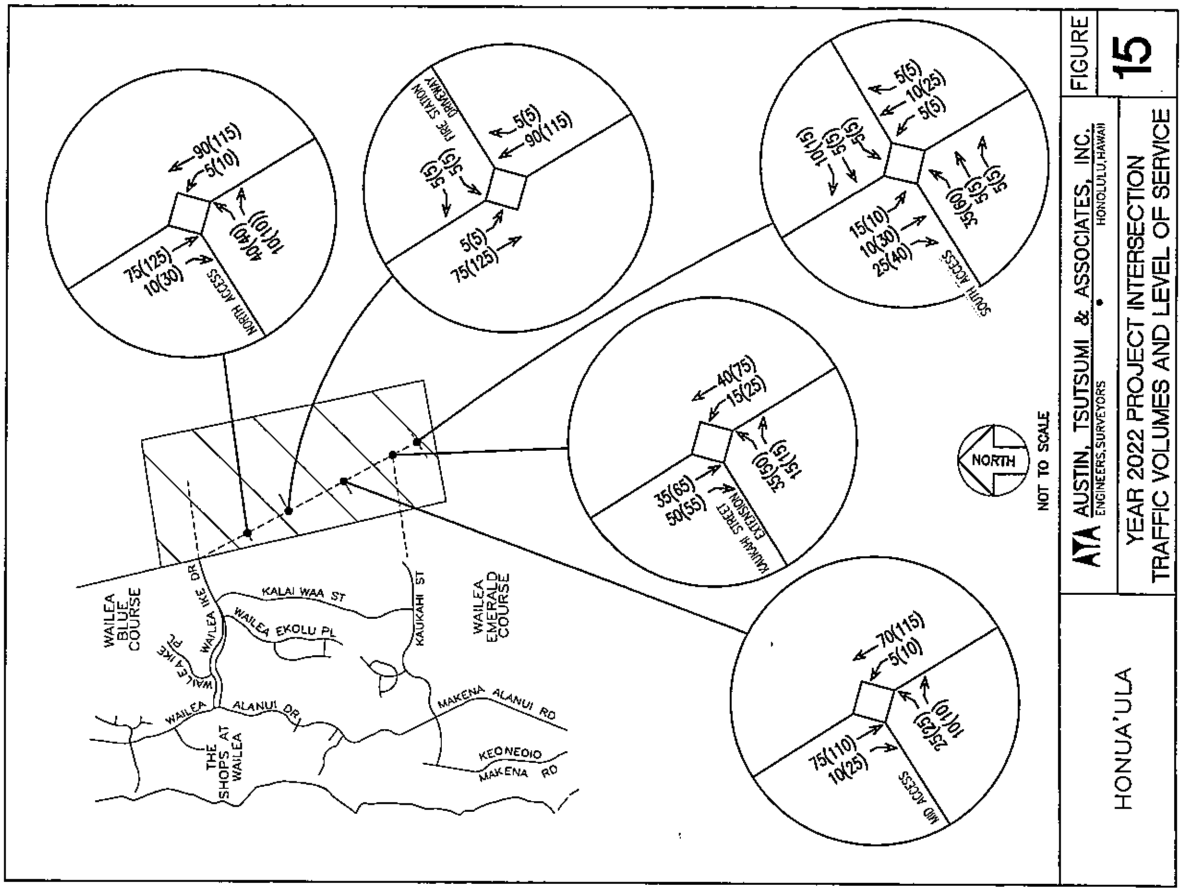


Table 7
LOS Summary for Project Access Intersections (FY 2022)

Intersection	UNSIGNALIZED INTERSECTION AM HCM Delay	AM v/c Ratio	AM LOS	PM HCM Delay	PM v/c Ratio	PM LOS	ROUNDABOUT AM HCM Delay	AM v/c Ratio	AM LOS	PM HCM Delay	PM v/c Ratio	PM LOS
Piilani Highway Extension & North Access												
EB LT/RT	9.7	0.07	A	10.4	0.08	B	3.6	--	A	3.6	--	B
NB LT	7.4	0	A	7.6	0.01	A	4.2	-	A	4.2	--	A
NB TH	0	0.06	A	0	0.07	A						
SB TH/RT	0	0.05	A	0	0.1	A	4.2	--	A	4.2	--	A
Overall	2.3	-	A	1.8	-	A	3.2	--	A	3.4	--	A
Piilani Highway Extension & Fire Station Driveway												
WB LT/RT	9.2	0.01	A	9.6	0.01	A	3.6	-	A	3.6	--	A
NB TH/RT	0	0.06	A	0	0.08	A	4.2	-	A	4.2	--	A
SB LT	7.4	0	A	7.5	0	A	4.2	-	A	4.2	--	A
SB TH	0	0.05	A	0	0.08	A						
Overall	0.7	-	A	0.5	-	A	3.2	-	A	3.4	--	A
Piilani Highway Extension & Mid Access												
EB LT/RT	9.4	0.04	A	10	0.05	A	3.6	-	A	3.6	--	A
NB LT	7.4	0	A	7.5	0.01	A	4.2	-	A	4.2	--	A
NB TH	0	0.04	A	0	0.07	A						
SB TH/RT	0	0.05	A	0	0.09	A	4.2	-	A	4.2	--	A
Overall	1.9	-	A	1.4	-	A	3.2	-	A	3.4	--	A
Piilani Highway Extension & Kaukahi Drive Extension												
EB LT/RT	9.3	0.06	A	10.1	0.09	A	3.6	-	A	3.6	--	A
NB LT	7.4	0.01	A	7.5	0.02	A	4.2	-	A	4.2	--	A
NB TH	0	0.03	A	0	0.05	A						
SB TH/RT	0	0.05	A	0	0.08	A	4.2	-	A	4.2	--	A
Overall	3	-	A	3	-	A	3.2	-	A	3.4	--	A
Piilani Highway Extension & South Access												
EB LT/TH/RT	9.3	0.06	A	9.8	0.09	A	3.6	-	A	4.2	-	A
WB LT/TH/RT	8.9	0.02	A	9	0.03	A	3.6	-	A	4.2	-	A
NB LT	7.3	0	A	7.4	0	A	3.6	-	A	3.6	-	A
NB TH/RT	0	0.01	A	0	0.02	A						
SB LT	7.3	0.01	A	7.3	0.01	A	4.2	-	A	4.2	-	A
SB TH/RT	0	0.02	A	0	0.04	A						
Overall	5.5	-	A	4.9	-	A	3.1	-	A	3.2	-	A

VI. SUMMARY AND RECOMMENDATIONS

A. Summary

Existing Conditions

The general paths vehicles utilize when traveling between areas north of Wailea and south in Makena are Piilani Highway, Wailea Ike Drive, and Wailea Alanui Drive.

The eastbound approach at the Piilani Highway/Okolani Drive/Mikioi Place intersections experience minimal gaps between vehicles traveling along Piilani Highway. However, as a condition for the development of the Kai Malu Project (MF-8) within the Wailea Resort, the Piilani Highway/Okolani Drive/Mikioi Place intersection will be signalized and the eastbound approach will be restriped to provide an exclusive left-turn lane and a shared through/right-turn lane.

Base Years WITHOUT the Project

For the purpose of this study Phase I of the Project is anticipated to be completed by Year 2016, Phase II by Year 2018, and Phase III by Year 2022. Therefore, traffic volume projections were determined for these three years (without project) using an annual vehicular de facto growth rate of 0.5 percent and including other known developments such as the Wailea Resort and Makena Resort projects. The improvements to Piilani Highway/Okolani Drive/Mikioi Place, as a result of the Kai Mahi Project (MF-8), are assumed to be completed by Year 2016.

Analysis of Base Year 2016 traffic conditions without the project indicates that some individual movements at the Piilani Highway/Kilohana Drive/Mapu Place intersection will operate at LOS F during the AM and PM peak hours of traffic. Widening of Piilani Highway to four-lanes between its intersection with Kilohana Drive/Mapu Place and Wailea Ike Drive is required, even without the Project. With widening of Piilani Highway, the Piilani Highway/Kilohana Drive/Mapu Place and Piilani Highway/Okolani Drive/Mikioi Place intersection will operate at LOS D or better during both the AM and PM peak hours of traffic. Base Year 2018 and 2022 traffic conditions at intersections along Piilani Highway

will continue to operate at LOS D or better during both the AM and PM peak hours of traffic.

With Base Year 2016, 2018, and 2022 projected traffic volumes, the stop-controlled approaches at the unsignalized intersections of Wailea Ike Drive/Kalai Waa Street and Wailea Alanui Drive/Kaukahi Drive will operate at LOS E or LOS F. However, in accordance with the HCM, projected volumes at both intersections do not warrant a traffic signal system. A roundabout was not studied at these intersections since Zoning Conditions for the Project require a traffic signal system when warranted.

The northbound left-turn movement at the all-way stop-controlled intersection of Wailea Alanui Drive/Okolani Drive will operate at LOS E with Base Year 2018 projected traffic volumes and LOS F with Base Year 2022 projected traffic volumes. A roundabout was studied at this intersection, however, in accordance with the U.S. Federal Highway Administration roundabout guidelines, a roundabout is not desirable where grades are greater than 4 percent. It appears that Okolani Drive is greater than 4 percent near its intersection with Wailea Alanui Drive.

Future Years WITH the Project

Phase I (anticipated completion Year 2016) of the Project will include approximately 26,000 square feet of Office Space, 74,000 square feet of Commercial Space, 75 Multi-Family Affordable units, 158 Multi-Family Market Rate Units, 40 Multi-Family Townhouse units, and 127 Single-Family units. Additionally, Phase I will also include construction of the east leg of the Piilani Highway/Wailea Ike Drive intersection, forming a "tee"-intersection and the extension of Kaukahi Street to intersect with the Piilani Highway Extension. Since Kaukahi Street is a private road, it is planned to be a gated access within the Project to address the concerns of current owners along Kaukahi Street.

Phase II (anticipated completion Year 2018) of the Project will include approximately 200 Multi-Family Affordable units, 30 Multi-Family Market Rate Units, 60 Multi-Family Townhouse units, and 110 Single-Family units. Additionally, Phase II will also include the construction the south leg of the Piilani

Highway/Wailea Ike Drive intersection, forming a cross intersection and extend Piilani Highway to intersect with the Kaukahi Street Extension.

Phase III of the Project will include approximately 175 Multi-Family Affordable units, 12 Multi-Family Market Rate Units, and 163 Single-Family units.

The following are Zoning Conditions for the Project and will be completed prior to construction or occupancy of the Project:

- Widen Piilani Highway between Kilohana Drive/Mapu Place and Wailea Ike Drive to four (4) lanes; which is required for sufficient capacity without the Project.
- The Wailea Alanui Drive/Wailea Ike Drive intersection shall be modified to provide a second northbound right-turn lane (signalize the movement) and a second westbound left-turn lane.
- The Wailea Ike Drive/Kalai Waa Street and Wailea Alanui Drive/Kaukahi Street intersections shall be signalized when warranted. Therefore, signal warrants are studied at the Wailea Ike Drive/Kalai Waa Street and Wailea Alanui Drive/Kaukahi Street intersections.

With Future Year 2022 projected traffic volumes, the northbound left-turn movement at the unsignalized intersection of Wailea Ike Drive/Kalai Waa Street will continue to operate at LOS F. However, in accordance with the HCM, a traffic signal at the intersection is not warranted.

At the Wailea Alanui Drive/Kaukahi Street intersection, with Future Year 2022 projected traffic volumes, a traffic signal system will most likely be warranted. However, due to the current condition of the Makena Resort development it is unknown if the land use assumed in Section III.B. is accurate, therefore, a traffic signal warrant should be evaluated in the future as projects become developed. As a signalized intersection, the intersection will operate at LOS C or better during the AM and PM peak hours of traffic.

Proposed Project Accesses Along Piilani Highway Extension

The five (5) proposed accesses along the Piilani Highway Extension were studied as single lanes roundabout and unsignalized intersection. During the AM and PM peak hours of traffic, both the single lane roundabout and unsignalized intersection will operate at LOS A at all proposed project intersections along Piilani Highway Extension. Due to the length of Piilani Highway Extension – as well as no traffic signals warranted – there is a possibility that speeding could occur. Therefore, single lane roundabouts were studied which are traffic calming, reducing the potential speeding of vehicles.

B. Recommendations

1. WITHOUT the Project

The following are recommendations that would be needed **WITHOUT the Project**:

- **Year 2016 (WITHOUT the Project)** - Widen Piilani Highway to four-lanes from Kilohana Drive/Mapu Place to Wailea Ike Drive. The following are the recommended lane configurations at intersections along Piilani Highway:

  Piilani Highway/Kilohana Drive/Mapu Place

  - Northbound and Southbound Approaches: Provide an exclusive left-turn lane (with a protected left-turn signal phase), two (2) exclusive through lanes, and an exclusive right-turn lane.
  - Eastbound Approach: Remain as an exclusive left-turn lane and a shared through/right-turn lane (with a permissive signal phase).
  - Westbound Approach: Provide an exclusive left-turn lane, an exclusive through lane and an exclusive right-turn lane (with a permissive signal phase).

<u>Piilani Highway/Okolani Drive/Mikioi Place</u>

- Northbound and Southbound Approaches: Provide an exclusive left-turn lane (with a protected left-turn signal phase), an exclusive through lane, and a shared through/right-turn lane.
- Eastbound Approach: Provide an exclusive left-turn lane and a shared through/right-turn lane (with a permissive signal phase).
- Westbound Approach: Remain as a shared left-turn/through/right-turn lane (with a permissive signal phase).

<u>Piilani Highway/Wailea Ike Drive</u>

- Southbound Approach: Remain as an exclusive free right-turn lane.
- Eastbound Approach: Remain as an exclusive free left-turn lane.
- Northbound and Westbound Approaches will only be constructed with the Project.

- <u>Year 2016 (WITHOUT the Project)</u> - At the **Wailea Alanui Drive/Kaukahi Drive** intersection, provide the eastbound and westbound approach with an exclusive left-turn lane and a shared through/right-turn lane in conjunction with the Makena Resort.

2. **WITH the Project**

The following are recommendations of the traffic study that would be needed **WITH the Project** and are in accordance with the Zoning Conditions for the Project:

- <u>Year 2016 (WITH the Project)</u> - Provide the following lane configuration at the **Piilani Highway/Wailea Ike Drive** with completion of Phase I (anticipated completion Year 2016) of the Project:

- Signalize the intersection.
- Southbound approach: Provide an exclusive left-turn lane and an exclusive right-turn lane. Allow the Piilani Highway southbound right-turn to be a free turning movement by providing an exclusive westbound receiving lane on Wailea Ike Drive.
- Eastbound approach: Provide two (2) exclusive left-turn lanes (with a protected left-turn signal phase) and an exclusive through lane.
- Westbound Approach: Provide an exclusive through lane, and an exclusive right-turn lane.

- <u>Year 2016 (WITH the Project)</u> - Provide the following lane configuration at the **Wailea Alanui Drive/Wailea Ike Drive**:
  - Northbound Approach: Provide an exclusive through lane and two (2) exclusive right-turn lanes. Signalize the two (2) exclusive right-turn lanes.
  - Southbound Approach: Remain as an exclusive left-turn lane and two (2) exclusive through lanes.
  - Westbound Approach: Provide two (2) exclusive left-turn lanes and an exclusive right-turn lane.
- <u>Year 2018 (WITH the Project)</u> - Provide the following lane configuration at the **Piilani Highway/Wailea Ike Drive** with completion of Phase II (anticipated completion Year 2018) of the Project:
  - Northbound Approach: Provide an exclusive left-turn lane (with a protected left-turn signal phase), two (2) exclusive through lanes, and an exclusive right-turn lane.
  - Southbound Approaches: Provide two (2) exclusive left-turn lanes (with a protected left-turn signal phase), an exclusive through lane, and an exclusive right-turn lane.

Also, it is recommended that the Piilani Highway southbound right-turn to be a free turning movement by providing an exclusive westbound receiving lane on Wailea Ike Drive.

  - Eastbound Approach: Provide two (2) exclusive left-turn lanes (with a protected left-turn signal phase) and a shared through/right-turn lane.
  - Westbound Approach: Provide an exclusive left-turn lane (with a protected left-turn signal phase), an exclusive through lane, and an exclusive right-turn lane.

- Year 2022 (WITH the Project) – Perform a traffic signal warrant study as projects become developed and signalize the **Wailea Alanui Drive/Kaukahi Street** intersection, if warranted.

3. **Proposed Project Intersections**

It is recommended that the Piilani Highway Extension be a two (2) lane roadway south of its intersection with Wailea Ike Drive. It is recommended that the proposed project intersections be single lane roundabouts or unsignalized intersections. The following are the recommended lane configurations at the proposed Project accesses as unsignalized intersections:

Piilani Highway Extension/North Access Intersection:

- Northbound Approach: Provide an exclusive left-turn lane and an exclusive through lane.
- Southbound Approach: Provide a shared through/right-turn lane.
- Eastbound Approach: Provide a shared left-turn/right-turn lane. The eastbound approach shall be the stop-controlled approach.

Piilani Highway Extension/Fire Station Driveway Intersection:

- Northbound Approach: Provide a shared through/right-turn lane.
- Southbound Approach: Provide an exclusive left-turn lane and an exclusive through lane.
- Westbound Approach: Provide a shared left-turn/right-turn lane. The westbound approach shall be the stop-controlled approach.

Piilani Highway Extension/Mid Access Intersection:

- Northbound Approach: Provide an exclusive left-turn lane and an exclusive through lane.
- Southbound Approach: Provide a shared through/right-turn lane.
- Eastbound Approach: Provide a shared left-turn/right-turn lane. The eastbound approach shall be the stop-controlled approach.

Piilani Highway Extension/Kaukahi Drive Extension:

- Northbound Approach: Provide an exclusive left-turn lane and an exclusive through lane.
- Southbound Approach: Provide a shared through/right-turn lane.
- Eastbound Approach: Provide a shared left-turn/right-turn lane. The eastbound approach shall be the stop-controlled approach.

Piilani Highway Extension/South Access:

- Northbound and Southbound Approach: Provide an exclusive left-turn lane and a shared through/right-turn lane.
- Eastbound and Westbound Approach: Provide a shared left-turn/through/right-turn lane. The westbound approach shall be the stop-controlled approach.

REFERENCES

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6. Wilson Okamoto Corporation, Traffic Impact Report for the Grand Wailea Resort Renovation, January 2009.

APPENDICES

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX A

TRAFFIC COUNT DATA

Austin, Tsutsumi & Associates
501 Sumner Street, Suite 521
Honolulu, HI 96817
Phone: 533-3646 Fax: 526-1267

Piilani - Kilohana AM
AM Peak Hour

File Name : Piilani - Kilohana AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 1

Groups Printed- Unshifted

	Piilani From North				Kilohana From East				Piilani From South				Kilohana From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	18	155	4	0	28	2	0	0	0	73	1	4	0	1	11	2	299
06:45	17	169	11	0	29	3	2	0	0	53	0	2	2	5	15	1	309
Total	35	324	15	0	57	5	2	0	0	126	1	6	2	6	26	3	608
07:00	30	166	6	0	39	8	3	0	2	71	1	3	2	1	9	1	342
07:15	30	198	10	0	35	7	1	0	0	76	1	0	2	5	19	0	384
07:30	21	208	11	0	35	5	3	1	0	67	0	2	1	3	23	1	381
07:45	31	208	22	0	36	4	4	0	1	77	0	0	2	6	15	0	406
Total	112	780	49	0	145	24	11	1	3	291	2	5	7	15	66	2	1513
08:00	23	153	9	0	38	1	1	1	0	67	1	1	1	4	18	0	318
08:15	13	135	23	0	39	7	3	0	3	68	0	1	3	12	21	0	328
Grand Total	183	1392	96	0	279	37	17	2	6	552	4	13	13	37	131	5	2767
Apprch %	11	83.3	5.7	0	83.3	11	5.1	0.6	1	96	0.7	2.3	7	19.9	70.4	2.7	
Total %	6.6	50.3	3.5	0	10.1	1.3	0.6	0.1	0.2	19.9	0.1	0.5	0.5	1.3	4.7	0.2	

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File Name : Piilani - Kilohana AM
Site Code : 00000000
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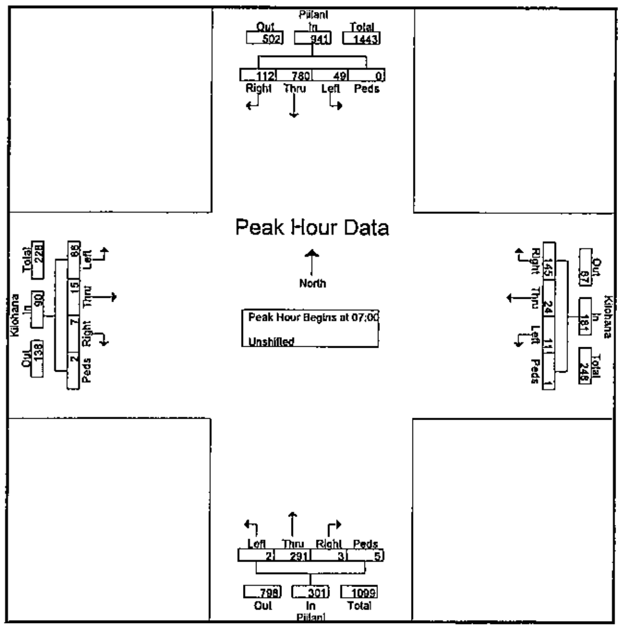
Page No : 2

	Piilani From North					Kilohana From East					Piilani From South					Kilohana From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	30	166	6	0	202	39	8	3	0	50	2	71	1	3	77	2	1	9	1	13	342
07:15	30	198	10	0	238	35	7	1	0	43	0	76	1	0	77	2	5	19	0	26	384
07:30	21	208	11	0	240	35	5	3	1	44	0	67	0	2	69	1	3	23	1	28	381
07:45	31	208	22	0	261	36	4	4	0	44	1	77	0	0	78	2	6	15	0	23	406
Total Volume	112	780	49	0	941	145	24	11	1	181	3	291	2	5	301	7	15	66	2	90	1513
% App. Total	11.9	82.9	5.2	0		80.1	13.3	6.1	0.6		1	96.7	0.7	1.7		7.8	16.7	73.3	2.2		
PHF	.903	.938	.557	.000	.901	.929	.750	.688	.250	.905	.375	.945	.500	.417	.955	.875	.625	.717	.500	.804	.932



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Piilani - Kilohana PM
PM Peak Hour

File Name : Piilani - Kilohana PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 1

Groups Printed- Unshifted

	Piilani From North				Kilohana From East				Piilani From South				Kilohana From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	28	152	23	0	21	3	2	0	3	154	0	0	1	6	26	0	419
15:30	26	111	21	1	22	3	1	0	4	178	5	0	3	11	30	0	416
15:45	17	140	19	0	16	3	4	0	27	107	8	0	2	9	29	0	381
Total	71	403	63	1	59	9	7	0	34	439	13	0	6	26	85	0	1216
16:00	19	145	38	0	27	6	3	0	2	229	2	0	4	9	31	0	515
16:15	36	126	43	0	31	7	1	0	1	220	5	1	1	12	28	1	513
16:30	28	117	36	1	39	8	2	0	5	190	0	0	2	5	36	0	469
16:45	43	104	39	0	32	7	3	0	2	163	2	1	1	7	17	0	421
Total	126	492	156	1	129	28	9	0	10	802	9	2	8	33	112	1	1918
17:00	24	104	44	0	36	9	2	0	1	190	3	0	0	9	17	0	439
17:15	32	101	27	0	38	8	0	0	0	158	3	0	5	10	21	0	403
Grand Total	253	1100	290	2	262	54	18	0	45	1589	28	2	19	78	235	1	3976
Apprch %	15.4	66.9	17.6	0.1	78.4	16.2	5.4	0	2.7	95.5	1.7	0.1	5.7	23.4	70.6	0.3	
Total %	6.4	27.7	7.3	0.1	6.6	1.4	0.5	0	1.1	40	0.7	0.1	0.5	2	5.9	0	

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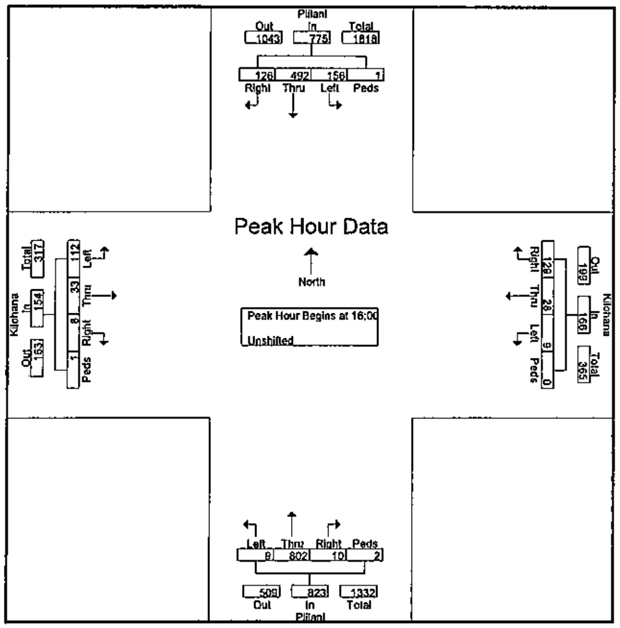
Page No : 2

	Piilani From North					Kilohana From East					Piilani From South					Kilohana From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	19	145	38	0	202	27	6	3	0	36	2	229	2	0	233	4	9	31	0	44	515
16:15	36	126	43	0	205	31	7	1	0	39	1	220	5	1	227	1	12	28	1	42	513
16:30	28	117	36	1	182	39	8	2	0	49	5	190	0	0	195	2	5	36	0	43	469
16:45	43	104	39	0	186	32	7	3	0	42	2	163	2	1	168	1	7	17	0	25	421
Total Volume	126	492	156	1	775	129	28	9	0	166	10	802	9	2	823	8	33	112	1	154	1918
% App. Total	16.3	63.5	20.1	0.1		77.7	16.9	5.4	0		1.2	97.4	1.1	0.2		5.2	21.4	72.7	0.6		
PHF	.733	.848	.907	.250	.945	.827	.875	.750	.000	.847	.500	.876	.450	.500	.883	.500	.688	.778	.250	.875	.931



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Piilani - Okolani AM
AM Peak Hour

File Name : Piilani - Okolani AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 1

Groups Printed- Unshifted

	Piilani From North				Okolani From East				Piilani From South				Okolani From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	10	147	5	0	23	1	1	0	2	46	0	1	1	2	11	0	250
06:45	10	162	4	0	18	1	10	0	1	33	0	0	1	2	5	0	247
Total	20	309	9	0	41	2	11	0	3	79	0	1	2	4	16	0	497
07:00	16	148	4	0	20	4	11	0	2	44	0	0	0	1	6	0	256
07:15	12	155	10	0	16	6	4	0	2	50	2	0	4	0	6	0	267
07:30	14	192	9	0	16	5	5	0	5	49	0	0	3	1	8	0	307
07:45	13	180	6	0	12	3	13	0	4	55	1	1	8	2	7	0	305
Total	55	675	29	0	64	18	33	0	13	198	3	1	15	4	27	0	1135
08:00	13	136	8	0	9	9	11	0	1	52	2	0	2	3	8	0	254
Grand Total	88	1120	46	0	114	29	55	0	17	329	5	2	19	11	51	0	1886
Apprch %	7	89.3	3.7	0	57.6	14.6	27.8	0	4.8	93.2	1.4	0.6	23.5	13.6	63	0	
Total %	4.7	59.4	2.4	0	6	1.5	2.9	0	0.9	17.4	0.3	0.1	1	0.6	2.7	0	

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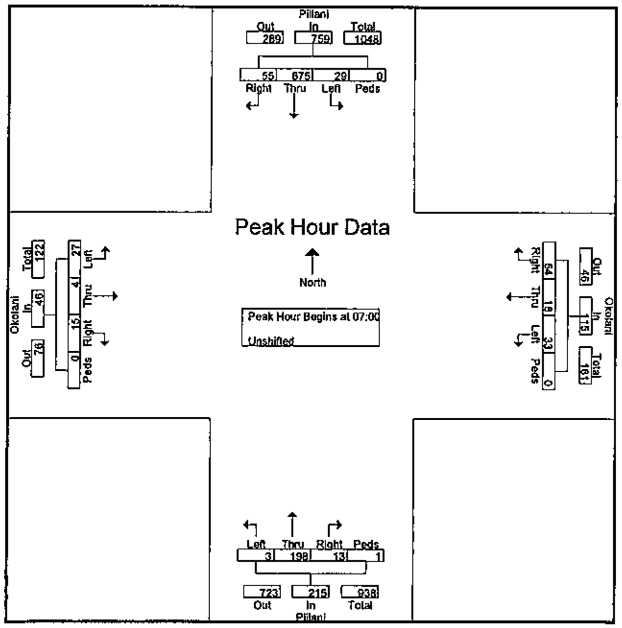
Page No : 2

	Piilani From North					Okolani From East					Piilani From South					Okolani From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	16	148	4	0	168	20	4	11	0	35	2	44	0	0	46	0	1	6	0	7	256
07:15	12	155	10	0	177	16	6	4	0	26	2	50	2	0	54	4	0	6	0	10	267
07:30	14	192	9	0	215	16	5	5	0	26	5	49	0	0	54	3	1	8	0	12	307
07:45	13	180	6	0	199	12	3	13	0	28	4	55	1	1	61	8	2	7	0	17	305
Total Volume	55	675	29	0	759	64	18	33	0	115	13	198	3	1	215	15	4	27	0	46	1135
% App. Total	7.2	88.9	3.8	0		55.7	15.7	28.7	0		6	92.1	1.4	0.5		32.6	8.7	58.7	0		
PHF	.859	.879	.725	.000	.883	.800	.750	.635	.000	.821	.650	.900	.375	.250	.881	.469	.500	.844	.000	.676	.924



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Piilani - Okolani PM
PM Peak Hour

File Name : Piilani - Okolani PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 1

Groups Printed- Unshifted

	Piilani From North				Okolani From East				Piilani From South				Okolani From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:30	8	103	13	0	12	3	3	0	11	174	2	0	1	2	7	0	339
15:45	15	123	13	0	10	1	4	0	8	152	0	0	4	4	18	0	352
Total	23	226	26	0	22	4	7	0	19	326	2	0	5	6	25	0	691
16:00	13	104	25	0	13	1	1	0	17	206	2	1	3	5	16	0	407
16:15	6	93	25	0	12	1	6	0	3	172	3	0	6	6	15	0	348
16:30	10	97	12	1	10	8	2	0	13	167	2	0	3	6	18	0	349
16:45	10	77	14	0	8	4	4	0	5	121	0	0	2	9	12	0	266
Total	39	371	76	1	43	14	13	0	38	666	7	1	14	26	61	0	1370
17:00	13	69	16	0	15	4	4	0	12	172	1	0	1	3	9	0	319
17:15	5	70	20	0	15	3	3	0	7	130	3	0	2	3	10	0	271
Grand Total	80	736	138	1	95	25	27	0	76	1294	13	1	22	38	105	0	2651
Apprch %	8.4	77.1	14.5	0.1	64.6	17	18.4	0	5.5	93.5	0.9	0.1	13.3	23	63.6	0	
Total %	3	27.8	5.2	0	3.6	0.9	1	0	2.9	48.8	0.5	0	0.8	1.4	4	0	

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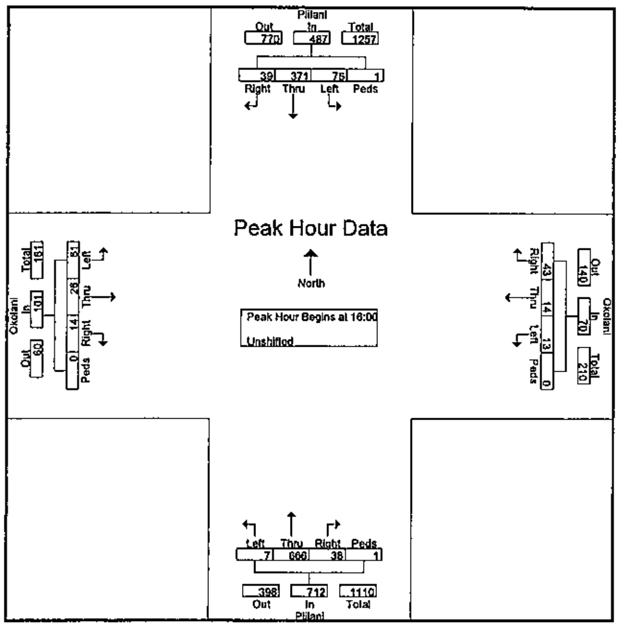
Page No : 2

	Piilani From North					Okolani From East					Piilani From South					Okolani From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	13	104	25	0	142	13	1	1	0	15	17	206	2	1	226	3	5	16	0	24	407
16:15	6	93	25	0	124	12	1	6	0	19	3	172	3	0	178	6	6	15	0	27	348
16:30	10	97	12	1	120	10	8	2	0	20	13	167	2	0	182	3	6	18	0	27	349
16:45	10	77	14	0	101	8	4	4	0	16	5	121	0	0	126	2	9	12	0	23	266
Total Volume	39	371	76	1	487	43	14	13	0	70	38	666	7	1	712	14	26	61	0	101	1370
% App. Total	8	76.2	15.6	0.2		61.4	20	18.6	0		5.3	93.5	1	0.1		13.9	25.7	60.4	0		
PHF	.750	.892	.760	.250	.857	.827	.438	.542	.000	.875	.559	.808	.583	.250	.788	.583	.722	.847	.000	.935	.842



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Wailea Ike - Kalai Waa AM
AM Peak Hour

File Name : Wailea Ike - Kalai Waa AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 1

Groups Printed- Unshifted

	Kalai Waa From North				Wailea Ike From East				Kalai Waa From South				Wailea Ike From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	0	0	0	0	1	117	22	0	10	0	1	0	2	38	0	0	191
06:45	0	0	0	0	0	145	27	0	4	0	2	0	1	29	0	0	208
Total	0	0	0	0	1	262	49	0	14	0	3	0	3	67	0	0	399
07:00	0	0	0	0	0	134	24	0	4	0	0	0	1	48	0	0	211
07:15	0	0	0	0	0	155	26	0	11	0	1	1	2	42	0	0	238
07:30	0	0	0	0	0	188	29	0	14	0	2	0	0	40	0	0	273
07:45	0	0	0	0	0	181	36	0	4	0	2	0	2	54	0	0	279
Total	0	0	0	0	0	658	115	0	33	0	5	1	5	184	0	0	1001
08:00	0	0	0	0	0	125	40	0	11	0	2	0	4	45	0	0	227
08:15	0	0	0	0	0	86	17	0	3	0	0	0	2	30	1	0	139
Grand Total	0	0	0	0	1	1131	221	0	61	0	10	1	14	326	1	0	1766
Apprch %	0	0	0	0	0.1	83.6	16.3	0	84.7	0	13.9	1.4	4.1	95.6	0.3	0	
Total %	0	0	0	0	0.1	64	12.5	0	3.5	0	0.6	0.1	0.8	18.5	0.1	0	

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File Name : Wailea Ike - Kalai Waa AM
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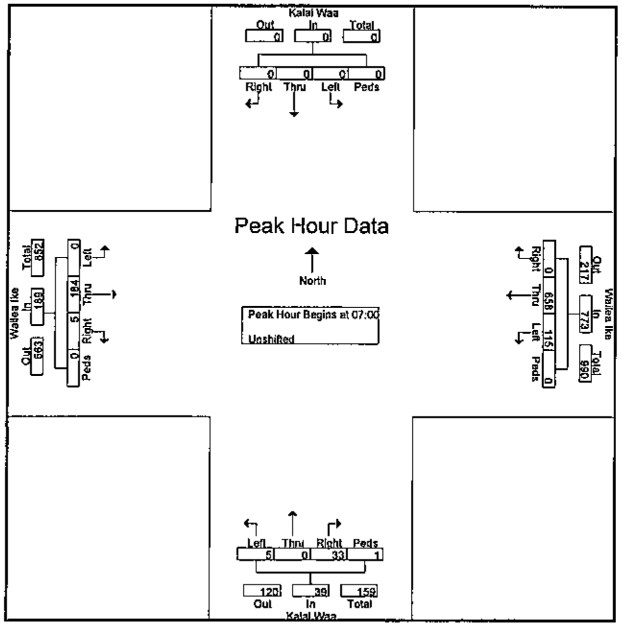
	Kalai Waa From North					Wailea Ike From East					Kalai Waa From South					Wailea Ike From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	0	0	0	0	0	0	134	24	0	158	4	0	0	0	4	1	48	0	0	49	211
07:15	0	0	0	0	0	0	155	26	0	181	11	0	1	1	13	2	42	0	0	44	238
07:30	0	0	0	0	0	0	188	29	0	217	14	0	2	0	16	0	40	0	0	40	273
07:45	0	0	0	0	0	0	181	36	0	217	4	0	2	0	6	2	54	0	0	56	279
Total Volume	0	0	0	0	0	0	658	115	0	773	33	0	5	1	39	5	184	0	0	189	1001
% App. Total	0	0	0	0		0	85.1	14.9	0		84.6	0	12.8	2.6		2.6	97.4	0	0		
PHF	.000	.000	.000	.000	.000	.000	.875	.799	.000	.891	.589	.000	.625	.250	.609	.625	.852	.000	.000	.844	.897



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Wailea Ike - Kalai Waa PM
PM Peak Hour

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Start Date : 6/24/2008
Page No : 1

Groups Printed- Unshifted

	Kalai Waa From North				Wailea Ike From East				Kalai Waa From South				Wailea Ike From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	0	0	0	0	0	98	10	0	36	0	1	1	2	134	0	0	282
15:30	0	0	0	0	0	109	10	0	53	0	3	0	1	139	1	0	316
15:45	0	0	0	0	2	110	25	0	34	0	1	0	3	127	0	0	302
Total	0	0	0	0	2	317	45	0	123	0	5	1	6	400	1	0	900
16:00	0	0	0	0	0	120	19	0	55	0	3	0	1	186	0	0	384
16:15	0	0	0	0	0	88	17	0	24	0	1	0	4	159	0	0	293
16:30	0	0	0	0	0	93	22	0	24	0	4	0	2	166	0	0	311
16:45	0	0	0	0	1	90	12	0	22	0	1	0	3	116	0	0	245
Total	0	0	0	0	1	391	70	0	125	0	9	0	10	627	0	0	1233
17:00	0	0	0	0	0	79	13	0	32	0	1	0	1	155	0	0	281
17:15	0	0	0	0	0	68	17	0	28	0	3	0	0	112	0	0	228
Grand Total	0	0	0	0	3	855	145	0	308	0	18	1	17	1294	1	0	2642
Apprch %	0	0	0	0	0.3	85.2	14.5	0	94.2	0	5.5	0.3	1.3	98.6	0.1	0	
Total %	0	0	0	0	0.1	32.4	5.5	0	11.7	0	0.7	0	0.6	49	0	0	

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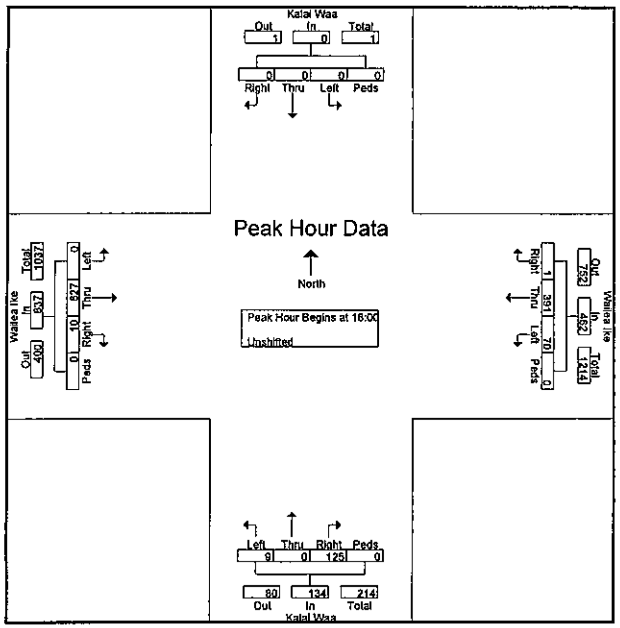
	Kalai Waa From North					Wailea Ike From East					Kalai Waa From South					Wailea Ike From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	0	0	0	0	0	0	120	19	0	139	55	0	3	0	58	1	186	0	0	187	384
16:15	0	0	0	0	0	0	88	17	0	105	24	0	1	0	25	4	159	0	0	163	293
16:30	0	0	0	0	0	0	93	22	0	115	24	0	4	0	28	2	166	0	0	168	311
16:45	0	0	0	0	0	1	90	12	0	103	22	0	1	0	23	3	116	0	0	119	245
Total Volume	0	0	0	0	0	1	391	70	0	462	125	0	9	0	134	10	627	0	0	637	1233
% App. Total	0	0	0	0		0.2	84.6	15.2	0		93.3	0	6.7	0		1.6	98.4	0	0		
PHF	.000	.000	.000	.000	.000	.250	.815	.795	.000	.831	.568	.000	.563	.000	.578	.625	.843	.000	.000	.852	.803



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Wailea Alanui - Wailea Ike
Am Peak Hour

File Name : Wailea Alanui - Wailea Ike AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 1

Groups Printed- Unshifted

	Wailea Alanui From North				Wailea Ike From East				Wailea Alanui From South				Wailea Ike From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	0	49	11	1	22	0	95	1	36	18	0	4	0	0	0	0	237
06:45	0	60	10	0	16	0	147	0	25	10	0	8	0	0	0	0	276
Total	0	109	21	1	38	0	242	1	61	28	0	12	0	0	0	0	513
07:00	0	57	20	2	13	0	140	0	43	23	0	1	0	0	0	0	299
07:15	0	65	20	1	22	0	129	0	37	19	0	4	0	0	0	0	297
07:30	0	76	21	1	45	0	144	1	27	39	0	10	0	0	0	0	364
07:45	0	67	13	0	36	0	150	0	47	30	0	3	0	0	0	0	346
Total	0	265	74	4	116	0	563	1	154	111	0	18	0	0	0	0	1306
08:00	0	45	16	0	20	2	110	0	32	26	0	3	0	0	0	0	254
08:15	0	50	20	0	37	0	75	0	37	31	0	4	0	0	0	0	254
Grand Total	0	469	131	5	211	2	990	2	284	196	0	37	0	0	0	0	2327
Apprch %	0	77.5	21.7	0.8	17.5	0.2	82.2	0.2	54.9	37.9	0	7.2	0	0	0	0	
Total %	0	20.2	5.6	0.2	9.1	0.1	42.5	0.1	12.2	8.4	0	1.6	0	0	0	0	

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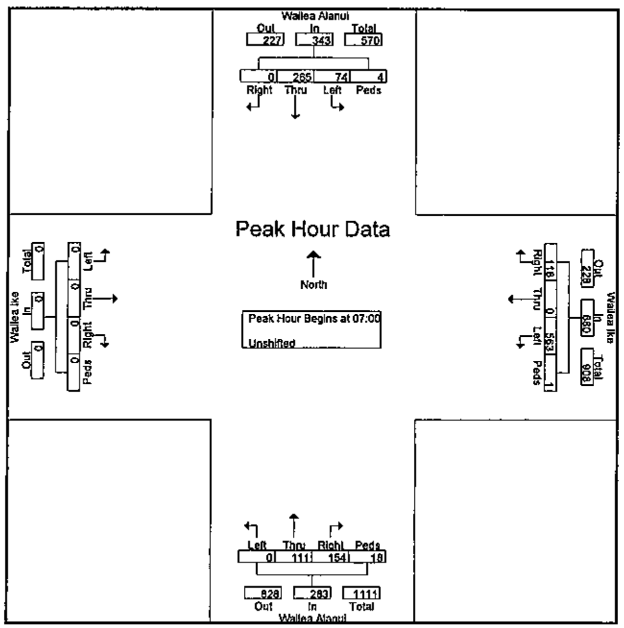
File Name : Wailea Alanui - Wailea Ike AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 2

	Wailea Alanui From North					Wailea Ike From East					Wailea Alanui From South					Wailea Ike From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	0	57	20	2	79	13	0	140	0	153	43	23	0	1	67	0	0	0	0	0	299
07:15	0	65	20	1	86	22	0	129	0	151	37	19	0	4	60	0	0	0	0	0	297
07:30	0	76	21	1	98	45	0	144	1	190	27	39	0	10	76	0	0	0	0	0	364
07:45	0	67	13	0	80	36	0	150	0	186	47	30	0	3	80	0	0	0	0	0	346
Total Volume	0	265	74	4	343	116	0	563	1	680	154	111	0	18	283	0	0	0	0	0	1306
% App. Total	0	77.3	21.6	1.2		17.1	0	82.8	0.1		54.4	39.2	0	6.4		0	0	0	0		
PHF	.000	.872	.881	.500	.875	.644	.000	.938	.250	.895	.819	.712	.000	.450	.884	.000	.000	.000	.000	.000	.897



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Wailea Alanui - Wailea Ike PM
PM Peak Hour

File Name : Wailea Alanui - Wailea Ike PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 1

Groups Printed- Unshifted - Bank 1

	Wailea Alanui From North				Wailea Ike From East				Wailea Alanui From South				Wailea Ike From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	0	53	29	1	31	0	79	1	110	72	0	5	0	0	0	0	381
15:30	0	58	29	3	37	0	75	0	121	73	1	5	0	0	0	0	402
15:45	0	60	23	0	34	0	88	0	116	56	0	1	0	0	0	0	376
Total	0	171	81	4	102	0	240	1	347	201	1	11	0	0	0	0	1159
16:00	0	58	46	2	32	0	99	0	162	89	0	1	0	0	0	0	487
16:15	0	76	35	2	31	1	73	3	128	71	0	6	0	0	0	0	426
16:30	0	51	42	3	29	0	77	0	122	77	0	9	0	0	0	0	410
16:45	0	40	23	0	21	0	82	0	82	68	0	3	0	0	0	0	319
Total	0	223	146	7	113	1	331	3	494	305	0	19	0	0	0	0	1642
17:00	0	42	37	0	24	0	54	0	122	82	0	3	0	0	0	0	364
17:15	0	37	26	0	24	0	47	0	96	69	0	1	0	0	0	0	300
Grand Total	0	473	290	11	263	1	672	4	1059	657	1	34	0	0	0	0	3465
Apprch %	0	61.1	37.5	1.4	28	0.1	71.5	0.4	60.5	37.5	0.1	1.9	0	0	0	0	
Total %	0	13.7	8.4	0.3	7.6	0	19.4	0.1	30.6	19	0	1	0	0	0	0	
Unshifted	0	473	290	11	263	1	672	4	1059	657	1	34	0	0	0	0	3465
% Unshifted	0	100	100	100	100	100	100	100	100	100	100	100	0	0	0	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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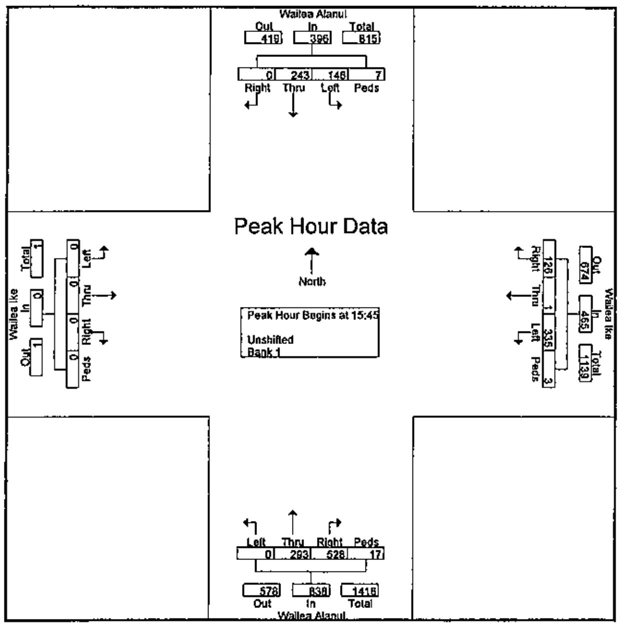
File Name : Wailea Alanui - Wailea Ike PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 2

	Wailea Alanui From North					Wailea Ike From East					Wailea Alanui From South					Wailea Ike From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 15:45 to 16:30 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	0	60	23	0	83	34	0	86	0	120	116	56	0	1	173	0	0	0	0	0	376
16:00	0	56	46	2	104	32	0	99	0	131	162	89	0	1	252	0	0	0	0	0	487
16:15	0	76	35	2	113	31	1	73	3	108	128	71	0	6	205	0	0	0	0	0	426
16:30	0	51	42	3	96	29	0	77	0	106	122	77	0	9	208	0	0	0	0	0	410
Total Volume	0	243	146	7	396	126	1	335	3	465	528	293	0	17	838	0	0	0	0	0	1699
% App. Total	0	61.4	36.9	1.8		27.1	0.2	72	0.6		63	35	0	2		0	0	0	0		
PHF	.000	.799	.793	.583	.876	.926	.250	.846	.250	.887	.815	.823	.000	.472	.831	.000	.000	.000	.000	.000	.872



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Wailea Alanui / Okolani
AM Peak Hour

File Name : Wailea Alanui - Okolani AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 1

Groups Printed- Unshifted - Bank 1

	Wailea Alanui From North				Okolani From East				Wailea Alanui From South				Okolani From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	2	9	0	5	0	1	11	1	5	2	15	1	49	8	1	10	120
06:45	2	16	1	3	1	3	14	1	2	1	15	1	63	5	1	16	145
Total	4	25	1	8	1	4	25	2	7	3	30	2	112	13	2	26	265
07:00	1	10	1	6	0	3	13	1	2	3	21	0	68	10	2	4	145
07:15	0	10	1	3	2	7	16	0	7	7	21	0	61	5	2	4	146
07:30	2	16	2	4	0	7	13	0	11	8	22	1	66	10	1	13	176
07:45	3	19	3	7	0	7	6	0	2	6	33	0	69	6	4	2	167
Total	6	55	7	20	2	24	48	1	22	24	97	1	264	31	9	23	634
08:00	0	11	1	2	0	10	16	0	6	5	27	3	52	5	2	5	145
Grand Total	10	91	9	30	3	38	89	3	35	32	154	6	428	49	13	54	1044
Apprch %	7.1	65	6.4	21.4	2.3	28.6	66.9	2.3	15.4	14.1	67.8	2.6	78.7	9	2.4	9.9	
Total %	1	8.7	0.9	2.9	0.3	3.6	8.5	0.3	3.4	3.1	14.8	0.6	41	4.7	1.2	5.2	
Unshifted	10	91	9	30	3	38	89	3	35	32	154	6	428	49	13	54	1044
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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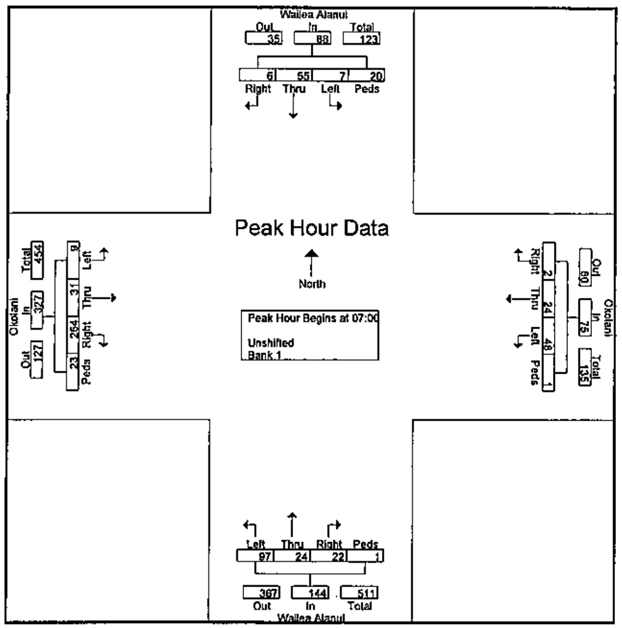
File Name : Wailea Alanui - Okolani AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 2

	Wailea Alanui From North					Okolani From East					Wailea Alanui From South					Okolani From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	1	10	1	6	18	0	3	13	1	17	2	3	21	0	26	68	10	2	4	84	145
07:15	0	10	1	3	14	2	7	16	0	25	7	7	21	0	35	61	5	2	4	72	146
07:30	2	16	2	4	24	0	7	13	0	20	11	8	22	1	42	66	10	1	13	90	176
07:45	3	19	3	7	32	0	7	6	0	13	2	6	33	0	41	69	6	4	2	81	167
Total Volume	6	55	7	20	88	2	24	48	1	75	22	24	97	1	144	264	31	9	23	327	634
% App. Total	6.8	62.5	8	22.7		2.7	32	64	1.3		15.3	16.7	67.4	0.7		80.7	9.5	2.8	7		
PHF	.500	.724	.583	.714	.688	.250	.857	.750	.250	.750	.500	.750	.735	.250	.857	.957	.775	.583	.442	.908	.901



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Wailea Alanui / Okolani
PM Peak Hour

File Name : Wailea Alanui - Okolani PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 1

Groups Printed- Unshifted - Bank 1

	Wailea Alanui From North				Okolani From East				Wailea Alanui From South				Okolani From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	0	10	0	0	1	6	9	0	16	15	68	0	47	11	3	0	186
15:30	0	9	4	0	3	8	11	0	17	28	73	0	62	6	3	3	227
15:45	4	10	1	0	1	4	11	0	16	18	71	0	47	8	3	0	194
Total	4	29	5	0	5	18	31	0	49	61	212	0	156	25	9	3	607
16:00	5	9	4	0	3	8	9	0	17	26	69	0	65	7	4	4	230
16:15	6	7	1	1	3	9	8	1	11	19	66	0	48	6	3	2	191
16:30	0	4	2	0	3	6	9	0	21	31	83	0	68	7	1	0	235
16:45	2	3	2	1	3	5	9	0	17	21	65	0	52	16	4	0	200
Total	13	23	9	2	12	28	35	1	66	97	283	0	233	36	12	6	856
17:00	0	12	0	0	2	10	9	0	13	23	73	0	51	11	4	0	208
17:15	1	4	0	0	1	6	7	0	11	13	57	0	44	11	4	2	161
Grand Total	18	68	14	2	20	62	82	1	139	194	625	0	484	83	29	11	1832
Apprch %	17.6	66.7	13.7	2	12.1	37.6	49.7	0.6	14.5	20.3	65.2	0	79.7	13.7	4.8	1.8	
Total %	1	3.7	0.8	0.1	1.1	3.4	4.5	0.1	7.6	10.6	34.1	0	26.4	4.5	1.6	0.6	
Unshifted	18	68	14	2	20	62	82	1	139	194	625	0	484	83	29	11	1832
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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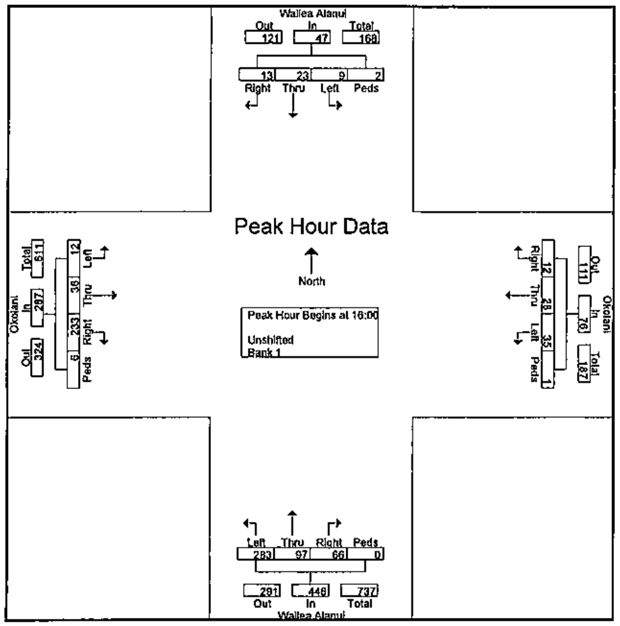
File Name : Wailea Alanui - Okolani PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 2

	Wailea Alanui From North					Okolani From East					Wailea Alanui From South					Okolani From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	5	9	4	0	18	3	8	9	0	20	17	26	69	0	112	65	7	4	4	80	230
16:15	6	7	1	1	15	3	9	8	1	21	11	19	66	0	96	48	6	3	2	59	191
16:30	0	4	2	0	6	3	6	9	0	18	21	31	83	0	135	68	7	1	0	76	235
16:45	2	3	2	1	8	3	5	9	0	17	17	21	65	0	103	52	16	4	0	72	200
Total Volume	13	23	9	2	47	12	28	35	1	76	66	97	283	0	446	233	36	12	6	287	856
% App. Total	27.7	48.9	19.1	4.3		15.8	36.8	46.1	1.3		14.8	21.7	63.5	0		81.2	12.5	4.2	2.1		
PHF	.542	.639	.563	.500	.653	1.000															



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S Kihei / Kilohana
AM Peak Hour

File Name : S Kihei - Kilohana AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 1

Groups Printed- Unshifted

	S Kihei From North				Kilohana From East				S Kihei From South				Kilohana From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	0	61	2	0	8	0	6	16	3	19	0	0	0	0	0	0	115
06:45	0	56	10	0	15	0	1	8	2	19	0	2	0	0	0	0	113
Total	0	117	12	0	23	0	7	24	5	38	0	2	0	0	0	0	228
07:00	0	72	17	0	14	0	1	13	1	23	0	4	0	0	0	0	145
07:15	0	74	31	1	13	0	1	10	6	25	0	3	0	0	0	0	164
07:30	0	64	15	0	13	0	0	5	0	25	0	1	0	0	0	0	123
07:45	0	78	18	0	23	0	3	9	2	36	0	0	0	0	0	0	169
Total	0	288	81	1	63	0	5	37	9	109	0	8	0	0	0	0	601
08:00	0	53	13	0	19	0	6	12	2	29	0	3	0	0	0	0	137
Grand Total	0	458	106	1	105	0	18	73	16	176	0	13	0	0	0	0	966
Apprch %	0	81.1	18.8	0.2	53.6	0	9.2	37.2	7.8	85.9	0	6.3	0	0	0	0	
Total %	0	47.4	11	0.1	10.9	0	1.9	7.6	1.7	18.2	0	1.3	0	0	0	0	

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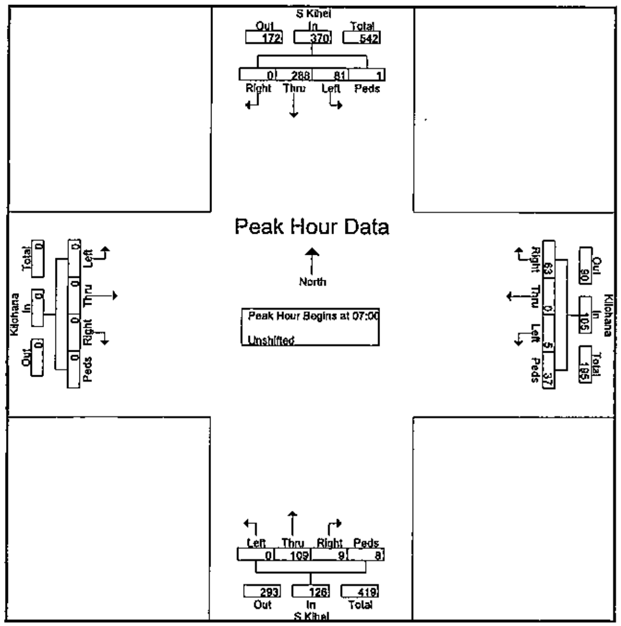
File Name : S Kihei - Kilohana AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 2

	S Kihei From North					Kilohana From East					S Kihei From South					Kilohana From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	0	72	17	0	89	14	0	1	13	28	1	23	0	4	28	0	0	0	0	0	145
07:15	0	74	31	1	106	13	0	1	10	24	6	25	0	3	34	0	0	0	0	0	164
07:30	0	64	15	0	79	13	0	0	5	18	0	25	0	1	26	0	0	0	0	0	123
07:45	0	78	18	0	96	23	0	3	9	35	2	36	0	0	38	0	0	0	0	0	169
Total Volume	0	288	81	1	370	63	0	5	37	105	9	109	0	8	126	0	0	0	0	0	601
% App. Total	0	77.8	21.9	0.3		60	0	4.8	35.2		7.1	86.5	0	6.3		0	0	0	0		
PHF	.000	.923	.653	.250	.873	.685	.000	.417	.712	.750	.375	.757	.000	.500	.829	.000	.000	.000	.000	.000	.889



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S Kihei / Kilohana
PM Peak Hour

File Name : S Kihei - Kilohana PM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 1

Groups Printed- Unshifted

	S Kihei From North				Kilohana From East				S Kihei From South				Kilohana From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	0	55	14	0	22	0	2	2	4	85	0	14	0	0	0	0	198
15:30	0	69	5	0	21	0	1	0	5	76	0	13	0	0	0	0	190
15:45	0	49	14	0	30	0	5	0	3	67	0	7	0	0	0	0	175
Total	0	173	33	0	73	0	8	2	12	228	0	34	0	0	0	0	563
16:00	0	74	16	0	39	0	6	0	7	89	0	3	0	0	0	0	234
16:15	0	63	14	0	24	0	13	0	4	73	1	2	0	0	0	0	194
16:30	0	67	14	0	32	0	5	0	7	87	0	5	0	0	0	0	217
16:45	0	56	22	0	33	0	5	0	4	55	1	7	0	0	0	0	183
Total	0	260	66	0	128	0	29	0	22	304	2	17	0	0	0	0	828
17:00	0	49	14	0	20	0	7	6	4	75	0	2	0	0	0	0	177
17:15	0	46	21	0	30	0	0	0	2	71	0	4	0	0	0	0	174
Grand Total	0	528	134	0	251	0	44	8	40	678	2	57	0	0	0	0	1742
Apprch %	0	79.8	20.2	0	82.8	0	14.5	2.6	5.1	87.3	0.3	7.3	0	0	0	0	
Total %	0	30.3	7.7	0	14.4	0	2.5	0.5	2.3	38.9	0.1	3.3	0	0	0	0	

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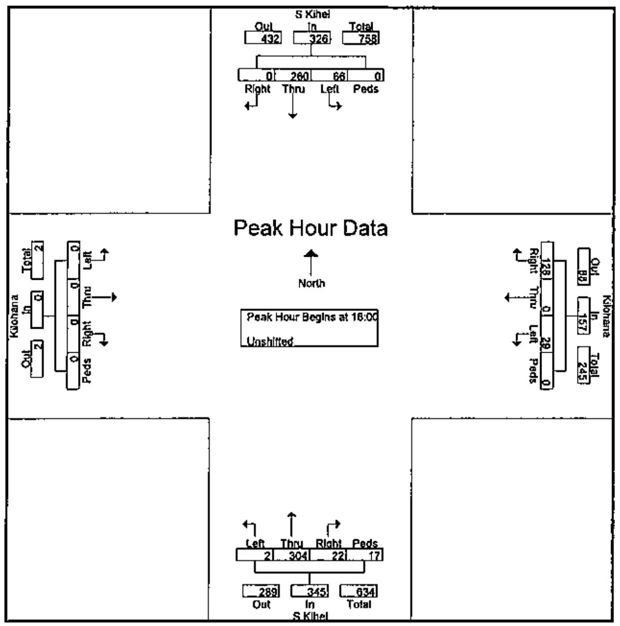
File Name : S Kihei - Kilohana PM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 2

	S Kihei From North					Kilohana From East					S Kihei From South					Kilohana From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	0	74	16	0	90	39	0	6	0	45	7	89	0	3	99	0	0	0	0	0	234
16:15	0	63	14	0	77	24	0	13	0	37	4	73	1	2	80	0	0	0	0	0	194
16:30	0	67	14	0	81	32	0	5	0	37	7	87	0	5	99	0	0	0	0	0	217
16:45	0	56	22	0	78	33	0	5	0	38	4	55	1	7	67	0	0	0	0	0	183
Total Volume	0	260	66	0	326	128	0	29	0	157	22	304	2	17	345	0	0	0	0	0	828
% App. Total	0	79.8	20.2	0		81.5	0	18.5	0		6.4	88.1	0.6	4.9		0	0	0	0		
PHF	.000	.878	.750	.000	.906	.821	.000	.558	.000	.872	.786	.854	.500	.607	.871	.000	.000	.000	.000	.000	.885



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Wailea Alanui / Grand Wailea
AM Peak Hour

File Name : Wailea Alanui - Grand Wailea AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 1

Groups Printed- Unshifted - Bank 1

	Wailea Alanui From North				Grand Wailea From East				Wailea Alanui From South				Grand Wailea From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	13	119	3	2	3	0	0	0	0	38	2	0	1	0	11	5	197
06:45	9	164	4	3	0	2	1	0	0	23	1	0	1	1	3	8	220
Total	22	283	7	5	3	2	1	0	0	61	3	0	2	1	14	13	417
07:00	9	167	2	1	0	1	1	0	2	57	0	0	0	1	3	4	248
07:15	11	150	5	0	1	0	1	2	1	37	2	0	0	0	3	2	215
07:30	10	153	6	5	2	0	0	2	0	54	1	0	0	0	1	13	247
07:45	8	140	7	1	0	0	0	0	0	58	1	0	2	0	8	5	230
Total	38	610	20	7	3	1	2	4	3	206	4	0	2	1	15	24	940
08:00	0	120	5	0	5	0	0	0	0	47	0	0	0	0	0	8	185
Grand Total	60	1013	32	12	11	3	3	4	3	314	7	0	4	2	29	45	1542
Apprch %	5.4	90.7	2.9	1.1	52.4	14.3	14.3	19	0.9	96.9	2.2	0	5	2.5	36.2	56.2	
Total %	3.9	65.7	2.1	0.8	0.7	0.2	0.2	0.3	0.2	20.4	0.5	0	0.3	0.1	1.9	2.9	
Unshifted	60	1013	32	12	11	3	3	4	3	314	7	0	4	2	29	45	1542
% Unshifted	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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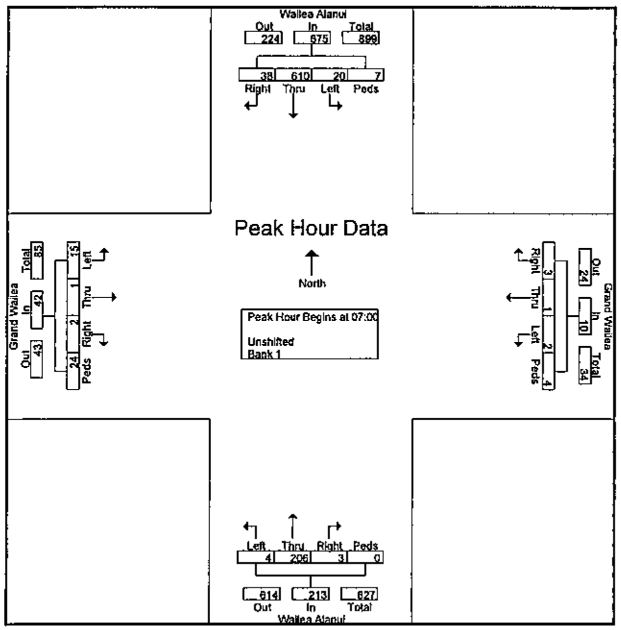
File Name : Wailea Alanui - Grand Wailea AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 2

	Wailea Alanui From North					Grand Wailea From East					Wailea Alanui From South					Grand Wailea From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	9	167	2	1	179	0	1	1	0	2	2	57	0	0	59	0	1	3	4	8	248
07:15	11	150	5	0	166	1	0	1	2	4	1	37	2	0	40	0	0	3	2	5	215
07:30	10	153	6	5	174	2	0	0	2	4	0	54	1	0	55	0	0	1	13	14	247
07:45	8	140	7	1	156	0	0	0	0	0	0	58	1	0	59	2	0	8	5	15	230
Total Volume	38	610	20	7	675	3	1	2	4	10	3	206	4	0	213	2	1	15	24	42	940
% App. Total	5.6	90.4	3	1		30	10	20	40		1.4	96.7	1.9	0		4.8	2.4	35.7	57.1		
PHF	.864	.913	.714	.350	.943	.375	.250	.500	.500	.625	.375	.888	.500	.000	.903	.250	.250	.469	.462	.700	.948



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Wailea Alanui / Grand Wailea
PM Peak Hour

File Name : Wailea Alanui - Grand Wailea PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 1

Groups Printed- Unshifted - Bank 1

	Wailea Alanui From North				Grand Wailea From East				Wailea Alanui From South				Grand Wailea From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	9	106	1	0	9	0	1	0	1	156	0	2	1	1	4	0	291
15:30	6	107	7	0	14	0	0	0	1	171	0	0	1	0	3	2	312
15:45	13	115	5	1	8	1	1	0	0	157	1	0	1	0	14	9	326
Total	28	328	13	1	31	1	2	0	2	484	1	2	3	1	21	11	929
16:00	8	111	6	0	11	3	0	0	0	227	3	0	1	0	14	3	387
16:15	9	88	3	8	3	1	1	0	0	137	3	0	0	0	11	4	268
16:30	9	89	3	0	3	2	1	0	1	147	1	0	2	1	10	8	277
16:45	2	93	3	1	4	4	0	0	1	116	2	0	1	3	11	7	248
Total	28	381	15	9	21	10	2	0	2	627	9	0	4	4	46	22	1180
17:00	2	80	1	2	6	1	0	0	2	173	0	0	0	2	17	1	287
17:15	7	66	3	7	2	1	1	0	1	155	0	0	0	0	9	3	255
Grand Total	65	855	32	19	60	13	5	0	7	1439	10	2	7	7	93	37	2651
Apprch %	6.7	88.1	3.3	2	76.9	16.7	6.4	0	0.5	98.7	0.7	0.1	4.9	4.9	64.6	25.7	
Total %	2.5	32.3	1.2	0.7	2.3	0.5	0.2	0	0.3	54.3	0.4	0.1	0.3	0.3	3.5	1.4	
Unshifted	65	855	32	19	60	13	5	0	7	1439	10	2	7	7	93	37	2651
% Unshifted	100	100	100	100	100	100	100	0	100	100	100	100	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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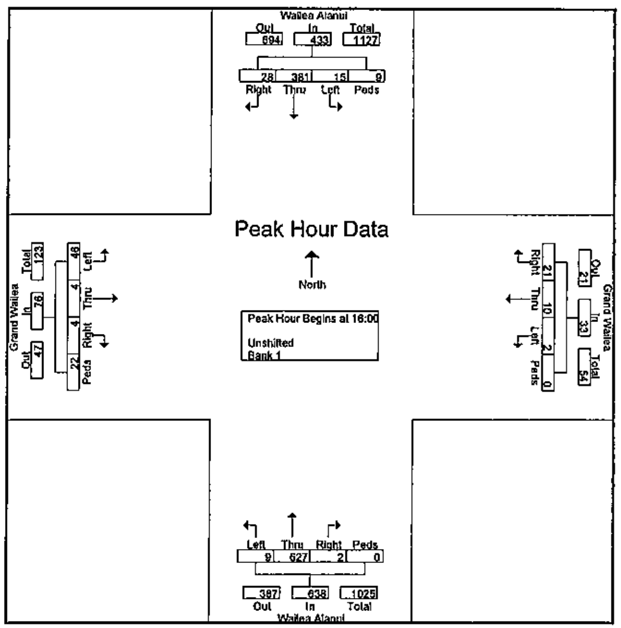
File Name : Wailea Alanui - Grand Wailea PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 2

	Wailea Alanui From North					Grand Wailea From East					Wailea Alanui From South					Grand Wailea From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	8	111	6	0	125	11	3	0	0	14	0	227	3	0	230	1	0	14	3	18	387
16:15	9	88	3	8	108	3	1	1	0	5	0	137	3	0	140	0	0	11	4	15	268
16:30	9	89	3	0	101	3	2	1	0	6	1	147	1	0	149	2	1	10	8	21	277
16:45	2	93	3	1	99	4	4	0	0	8	1	116	2	0	119	1	3	11	7	22	248
Total Volume	28	381	15	9	433	21	10	2	0	33	2	627	9	0	638	4	4	46	22	76	1180
% App. Total	6.5	88	3.5	2.1		63.6	30.3	6.1	0		0.3	98.3	1.4	0		5.3	5.3	60.5	28.9		
PHF	.778	.858	.625	.281	.866	.477	.625	.500	.000	.589	.500	.691	.750	.000	.693	.500	.333	.821	.688	.864	.762



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Wailea Alanui / Kauakahi
AM Peak Hour

File Name : Wailea Alanui - Kauakahi AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 1

Groups Printed- Unshifted

	Wailea Alanui From North				Kauakahi From East				Wailea Alanui From South				Kauakahi From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:15	12	40	9	0	5	5	3	0	1	12	1	0	1	1	3	0	93
06:30	11	43	9	0	5	3	3	0	1	14	1	0	1	3	3	0	97
06:45	20	67	4	1	7	5	3	0	2	11	0	0	1	1	6	4	132
Total	43	150	22	1	17	13	9	0	4	37	2	0	3	5	12	4	322
07:00	30	63	4	9	8	6	3	0	2	10	0	0	0	0	7	3	145
07:15	36	40	5	1	11	8	8	0	0	17	1	0	0	5	4	0	136
07:30	30	53	6	3	4	2	11	0	3	22	0	0	3	8	9	0	154
07:45	37	51	7	0	3	9	13	0	0	18	1	0	1	3	5	5	153
Total	133	207	22	13	26	25	35	0	5	67	2	0	4	16	25	8	588
08:00	17	47	3	1	4	4	8	0	1	20	0	0	2	2	4	4	117
Grand Total	193	404	47	15	47	42	52	0	10	124	4	0	9	23	41	16	1027
Apprch %	29.3	61.3	7.1	2.3	33.3	29.8	36.9	0	7.2	89.9	2.9	0	10.1	25.8	46.1	18	
Total %	18.8	39.3	4.6	1.5	4.6	4.1	5.1	0	1	12.1	0.4	0	0.9	2.2	4	1.6	

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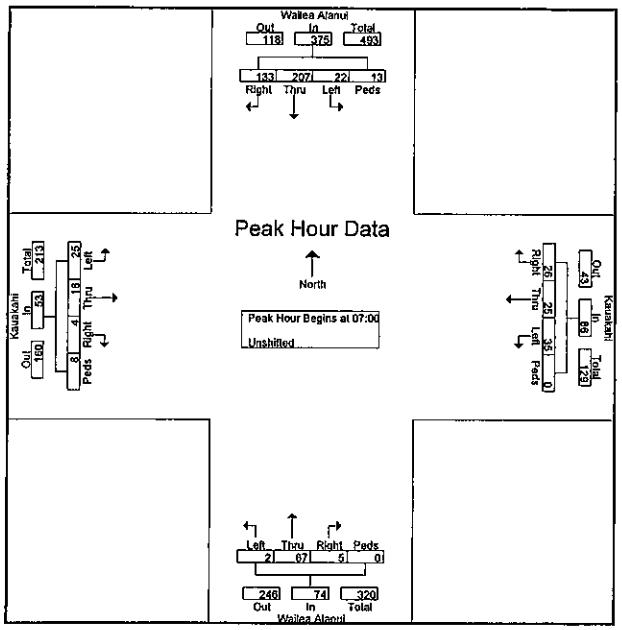
File Name : Wailea Alanui - Kauakahi AM
Site Code : 00000000
Start Date : 6/25/2008
Page No : 2

	Wailea Alanui From North					Kauakahi From East					Wailea Alanui From South					Kauakahi From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 07:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	30	63	4	9	106	8	6	3	0	17	2	10	0	0	12	0	0	7	3	10	145
07:15	36	40	5	1	82	11	8	8	0	27	0	17	1	0	18	0	5	4	0	9	136
07:30	30	53	6	3	92	4	2	11	0	17	3	22	0	0	25	3	8	9	0	20	154
07:45	37	51	7	0	95	3	9	13	0	25	0	18	1	0	19	1	3	5	5	14	153
Total Volume	133	207	22	13	375	26	25	35	0	86	5	67	2	0	74	4	16	25	8	53	588
% App. Total	35.5	55.2	5.9	3.5		30.2	29.1	40.7	0		6.8	90.5	2.7	0		7.5	30.2	47.2	15.1		
PHF	.899	.821	.786	.361	.884	.591	.694	.673	.000	.796	.417	.761	.500	.000	.740	.333	.500	.694	.400	.663	.955



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Wailea Alanui / Kauakahi
PM Peak Hour

File Name : Wailea Alanui - Kauakahi PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 1

Groups Printed- Unshifted - Bank 1

	Wailea Alanui From North				Kauakahi From East				Wailea Alanui From South				Kauakahi From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	16	38	19	0	0	1	3	0	13	62	2	0	1	5	11	0	171
15:30	18	46	11	0	0	1	4	0	9	58	1	0	4	15	26	1	194
15:45	17	34	8	0	0	4	8	0	10	54	2	0	2	9	16	0	164
Total	51	118	38	0	0	6	15	0	32	174	5	0	7	29	53	1	529
16:00	13	53	10	0	0	2	8	0	17	87	1	0	2	6	47	2	248
16:15	18	46	8	0	3	4	4	0	6	57	0	0	2	4	12	0	164
16:30	18	65	5	0	1	3	9	0	8	75	2	0	4	7	16	1	214
16:45	10	34	5	1	3	3	3	0	7	63	2	0	0	4	11	1	147
Total	59	198	28	1	7	12	24	0	38	282	5	0	8	21	86	4	773
17:00	8	41	4	0	3	2	6	0	4	67	3	0	5	6	20	1	170
17:15	5	34	4	0	2	2	7	0	14	69	1	0	2	4	17	0	161
Grand Total	123	391	74	1	12	22	52	0	88	592	14	0	22	60	176	6	1633
Apprch %	20.9	66.4	12.6	0.2	14	25.6	60.5	0	12.7	85.3	2	0	8.3	22.7	66.7	2.3	
Total %	7.5	23.9	4.5	0.1	0.7	1.3	3.2	0	5.4	36.3	0.9	0	1.3	3.7	10.8	0.4	
Unshifted	123	391	74	1	12	22	52	0	88	592	14	0	22	60	176	6	1633
% Unshifted	100	100	100	100	100	100	100	0	100	100	100	0	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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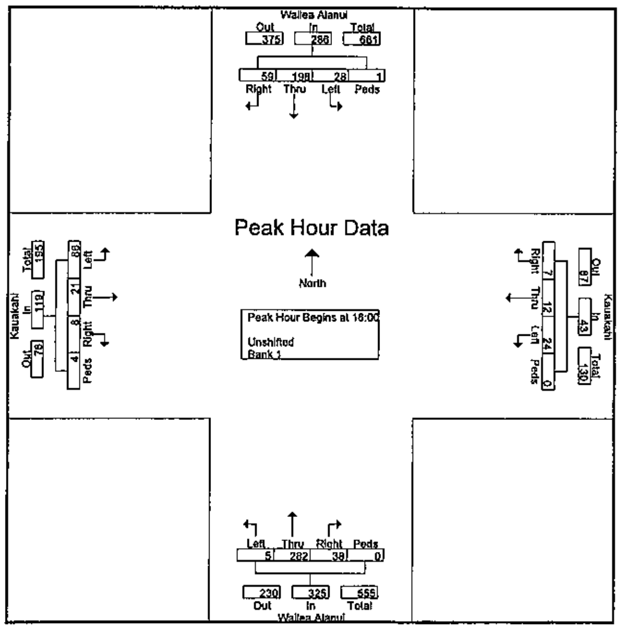
File Name : Wailea Alanui - Kauakahi PM
Site Code : 00000000
Start Date : 6/24/2008
Page No : 2

	Wailea Alanui From North					Kauakahi From East					Wailea Alanui From South					Kauakahi From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	13	53	10	0	76	0	2	8	0	10	17	87	1	0	105	2	6	47	2	57	248
16:15	18	46	8	0	72	3	4	4	0	11	6	57	0	0	63	2	4	12	0	18	164
16:30	18	65	5	0	88	1	3	9	0	13	8	75	2	0	85	4	7	16	1	28	214
16:45	10	34	5	1	50	3	3	3	0	9	7	63	2	0	72	0	4	11	1	16	147
Total Volume	59	198	28	1	286	7	12	24	0	43	38	282	5	0	325	8	21	86	4	119	773
% App. Total	20.6	69.2	9.8	0.3		16.3	27.9	55.8	0		11.7	86.8	1.5	0		6.7	17.6	72.3	3.4		
PHF	.819	.762	.700	.250	.813	.583	.750	.667	.000	.827	.559	.810	.625	.000	.774	.500	.750	.457	.500	.522	.779



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APPENDIX B

LEVEL OF SERVICE CRITERIA

APPENDIX B – LEVEL OF SERVICE (LOS) CRITERIA

LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 2000)

The level of service criteria for unsignalized intersections is defined as the average total delay, in seconds per vehicle. As used here, total delay is defined as the total elapsed time from when a vehicle stops at the end of the queue until the vehicle departs from the stop line; this time includes the time required for the vehicle to travel from the last-in-queue position to the first-in-queue position. While the criteria for level of service for TWSC and AWSC intersections are the same, procedures to calculate the average total delay may differ.

Level of Service Criteria for Two-Way Stop-Controlled Intersections

Level of Service	Average Total Delay (sec/veh)
A	≤ 10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	> 50

LEVEL OF SERVICE CRITERIA FOR ALL-WAY STOP-CONTROLLED INTERSECTIONS (HCM 2000)

The all-way stop-controlled intersection is a special type of unsignalized intersection, where vehicles on all approaches are required to stop before entering the intersection. Generally, the sequence of entry into the intersection is on a "first come, first serve basis", according to order of arrival at the intersection. In theory, if vehicles arrive at two or more of the approaches at the same time, then according the "rules of the road", the vehicle to the right is allowed to proceed first. However, it has been observed that two-lane AWSC intersections often operate on a virtual 2-phase patterns, where North-South streams alternate right-of-way with East-West streams. Multilane AWSC intersections generally operate in 4 phases, where each approach will take up a single phase. The table, shown below, identifies the Level of Service and corresponding average stopped delay for all-way stop-controlled intersections.

Level of Service Criteria for AWSC Intersections

Level of Service	Average Total Delay (sec/veh)
A	≤ 10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	> 50

LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 2000)

Level of service for signalized intersections is directly related to delay values and is assigned on that basis. Level of Service is a measure of the acceptability of delay values to motorists at a given intersection. The criteria are given in table below.

Level-of Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec./veh.)
A	< 10.0
B	>10.0 and ≤ 20.0
C	>20.0 and ≤ 35.0
D	>35.0 and ≤ 55.0
E	>55.0 and ≤ 80.0
F	> 80.0

Delay is a complex measure, and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group or approach in question.

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APPENDIX C

LEVEL OF SERVICE CALCULATIONS

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APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing Conditions

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	66	15	11	24	145	2	291	49	780	112
Turn Type	Perm		Perm		Perm	Prot		Prot		Perm
Protected Phases		4		8		5	2	1	6	
Permitted Phases	4		8		8					6
Detector Phase	4	4	8	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	10.0	24.0	24.0
Total Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	37.0	11.0	38.0	38.0
Total Split (%)	20.0%	20.0%	20.0%	20.0%	20.0%	16.7%	61.7%	18.3%	63.3%	63.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	None	Max	Max
Act Effct Green (s)	6.7	6.7		6.7	6.7	5.7	37.3	6.5	41.6	41.6
Actuated g/C Ratio	0.12	0.12		0.12	0.12	0.10	0.66	0.11	0.73	0.73
v/c Ratio	0.45	0.11		0.20	0.49	0.01	0.26	0.26	0.62	0.10
Control Delay	34.1	20.7		26.5	10.8	24.5	7.4	27.5	9.8	1.6
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.1	20.7		26.5	10.8	24.5	7.4	27.5	9.8	1.6
LOS	C	C		C	B	C	A	C	A	A
Approach Delay		30.7		13.9			7.5		9.8	
Approach LOS		C		B			A		A	

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 56.9
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.62
Intersection Signal Delay: 11.0 Intersection LOS: B
Intersection Capacity Utilization 59.7% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: Kilohana Dr & Piilani HWY

ø1 11 s	ø2 37 s	ø4 12 s
ø5 10 s	ø6 38 s	ø8 12 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	66	15	7	11	24	145	2	291	3	49	780	112
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0	5.0	4.0	5.0		4.0	5.0	5.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.95			1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.98	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1770			1834	1583	1770	1860		1770	1863	1583
Flt Permitted	0.73	1.00			0.89	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1364	1770			1649	1583	1770	1860		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	72	16	8	12	26	158	2	316	3	53	848	122
RTOR Reduction (vph)	0	7	0	0	0	144	0	0	0	0	0	41
Lane Group Flow (vph)	72	17	0	0	38	14	2	319	0	53	848	81
Turn Type	Perm			Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	5.5	5.5			5.5	5.5	1.1	37.6		4.0	40.5	40.5
Effective Green, g (s)	5.5	5.5			5.5	5.5	1.1	37.6		4.0	40.5	40.5
Actuated g/C Ratio	0.09	0.09			0.09	0.09	0.02	0.62		0.07	0.66	0.66
Clearance Time (s)	5.0	5.0			5.0	5.0	4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	123	159			148	142	32	1145		116	1235	1049
v/s Ratio Prot		0.01					0.00	0.17		c0.03	c0.46	
v/s Ratio Perm	c0.05				0.02	0.01						0.05
v/c Ratio	0.59	0.11			0.26	0.10	0.06	0.28		0.46	0.69	0.08
Uniform Delay, d1	26.7	25.5			25.9	25.5	29.5	5.5		27.5	6.4	3.7
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	6.9	0.3			0.9	0.3	0.8	0.6		2.8	3.1	0.1
Delay (s)	33.6	25.8			26.8	25.8	30.3	6.1		30.3	9.5	3.8
Level of Service	C	C			C	C	C	A		C	A	A
Approach Delay (s)		31.7			26.0			6.2			9.9	
Approach LOS		C			C			A			A	

Intersection Summary

HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	61.1	Sum of lost time (s)	14.0
Intersection Capacity Utilization	59.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱	↱		↰↑↱	↱	↰	↑	↱	↰	↑	↱
Volume (veh/h)	27	4	15	33	18	65	3	198	13	29	675	55
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	29	4	16	36	20	71	3	215	14	32	734	60
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			2			2						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1028	1018	734	1021	1018	215	734			215		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1028	1018	734	1021	1018	215	734			215		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	83	98	96	82	92	91	100			98		
cM capacity (veh/h)	178	231	420	199	231	825	871			1355		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	50	126	3	215	14	32	734	60
Volume Left	29	36	3	0	0	32	0	0
Volume Right	16	71	0	0	14	0	0	60
cSH	274	479	871	1700	1700	1355	1700	1700
Volume to Capacity	0.18	0.26	0.00	0.13	0.01	0.02	0.43	0.04
Queue Length 95th (ft)	16	26	0	0	0	2	0	0
Control Delay (s)	23.9	17.8	9.1	0.0	0.0	7.7	0.0	0.0
Lane LOS	C	C	A			A		
Approach Delay (s)	23.9	17.8	0.1			0.3		
Approach LOS	C	C						

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	184	5	115	658	5	33
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	200	5	125	715	5	36
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				749		
pX, platoon unblocked						
vC, conflicting volume			205		810	103
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			205		810	103
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		98	96
cM capacity (veh/h)			1363		288	932

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	133	72	125	358	358	5	36
Volume Left	0	0	125	0	0	5	0
Volume Right	0	5	0	0	0	0	36
cSH	1700	1700	1363	1700	1700	288	932
Volume to Capacity	0.08	0.04	0.09	0.21	0.21	0.02	0.04
Queue Length 95th (ft)	0	0	8	0	0	1	3
Control Delay (s)	0.0	0.0	7.9	0.0	0.0	17.7	9.0
Lane LOS			A			C	A
Approach Delay (s)	0.0		1.2			10.2	
Approach LOS						B	

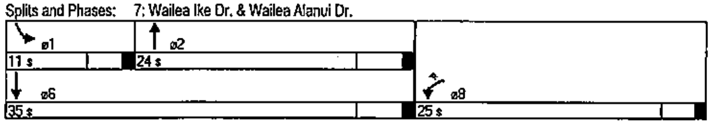
Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	28.2%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	563	116	111	154	74	265
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Detector Phase	8	8	2		1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	25.0	25.0	24.0	0.0	11.0	35.0
Total Split (%)	41.7%	41.7%	40.0%	0.0%	18.3%	58.3%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	None		None	None
Act Effct Green (s)	21.1	21.1	8.8	45.0	6.6	14.6
Actuated g/C Ratio	0.47	0.47	0.20	1.00	0.15	0.32
v/c Ratio	0.74	0.16	0.33	0.11	0.31	0.25
Control Delay	20.1	3.1	20.0	0.1	23.1	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.1	3.1	20.0	0.1	23.1	10.9
LOS	C	A	C	A	C	B
Approach Delay	17.2		8.5			13.6
Approach LOS	B		A			B

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 45
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.74
Intersection Signal Delay: 14.5 — Intersection LOS: B
Intersection Capacity Utilization 49.5% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	563	116	111	154	74	265
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	612	126	121	167	80	288
RTOR Reduction (vph)	0	69	0	0	0	0
Lane Group Flow (vph)	612	57	121	167	80	288
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Actuated Green, G (s)	21.2	21.2	8.8	46.7	3.7	16.5
Effective Green, g (s)	21.2	21.2	8.8	46.7	3.7	16.5
Actuated g/C Ratio	0.45	0.45	0.19	1.00	0.08	0.35
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	804	719	351	1583	140	1250
v/s Ratio Prot	c0.35		c0.06		c0.05	0.08
v/s Ratio Perm		0.04		0.11		
v/c Ratio	0.76	0.08	0.34	0.11	0.57	0.23
Uniform Delay, d1	10.6	7.2	16.4	0.0	20.7	10.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.3	0.0	0.6	0.1	5.5	0.1
Delay (s)	14.9	7.3	17.0	0.1	26.3	10.7
Level of Service	B	A	B	A	C	B
Approach Delay (s)	13.6		7.2			14.1
Approach LOS	B		A			B

Intersection Summary			
HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	46.7	Sum of lost time (s)	13.0
Intersection Capacity Utilization	49.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

8: Okolani Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	9	31	264	48	24	2	97	24	22	7	55	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	34	287	52	26	2	105	26	24	8	60	7

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	10	34	287	78	2	105	26	24	67	7
Volume Left (vph)	10	0	0	52	0	105	0	0	8	0
Volume Right (vph)	0	0	287	0	2	0	0	24	0	7
Hadj (s)	0.53	0.03	-0.67	0.37	-0.67	0.53	0.03	-0.67	0.09	-0.67
Departure Headway (s)	5.6	5.1	3.2	5.4	4.4	5.4	4.9	3.2	5.0	4.3
Degree Utilization, x	0.02	0.05	0.26	0.12	0.00	0.16	0.04	0.02	0.09	0.01
Capacity (veh/h)	605	668	1112	636	776	645	706	1121	690	806
Control Delay (s)	7.5	7.2	6.1	8.0	6.2	8.3	6.9	5.1	7.4	6.1
Approach Delay (s)	6.2			7.9		7.5			7.3	
Approach LOS	A			A		A			A	

Intersection Summary			
Delay	6.9		
HCM Level of Service	A		
Intersection Capacity Utilization	33.6%	ICU Level of Service	A
Analysis Period (min)	15		

9: Kilohana Dr & South Kihei Rd

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	5	63	109	9	81	288
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	68	118	10	88	313
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	612	123			128	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	612	123			128	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	93			94	
cM capacity (veh/h)	429	927			1458	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	74	128	401
Volume Left	5	0	88
Volume Right	68	10	0
cSH	1001	1700	1458
Volume to Capacity	0.07	0.08	0.06
Queue Length 95th (ft)	6	0	5
Control Delay (s)	9.5	0.0	2.1
Lane LOS	A		A
Approach Delay (s)	9.5	0.0	2.1
Approach LOS	A		

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	38.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✣		✣	↰	↑↱	↰	↑↱
Volume (vph)	15	1	2	1	4	206	20	610
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	25.0	25.0	25.0	25.0
Total Split (%)	44.4%	44.4%	44.4%	44.4%	55.6%	55.6%	55.6%	55.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		6.3		6.1	30.0	30.0	30.0	30.0
Actuated g/C Ratio		0.20		0.19	0.93	0.93	0.93	0.93
v/c Ratio		0.05		0.02	0.01	0.07	0.02	0.22
Control Delay		13.5		12.3	2.0	1.3	1.8	1.4
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		13.5		12.3	2.0	1.3	1.8	1.4
LOS		B		B	A	A	A	A
Approach Delay		13.5		12.3		1.3		1.4
Approach LOS		B		B		A		A

Intersection Summary

Cycle Length: 45
Actuated Cycle Length: 32.3
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.22
Intersection Signal Delay: 1.7 — Intersection LOS: A
Intersection Capacity Utilization 29.7% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.

ø2	ø4
25 s	20 s
ø6	ø8
25 s	20 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣		↰	↑↱		↰	↑↱	
Volume (vph)	15	1	2	2	1	3	4	206	3	20	610	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.99			0.93		1.00	1.00		1.00	0.99	
Flt Protected		0.96			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1762			1709		1770	3532		1770	3508	
Flt Permitted		1.00			1.00		0.38	1.00		0.61	1.00	
Satd. Flow (perm)		1836			1737		715	3532		1137	3508	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	1	2	2	1	3	4	224	3	22	663	41
RTOR Reduction (vph)	0	2	0	0	3	0	0	1	0	0	5	0
Lane Group Flow (vph)	0	17	0	0	3	0	4	226	0	22	699	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		1.0			1.0		25.3	25.3		25.3	25.3	
Effective Green, g (s)		1.0			1.0		25.3	25.3		25.3	25.3	
Actuated g/C Ratio		0.03			0.03		0.70	0.70		0.70	0.70	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		51			48		498	2462		792	2445	
v/s Ratio Prot								0.06			c0.20	
v/s Ratio Perm		c0.01			0.00		0.01			0.02		
v/c Ratio		0.33			0.06		0.01	0.09		0.03	0.29	
Uniform Delay, d1		17.3			17.2		1.7	1.8		1.7	2.1	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		3.9			0.6		0.0	0.0		0.0	0.1	
Delay (s)		21.2			17.8		1.7	1.8		1.7	2.1	
Level of Service		C			B		A	A		A	A	
Approach Delay (s)		21.2			17.8			1.8			2.1	
Approach LOS		C			B			A			A	

Intersection Summary

HCM Average Control Delay	2.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	36.3	Sum of lost time (s)	10.0
Intersection Capacity Utilization	29.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			↰↑	↱		↰↑	↱	↰	↑	↱
Volume (veh/h)	25	16	4	35	25	26	2	67	5	22	207	133
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	17	4	38	27	28	2	73	5	24	225	145
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	364	350	225	363	495	73	370			73		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	364	350	225	363	495	73	370			73		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	97	99	93	94	97	100			98		
cM capacity (veh/h)	543	564	814	588	468	989	1189			1527		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	49	65	28	75	5	24	225	145
Volume Left	27	38	0	2	0	24	0	0
Volume Right	4	0	28	0	5	0	0	145
cSH	567	522	989	1189	1700	1527	1700	1700
Volume to Capacity	0.09	0.13	0.03	0.00	0.00	0.02	0.13	0.09
Queue Length 95th (ft)	7	11	2	0	0	1	0	0
Control Delay (s)	11.9	12.9	8.7	0.2	0.0	7.4	0.0	0.0
Lane LOS	B	B	A	A		A		
Approach Delay (s)	11.9	11.6		0.2		0.4		
Approach LOS	B	B						

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	27.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰↑	↱	↰	↑↱	↰	↑	↱
Volume (vph)	112	33	9	28	129	9	802	156	555	126
Turn Type	Perm		Perm		Perm	Prot		Prot		Perm
Protected Phases		4		8		5	2	1	6	
Permitted Phases	4		8		8					6
Detector Phase	4	4	8	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	10.0	24.0	24.0
Total Split (s)	25.0	25.0	25.0	25.0	25.0	10.0	49.0	16.0	55.0	55.0
Total Split (%)	27.8%	27.8%	27.8%	27.8%	27.8%	11.1%	54.4%	17.8%	61.1%	61.1%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Min	Max	Min	Max	Max
Act Effct Green (s)	12.6	12.6		12.6	12.6	5.8	44.7	11.2	50.2	50.2
Actuated g/C Ratio	0.15	0.15		0.15	0.15	0.07	0.54	0.14	0.61	0.61
v/c Ratio	0.59	0.16		0.15	0.39	0.08	0.88	0.71	0.53	0.13
Control Delay	44.1	26.2		30.9	9.0	39.4	30.0	52.4	12.4	2.0
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.1	26.2		30.9	9.0	39.4	30.0	52.4	12.4	2.0
LOS	D	C		C	A	D	C	D	B	A
Approach Delay		39.3		13.9			30.1		18.3	
Approach LOS		D		B			C		B	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 82.6
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 24.5 — Intersection LOS: C
Intersection Capacity Utilization 76.0% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 1: Kilohana Dr & Piilani HWY

ø1	ø2	ø4
16 s	49 s	25 s

ø5	ø6	ø8
10 s	55 s	25 s

HCM Signalized Intersection Capacity Analysis
1: Kilohana Dr & Piilani HWY

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			↰	↱	↰	↱		↰	↑	↱
Volume (vph)	112	33	8	9	28	129	9	802	10	156	555	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0	5.0	4.0	5.0		4.0	5.0	5.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.97			1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1807			1840	1583	1770	1859		1770	1863	1583
Flt Permitted	0.73	1.00			0.93	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1362	1807			1735	1583	1770	1859		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	122	36	9	10	30	140	10	872	11	170	603	137
RTOR Reduction (vph)	0	8	0	0	0	119	0	0	0	0	0	54
Lane Group Flow (vph)	122	37	0	0	40	21	10	883	0	170	603	83
Turn Type	Perm			Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	12.6	12.6			12.6	12.6	5.8	44.7		11.2	50.1	50.1
Effective Green, g (s)	12.6	12.6			12.6	12.6	5.8	44.7		11.2	50.1	50.1
Actuated g/C Ratio	0.15	0.15			0.15	0.15	0.07	0.54		0.14	0.61	0.61
Clearance Time (s)	5.0	5.0			5.0	5.0	4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	208	276			265	242	124	1007		240	1131	961
v/s Ratio Prot		0.02					0.01	c0.47		c0.10	0.32	
v/s Ratio Perm	c0.09				0.02	0.01						0.05
v/c Ratio	0.59	0.14			0.15	0.09	0.08	0.88		0.71	0.53	0.09
Uniform Delay, d1	32.5	30.2			30.3	30.0	35.9	16.5		34.1	9.4	6.7
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	4.2	0.2			0.3	0.2	0.3	10.6		9.2	1.8	0.2
Delay (s)	36.7	30.5			30.6	30.2	36.1	27.1		43.3	11.2	6.9
Level of Service	D	C			C	C	D	C		D	B	A
Approach Delay (s)		35.0			30.3			27.2			16.6	
Approach LOS		D			C			C			B	

Intersection Summary			
HCM Average Control Delay	23.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	82.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	76.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
2: Okolani Dr. & Piilani HWY

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥	↱		✥	↱	↰	↑	↱	↰	↑	↱
Volume (veh/h)	61	26	14	13	14	43	7	666	38	76	434	39
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	66	28	15	14	15	47	8	724	41	83	472	42
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			2			2						
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1384	1376	472	1390	1376	724	472			724		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1384	1376	472	1390	1376	724	472			724		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	27	78	97	84	88	89	99			91		
cM capacity (veh/h)	91	131	592	90	131	426	1090			879		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	110	76	8	724	41	83	472	42
Volume Left	66	14	8	0	0	83	0	0
Volume Right	15	47	0	0	41	0	0	42
cSH	115	288	1090	1700	1700	879	1700	1700
Volume to Capacity	0.95	0.26	0.01	0.43	0.02	0.09	0.28	0.02
Queue Length 95th (ft)	152	26	1	0	0	8	0	0
Control Delay (s)	141.7	27.7	8.3	0.0	0.0	9.5	0.0	0.0
Lane LOS	F	D	A			A		
Approach Delay (s)	141.7	27.7	0.1			1.3		
Approach LOS	F	D						

Intersection Summary			
Average Delay	11.9		
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	627	10	70	391	9	125
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	682	11	76	425	10	136
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				749		
pX, platoon unblocked						
vC, conflicting volume			692		1052	346
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			692		1052	346
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		95	79
cM capacity (veh/h)			899		203	650

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	454	238	76	212	212	10	136
Volume Left	0	0	76	0	0	10	0
Volume Right	0	11	0	0	0	0	136
cSH	1700	1700	899	1700	1700	203	650
Volume to Capacity	0.27	0.14	0.08	0.13	0.13	0.05	0.21
Queue Length 95th (ft)	0	0	7	0	0	4	20
Control Delay (s)	0.0	0.0	9.4	0.0	0.0	23.6	12.0
Lane LOS			A			C	B
Approach Delay (s)	0.0		1.4			12.8	
Approach LOS						B	

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	34.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	335	126	293	528	146	243
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Detector Phase	8	8	2		1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	22.0	22.0	25.0	0.0	13.0	38.0
Total Split (%)	36.7%	36.7%	41.7%	0.0%	21.7%	63.3%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	None		None	None
Act Effct Green (s)	14.5	14.5	13.8	47.6	8.7	23.0
Actuated g/C Ratio	0.30	0.30	0.29	1.00	0.18	0.48
v/c Ratio	0.67	0.24	0.59	0.36	0.49	0.15
Control Delay	23.9	4.8	21.1	0.6	28.1	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.9	4.8	21.1	0.6	28.1	6.8
LOS	C	A	C	A	C	A
Approach Delay	18.7		7.9			14.8
Approach LOS	B		A			B

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 47.6
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.67
Intersection Signal Delay: 12.5 Intersection LOS: B
Intersection Capacity Utilization 52.9% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.

ø1 13 s | ø2 25 s
ø6 38 s | ø8 22 s

7: Wailea Ike Dr. & Wailea Alanui Dr.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	335	126	293	528	146	243
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	364	137	318	574	159	264
RTOR Reduction (vph)	0	95	0	0	0	0
Lane Group Flow (vph)	364	42	318	574	159	264
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Actuated Green, G (s)	14.5	14.5	13.8	47.6	6.3	24.1
Effective Green, g (s)	14.5	14.5	13.8	47.6	6.3	24.1
Actuated g/C Ratio	0.30	0.30	0.29	1.00	0.13	0.51
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	539	482	540	1583	234	1792
v/s Ratio Prot	c0.21		c0.17		c0.09	0.07
v/s Ratio Perm		0.03		0.36		
v/c Ratio	0.68	0.09	0.59	0.36	0.68	0.15
Uniform Delay, d1	14.5	11.8	14.5	0.0	19.7	6.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.3	0.1	1.6	0.6	7.6	0.0
Delay (s)	17.8	11.9	16.1	0.6	27.3	6.3
Level of Service	B	B	B	A	C	A
Approach Delay (s)	16.2		6.2			14.2
Approach LOS	B		A			B

Intersection Summary			
HCM Average Control Delay	10.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	47.6	Sum of lost time (s)	13.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

8: Okolani Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	12	36	233	35	28	12	283	97	66	9	23	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	39	253	38	30	13	308	105	72	10	25	14

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	13	39	253	68	13	308	105	72	35	14
Volume Left (vph)	13	0	0	38	0	308	0	0	10	0
Volume Right (vph)	0	0	253	0	13	0	0	72	0	14
Hadj (s)	0.53	0.03	-0.67	0.31	-0.67	0.53	0.03	-0.67	0.17	-0.67
Departure Headway (s)	6.3	5.8	3.2	6.0	5.1	5.5	5.0	3.2	5.5	4.6
Degree Utilization, x	0.02	0.06	0.23	0.11	0.02	0.47	0.15	0.06	0.05	0.02
Capacity (veh/h)	532	580	1122	561	660	647	705	1121	632	741
Control Delay (s)	8.2	8.0	5.9	8.6	6.9	12.0	7.6	5.2	7.6	6.5
Approach Delay (s)	6.3			8.3		10.0			7.3	
Approach LOS	A			A		B			A	

Intersection Summary			
Delay	8.5		
HCM Level of Service	A		
Intersection Capacity Utilization	39.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	29	128	304	22	66	260
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	32	139	330	24	72	283
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	768	342			354	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	768	342			354	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	91	80			94	
cM capacity (veh/h)	348	700			1204	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	171	354	354
Volume Left	32	0	72
Volume Right	139	24	0
cSH	859	1700	1204
Volume to Capacity	0.20	0.21	0.06
Queue Length 95th (ft)	18	0	5
Control Delay (s)	12.3	0.0	2.1
Lane LOS	B		A
Approach Delay (s)	12.3	0.0	2.1
Approach LOS	B		

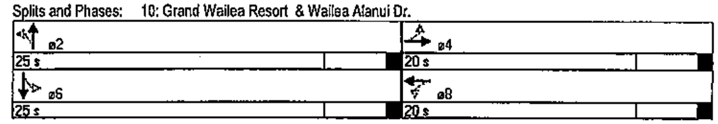
Intersection Summary			
Average Delay	3.2		
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✥		✥	↰	↑↑↱	↰	↑↑↱
Volume (vph)	46	4	2	10	9	627	15	381
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	25.0	25.0	25.0	25.0
Total Split (%)	44.4%	44.4%	44.4%	44.4%	55.6%	55.6%	55.6%	55.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		6.9		6.6	24.7	24.7	24.7	24.7
Actuated g/C Ratio		0.22		0.21	0.80	0.80	0.80	0.80
v/c Ratio		0.14		0.10	0.01	0.24	0.03	0.16
Control Delay		10.9		7.5	4.4	3.6	4.5	3.2
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		10.9		7.5	4.4	3.6	4.5	3.2
LOS		B		A	A	A	A	A
Approach Delay		10.9		7.5		3.6		3.3
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 45
Actuated Cycle Length: 31
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.24
Intersection Signal Delay: 3.9 — Intersection LOS: A
Intersection Capacity Utilization 35.4% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.



HCM Signalized Intersection Capacity Analysis

Austin, Tsutsumi & Associates, Inc.

10: Grand Wailea Resort & Wailea Alanui Dr.

7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑↱		↰	↑↱		↰	↑↱	
Volume (vph)	46	4	4	2	10	21	9	627	2	15	381	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.99			0.91		1.00	1.00		1.00	0.99	
Flt Protected		0.96			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1769			1697		1770	3538		1770	3503	
Flt Permitted		1.00			0.97		0.49	1.00		0.39	1.00	
Satd. Flow (perm)		1845			1659		922	3538		729	3503	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	50	4	4	2	11	23	10	682	2	16	414	30
RTOR Reduction (vph)	0	4	0	0	21	0	0	0	0	0	8	0
Lane Group Flow (vph)	0	54	0	0	15	0	10	684	0	16	436	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		2.9			2.9		21.3	21.3		21.3	21.3	
Effective Green, g (s)		2.9			2.9		21.3	21.3		21.3	21.3	
Actuated g/C Ratio		0.08			0.08		0.62	0.62		0.62	0.62	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		156			141		574	2203		454	2182	
v/s Ratio Prot								c0.19			0.12	
v/s Ratio Perm		c0.03			0.01		0.01			0.02		
v/c Ratio		0.35			0.11		0.02	0.31		0.04	0.20	
Uniform Delay, d1		14.8			14.5		2.5	3.0		2.5	2.8	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.4			0.3		0.0	0.1		0.0	0.0	
Delay (s)		16.1			14.8		2.5	3.1		2.5	2.8	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		16.1			14.8			3.1			2.8	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	3.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.31		
Actuated Cycle Length (s)	34.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	35.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis

Austin, Tsutsumi & Associates, Inc.

11: Kaukahi Dr & Wailea Alanui Dr.

7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑	↱		↰↑	↱	↰	↑	↱
Volume (veh/h)	86	21	8	24	12	7	5	282	38	28	198	59
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	93	23	9	26	13	8	5	307	41	30	215	64
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	600	593	215	614	658	307	279			307		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	600	593	215	614	658	307	279			307		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	76	94	99	93	97	99	100			98		
cM capacity (veh/h)	389	406	825	375	373	733	1283			1254		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	125	39	8	312	41	30	215	64
Volume Left	93	26	0	5	0	30	0	0
Volume Right	9	0	8	0	41	0	0	64
cSH	407	374	733	1283	1700	1254	1700	1700
Volume to Capacity	0.31	0.10	0.01	0.00	0.02	0.02	0.13	0.04
Queue Length 95th (ft)	32	9	1	0	0	2	0	0
Control Delay (s)	17.7	15.7	10.0	0.2	0.0	7.9	0.0	0.0
Lane LOS	C	C	A	A		A		
Approach Delay (s)	17.7	14.8		0.2		0.8		
Approach LOS	C	B						

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	43.0%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

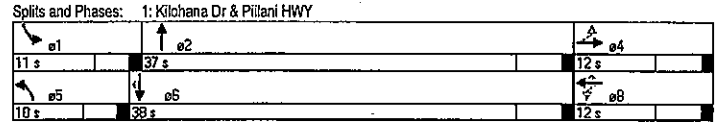
- Base Year 2016 WITHOUT Project

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	155	20	15	25	155	5	685	50	1240	150
Turn Type	Perm		Perm		Perm	Prot		Prot		Perm
Protected Phases		4		8		5	2	1	6	
Permitted Phases	4		8		8					6
Detector Phase	4	4	8	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	10.0	24.0	24.0
Total Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	37.0	11.0	38.0	38.0
Total Split (%)	20.0%	20.0%	20.0%	20.0%	20.0%	16.7%	61.7%	18.3%	63.3%	63.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Max	None	Max	Max
Act Effct Green (s)	7.1	7.1		7.1	7.1	5.7	35.4	6.6	39.9	39.9
Actuated g/C Ratio	0.12	0.12		0.12	0.12	0.10	0.60	0.11	0.68	0.68
v/c Ratio	1.04	0.15		0.22	0.50	0.03	0.67	0.27	1.07	0.15
Control Delay	113.7	20.4		27.0	10.7	25.0	13.5	27.8	60.4	1.5
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	113.7	20.4		27.0	10.7	25.0	13.5	27.8	60.4	1.5
LOS	F	C		C	B	C	B	C	E	A
Approach Delay		98.4		14.0			13.6		53.2	
Approach LOS		F		B			B		D	

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 59
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.07
Intersection Signal Delay: 42.5 Intersection LOS: D
Intersection Capacity Utilization 88.9% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 1: Kilohana Dr & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✥	↱	↰	↱		↰	↑	↱
Volume (vph)	155	20	10	15	25	155	5	685	5	50	1240	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0	5.0	4.0	5.0		4.0	5.0	5.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.95			1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.98	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1770			1829	1583	1770	1861		1770	1863	1583
Flt Permitted	0.73	1.00			0.86	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1358	1770			1609	1583	1770	1861		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	168	22	11	16	27	168	5	745	5	54	1348	163
RTOR Reduction (vph)	0	10	0	0	0	149	0	0	0	0	0	58
Lane Group Flow (vph)	168	23	0	0	43	19	5	750	0	54	1348	105
Turn Type	Perm			Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	7.1	7.1			7.1	7.1	1.2	37.0		4.1	39.9	39.9
Effective Green, g (s)	7.1	7.1			7.1	7.1	1.2	37.0		4.1	39.9	39.9
Actuated g/C Ratio	0.11	0.11			0.11	0.11	0.02	0.59		0.07	0.64	0.64
Clearance Time (s)	5.0	5.0			5.0	5.0	4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	155	202			184	181	34	1107		117	1195	1015
v/s Ratio Prot		0.01					0.00	0.40		c0.03	c0.72	
v/s Ratio Perm	c0.12				0.03	0.01						0.07
v/c Ratio	1.08	0.12			0.23	0.11	0.15	0.68		0.46	1.13	0.10
Uniform Delay, d1	27.6	24.7			25.1	24.7	30.0	8.5		28.0	11.2	4.3
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	96.5	0.3			0.7	0.3	2.0	3.3		2.9	68.7	0.2
Delay (s)	124.0	25.0			25.7	25.0	32.0	11.9		30.9	79.9	4.5
Level of Service	F	C			C	C	C	B		C	E	A
Approach Delay (s)		107.8			25.1			12.0			70.3	
Approach LOS		F			C			B			E	

Intersection Summary			
HCM Average Control Delay	53.5	HCM Level of Service	D
HCM Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	62.2	Sum of lost time (s)	14.0
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		✥	↰	↑	↱	↰	↑	↱
Volume (vph)	185	15	35	20	10	440	15	35	1055	135
Turn Type	Perm		Perm		Perm		Perm	Perm		Perm
Protected Phases		4		8		2			6	
Permitted Phases	4		8		2		2	6		6
Detector Phase	4	4	8	8	2	2	2	6	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	24.0	24.0	24.0	24.0	41.0	41.0	41.0	41.0	41.0	41.0
Total Split (%)	36.9%	36.9%	36.9%	36.9%	63.1%	63.1%	63.1%	63.1%	63.1%	63.1%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	Min	Min	Min	Min	Min	Min
Act Effct Green (s)	14.2	14.2		14.2	38.9	38.9	38.9	38.9	38.9	38.9
Actuated g/C Ratio	0.23	0.23		0.23	0.62	0.62	0.62	0.62	0.62	0.62
v/c Ratio	0.68	0.11		0.33	0.09	0.42	0.02	0.07	1.00	0.14
Control Delay	33.6	10.6		11.5	8.9	8.5	3.4	6.7	43.3	1.8
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.6	10.6		11.5	8.9	8.5	3.4	6.7	43.3	1.8
LOS	C	B		B	A	A	A	A	D	A
Approach Delay		29.6		11.5		8.3			37.7	
Approach LOS		C		B		A			D	

Intersection Summary

Cycle Length: 65
Actuated Cycle Length: 63.1
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 28.5 Intersection LOS: C
Intersection Capacity Utilization 80.8% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY

ø2 41 s | ø4 24 s
ø6 41 s | ø8 24 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱			✥		↰	↑	↱	↰	↑	↱
Volume (vph)	185	15	25	35	20	70	10	440	15	35	1055	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00			1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.91			0.92		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00			0.99		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1687			1698		1770	1863	1583	1770	1863	1583
Flt Permitted	0.71	1.00			0.91		0.10	1.00	1.00	0.44	1.00	1.00
Satd. Flow (perm)	1314	1687			1564		192	1863	1583	825	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	201	16	27	38	22	76	11	478	16	38	1147	147
RTOR Reduction (vph)	0	21	0	0	59	0	0	0	6	0	0	56
Lane Group Flow (vph)	201	22	0	0	77	0	11	478	10	38	1147	91
Turn Type	Perm			Perm			Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	14.2	14.2			14.2		38.9	38.9	38.9	38.9	38.9	38.9
Effective Green, g (s)	14.2	14.2			14.2		38.9	38.9	38.9	38.9	38.9	38.9
Actuated g/C Ratio	0.23	0.23			0.23		0.62	0.62	0.62	0.62	0.62	0.62
Clearance Time (s)	5.0	5.0			5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	296	380			352		118	1149	976	509	1149	976
v/s Ratio Prot		0.01						0.26			c0.62	
v/s Ratio Perm	c0.15				0.05		0.06		0.01	0.05		0.06
v/c Ratio	0.68	0.06			0.22		0.09	0.42	0.01	0.07	1.00	0.09
Uniform Delay, d1	22.4	19.2			19.9		4.9	6.2	4.7	4.9	12.1	4.9
Progression Factor	1.00	1.00			1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.1	0.1			0.3		0.3	0.2	0.0	0.1	25.9	0.0
Delay (s)	28.4	19.3			20.2		5.3	6.5	4.7	4.9	38.0	5.0
Level of Service	C	B			C		A	A	A	A	D	A
Approach Delay (s)		26.8			20.2			6.4			33.4	
Approach LOS		C			C			A			C	

Intersection Summary			
HCM Average Control Delay	25.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	63.1	Sum of lost time (s)	10.0
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	415	25	120	1070	35	70
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	451	27	130	1163	38	76
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			478		1307	239
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			478		1307	239
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			88		71	90
cM capacity (veh/h)			1080		133	762

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	301	178	130	582	582	38	76
Volume Left	0	0	130	0	0	38	0
Volume Right	0	27	0	0	0	0	76
cSH	1700	1700	1080	1700	1700	133	762
Volume to Capacity	0.18	0.10	0.12	0.34	0.34	0.29	0.10
Queue Length 95th (ft)	0	0	10	0	0	28	8
Control Delay (s)	0.0	0.0	8.8	0.0	0.0	42.6	10.2
Lane LOS			A			E	B
Approach Delay (s)	0.0		0.9			21.0	
Approach LOS						C	

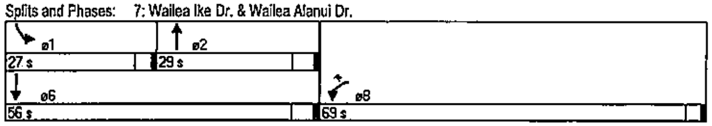
Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	39.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	840	185	170	285	140	420
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Detector Phase	8	8	2		1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	69.0	69.0	29.0	0.0	27.0	56.0
Total Split (%)	55.2%	55.2%	23.2%	0.0%	21.6%	44.8%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	None		None	None
Act Effct Green (s)	62.0	62.0	16.0	105.9	14.6	34.7
Actuated g/C Ratio	0.59	0.59	0.15	1.00	0.14	0.33
v/c Ratio	0.88	0.20	0.66	0.20	0.62	0.39
Control Delay	32.2	4.6	55.4	0.3	56.3	28.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.2	4.6	55.4	0.3	56.3	28.4
LOS	C	A	E	A	E	C
Approach Delay	27.2		20.9			35.3
Approach LOS	C		C			D

Intersection Summary

Cycle Length: 125
Actuated Cycle Length: 105.9
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 28.0 — Intersection LOS: C
Intersection Capacity Utilization 74.1% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	840	185	170	285	140	420
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	913	201	185	310	152	457
RTOR Reduction (vph)	0	60	0	0	0	0
Lane Group Flow (vph)	913	141	185	310	152	457
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Actuated Green, G (s)	62.0	62.0	16.1	105.7	14.6	34.7
Effective Green, g (s)	62.0	62.0	16.1	105.7	14.6	34.7
Actuated g/C Ratio	0.59	0.59	0.15	1.00	0.14	0.33
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	1038	929	284	1583	244	1162
v/s Ratio Prot	c0.52		c0.10		c0.09	0.13
v/s Ratio Perm		0.09		0.20		
v/c Ratio	0.88	0.15	0.65	0.20	0.62	0.39
Uniform Delay, d1	18.7	9.9	42.2	0.0	43.0	27.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.7	0.1	5.3	0.3	4.9	0.2
Delay (s)	27.3	10.0	47.4	0.3	47.8	27.6
Level of Service	C	A	D	A	D	C
Approach Delay (s)	24.2		17.9			32.7
Approach LOS	C		B			C

Intersection Summary

HCM Average Control Delay	25.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	105.7	Sum of lost time (s)	13.0
Intersection Capacity Utilization	74.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	10	50	440	100	65	5	200	30	55	10	70	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	54	478	109	71	5	217	33	60	11	76	11

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	11	54	478	179	5	217	33	60	87	11
Volume Left (vph)	11	0	0	109	0	217	0	0	11	0
Volume Right (vph)	0	0	478	0	5	0	0	60	0	11
Hadj (s)	0.53	0.03	-0.67	0.34	-0.67	0.53	0.03	-0.67	0.10	-0.67
Departure Headway (s)	6.2	5.7	3.2	5.9	4.9	5.9	5.4	3.2	5.6	4.8
Degree Utilization, x	0.02	0.09	0.43	0.29	0.01	0.35	0.05	0.05	0.14	0.01
Capacity (veh/h)	540	589	1115	586	694	594	641	1121	610	698
Control Delay (s)	8.1	8.1	7.3	10.1	6.7	10.8	7.4	5.2	8.3	6.7
Approach Delay (s)	7.4			10.0		9.4			8.1	
Approach LOS	A			A		A			A	

Intersection Summary			
Delay	8.4		
HCM Level of Service	A		
Intersection Capacity Utilization	50.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	10	95	250	10	95	475
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	103	272	11	103	516
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1000	277			283	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1000	277			283	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	86			92	
cM capacity (veh/h)	248	762			1280	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	114	283	620
Volume Left	11	0	103
Volume Right	103	11	0
cSH	842	1700	1280
Volume to Capacity	0.14	0.17	0.08
Queue Length 95th (ft)	12	0	7
Control Delay (s)	11.4	0.0	2.1
Lane LOS	B		A
Approach Delay (s)	11.4	0.0	2.1
Approach LOS	B		

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↰↑↱		↰↑↱	↰	↑↑↱	↰	↑↑↱
Volume (vph)	35	5	10	5	20	330	180	815
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	25.0	25.0	25.0	25.0
Total Split (%)	44.4%	44.4%	44.4%	44.4%	55.6%	55.6%	55.6%	55.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		6.7		6.5	27.4	27.4	27.4	27.4
Actuated g/C Ratio		0.20		0.19	0.81	0.81	0.81	0.81
v/c Ratio		0.16		0.20	0.05	0.14	0.25	0.35
Control Delay		10.9		7.7	4.4	2.9	4.9	3.6
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		10.9		7.7	4.4	2.9	4.9	3.6
LOS		B		A	A	A	A	A
Approach Delay		10.9		7.7		3.0		3.8
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 45
Actuated Cycle Length: 33.7
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.35
Intersection Signal Delay: 4.0 — Intersection LOS: A
Intersection Capacity Utilization 51.1% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.

ø2 — 25 s	ø4 — 20 s
ø6 — 25 s	ø8 — 20 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑↱		↰	↑↑↱		↰	↑↑↱	
Volume (vph)	35	5	15	10	5	50	20	330	25	180	815	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.96			0.90		1.00	0.99		1.00	0.98	
Flt Protected		0.97			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1739			1656		1770	3502		1770	3481	
Flt Permitted		1.00			0.93		0.29	1.00		0.52	1.00	
Satd. Flow (perm)		1795			1555		531	3502		975	3481	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	5	16	11	5	54	22	359	27	196	886	109
RTOR Reduction (vph)	0	15	0	0	50	0	0	8	0	0	13	0
Lane Group Flow (vph)	0	44	0	0	20	0	22	378	0	196	982	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		2.8			2.8		24.1	24.1		24.1	24.1	
Effective Green, g (s)		2.8			2.8		24.1	24.1		24.1	24.1	
Actuated g/C Ratio		0.08			0.08		0.65	0.65		0.65	0.65	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		136			118		347	2287		637	2273	
v/s Ratio Prot								0.11			c0.28	
v/s Ratio Perm		c0.02			0.01		0.04			0.20		
v/c Ratio		0.33			0.17		0.06	0.17		0.31	0.43	
Uniform Delay, d1		16.2			16.0		2.3	2.5		2.8	3.1	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.4			0.7		0.1	0.0		0.3	0.1	
Delay (s)		17.6			16.7		2.4	2.5		3.1	3.2	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		17.6			16.7			2.5			3.2	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	4.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	36.9	Sum of lost time (s)	10.0
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	30	20	5	45	30	35	5	210	5	20	415	140
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	22	5	49	33	38	5	228	5	22	451	152
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	750	734	451	750	886	228	603			228		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	750	734	451	750	886	228	603			228		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	88	94	99	84	88	95	99			98		
cM capacity (veh/h)	279	340	608	304	277	811	974			1340		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	60	82	38	234	5	22	451	152
Volume Left	33	49	0	5	0	22	0	0
Volume Right	5	0	38	0	5	0	0	152
cSH	315	293	811	974	1700	1340	1700	1700
Volume to Capacity	0.19	0.28	0.05	0.01	0.00	0.02	0.27	0.09
Queue Length 95th (ft)	17	28	4	0	0	1	0	0
Control Delay (s)	19.1	22.0	9.7	0.3	0.0	7.7	0.0	0.0
Lane LOS	C	C	A	A		A		
Approach Delay (s)	19.1	18.1		0.3		0.3		
Approach LOS	C	C						

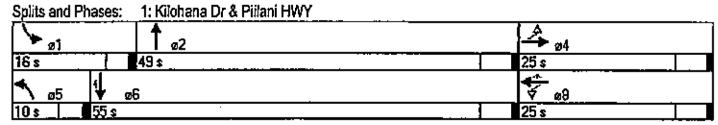
Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	38.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	175	35	10	30	135	20	1355	160	1115	230
Turn Type	Perm		Perm		Perm	Prot		Prot		Perm
Protected Phases		4		8		5	2	1	6	
Permitted Phases	4		8		8					6
Detector Phase	4	4	8	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	10.0	24.0	24.0
Total Split (s)	25.0	25.0	25.0	25.0	25.0	10.0	49.0	16.0	55.0	55.0
Total Split (%)	27.8%	27.8%	27.8%	27.8%	27.8%	11.1%	54.4%	17.8%	61.1%	61.1%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Min	Max	Min	Max	Max
Act Effct Green (s)	16.1	16.1		16.1	16.1	5.8	44.7	11.4	50.2	50.2
Actuated g/C Ratio	0.19	0.19		0.19	0.19	0.07	0.52	0.13	0.58	0.58
v/c Ratio	0.75	0.14		0.13	0.35	0.18	1.54	0.75	1.12	0.25
Control Delay	51.7	24.5		29.6	7.8	43.1	272.7	57.5	86.7	3.1
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.7	24.5		29.6	7.8	43.1	272.7	57.5	86.7	3.1
LOS	D	C		C	A	D	F	E	F	A
Approach Delay		46.1		12.8			269.3		70.8	
Approach LOS		D		B			F		E	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 86.2
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.54
Intersection Signal Delay: 149.9 Intersection LOS: F
Intersection Capacity Utilization 109.1% ICU Level of Service H
Analysis Period (min) 15

Splits and Phases: 1: Kilohana Dr & Piilani HWY



HCM Signalized Intersection Capacity Analysis
1: Kilohana Dr & Piilani HWY

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	35	10	10	30	135	20	1355	15	160	1115	230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0	5.0	4.0	5.0		4.0	5.0	5.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.97			1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1800			1840	1583	1770	1860		1770	1863	1583
Flt Permitted	0.73	1.00			0.94	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1357	1800			1746	1583	1770	1860		1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	38	11	11	33	147	22	1473	16	174	1212	250
RTOR Reduction (vph)	0	9	0	0	0	120	0	0	0	0	0	85
Lane Group Flow (vph)	190	40	0	0	44	27	22	1489	0	174	1212	165
Turn Type	Perm			Perm		Perm	Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	16.1	16.1			16.1	16.1	5.8	44.7		11.4	50.3	50.3
Effective Green, g (s)	16.1	16.1			16.1	16.1	5.8	44.7		11.4	50.3	50.3
Actuated g/C Ratio	0.19	0.19			0.19	0.19	0.07	0.52		0.13	0.58	0.58
Clearance Time (s)	5.0	5.0			5.0	5.0	4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	253	336			326	296	119	965		234	1087	924
v/s Ratio Prot		0.02					0.01	c0.80		c0.10	c0.65	
v/s Ratio Perm	c0.14				0.03	0.02						0.10
v/c Ratio	0.75	0.12			0.13	0.09	0.18	1.54		0.74	1.11	0.18
Uniform Delay, d1	33.2	29.2			29.2	29.0	38.0	20.8		36.0	18.0	8.3
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	11.8	0.2			0.2	0.1	0.8	249.3		12.0	64.6	0.4
Delay (s)	45.0	29.3			29.4	29.1	38.7	270.1		48.0	82.6	8.8
Level of Service	D	C			C	C	D	F		D	F	A
Approach Delay (s)		41.8			29.2			266.7			67.6	
Approach LOS		D			C			F			E	

Intersection Summary

HCM Average Control Delay	147.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.34		
Actuated Cycle Length (s)	86.2	Sum of lost time (s)	19.0
Intersection Capacity Utilization	109.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

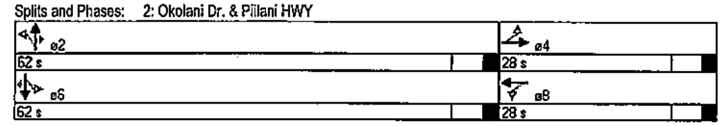
Timings
2: Okolani Dr. & Piilani HWY

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	250	35	15	20	40	1035	40	80	765	270
Turn Type	Perm		Perm		Perm		Perm	Perm		Perm
Protected Phases		4		8		2			6	
Permitted Phases	4		8		2		2	6		6
Detector Phase	4	4	8	8	2	2	2	6	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	28.0	28.0	28.0	28.0	62.0	62.0	62.0	62.0	62.0	62.0
Total Split (%)	31.1%	31.1%	31.1%	31.1%	68.9%	68.9%	68.9%	68.9%	68.9%	68.9%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	Max	Max	Max	Max	Max	Max
Act Effct Green (s)	19.8	19.8		19.8	56.6	56.6	56.6	56.6	56.6	56.6
Actuated g/C Ratio	0.22	0.22		0.22	0.64	0.64	0.64	0.64	0.64	0.64
v/c Ratio	0.85	0.17		0.22	0.16	0.94	0.04	1.04	0.70	0.26
Control Delay	57.1	17.7		15.5	9.0	32.6	2.3	133.7	14.9	1.5
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.1	17.7		15.5	9.0	32.6	2.3	133.7	14.9	1.5
LOS	E	B		B	A	C	A	F	B	A
Approach Delay		48.9		15.5		30.7			20.2	
Approach LOS		D		B		C			C	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 88.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.04
Intersection Signal Delay: 28.0 — Intersection LOS: C
Intersection Capacity Utilization 94.4% — ICU Level of Service F
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY



HCM Signalized Intersection Capacity Analysis
2: Okolani Dr. & Piilani HWY

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✥		↰	↑	↱	↰	↑	↱
Volume (vph)	250	35	30	15	20	45	40	1035	40	80	765	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00			1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.93			0.92		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00			0.99		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1733			1705		1770	1863	1583	1770	1863	1583
Flt Permitted	0.77	1.00			0.94		0.22	1.00	1.00	0.07	1.00	1.00
Satd. Flow (perm)	1433	1733			1625		409	1863	1583	132	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	38	33	16	22	49	43	1125	43	87	832	293
RTOR Reduction (vph)	0	26	0	0	38	0	0	0	15	0	0	105
Lane Group Flow (vph)	272	45	0	0	49	0	43	1125	28	87	832	188
Turn Type	Perm			Perm			Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	19.8	19.8			19.8		56.6	56.6	56.6	56.6	56.6	56.6
Effective Green, g (s)	19.8	19.8			19.8		56.6	56.6	56.6	56.6	56.6	56.6
Actuated g/C Ratio	0.22	0.22			0.22		0.64	0.64	0.64	0.64	0.64	0.64
Clearance Time (s)	6.0	6.0			6.0		6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	321	388			364		262	1193	1014	85	1193	1014
v/s Ratio Prot		0.03						0.60			0.45	
v/s Ratio Perm	c0.19				0.03		0.11		0.02	c0.66		0.12
v/c Ratio	0.85	0.12			0.13		0.16	0.94	0.03	1.02	0.70	0.19
Uniform Delay, d1	32.9	27.3			27.4		6.4	14.4	5.8	15.9	10.3	6.5
Progression Factor	1.00	1.00			1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	18.3	0.1			0.2		1.3	15.5	0.0	104.2	3.4	0.4
Delay (s)	51.1	27.5			27.6		7.7	30.0	5.9	120.1	13.7	6.9
Level of Service	D	C			C		A	C	A	F	B	A
Approach Delay (s)		46.2			27.6			28.3			19.7	
Approach LOS		D			C			C			B	

Intersection Summary			
HCM Average Control Delay	26.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	88.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
4: Wailea Ike Dr. & Kalai Waa St

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	1035	75	110	730	65	150
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1125	82	120	793	71	163
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1207		1802	603
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1207		1802	603
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			79		0	63
cM capacity (veh/h)			574		56	442

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	750	457	120	397	397	71	163
Volume Left	0	0	120	0	0	71	0
Volume Right	0	82	0	0	0	0	163
cSH	1700	1700	574	1700	1700	56	442
Volume to Capacity	0.44	0.27	0.21	0.23	0.23	1.26	0.37
Queue Length 95th (ft)	0	0	19	0	0	153	42
Control Delay (s)	0.0	0.0	12.9	0.0	0.0	326.3	17.8
Lane LOS			B			F	C
Approach Delay (s)	0.0		1.7			111.1	
Approach LOS						F	

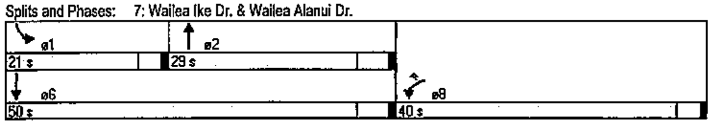
Intersection Summary			
Average Delay	11.7		
Intersection Capacity Utilization	50.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	490	225	400	745	245	370
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Detector Phase	8	8	2		1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	40.0	40.0	29.0	0.0	21.0	50.0
Total Split (%)	44.4%	44.4%	32.2%	0.0%	23.3%	55.6%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	None		None	None
Act Effct Green (s)	28.6	28.6	21.9	79.3	15.4	41.4
Actuated g/C Ratio	0.36	0.36	0.28	1.00	0.19	0.52
v/c Ratio	0.84	0.34	0.85	0.51	0.77	0.22
Control Delay	36.3	3.9	45.9	1.2	49.4	11.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.3	3.9	45.9	1.2	49.4	11.5
LOS	D	A	D	A	D	B
Approach Delay	26.1		16.8			26.6
Approach LOS	C		B			C

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 79.3
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 21.9 — Intersection LOS: C
Intersection Capacity Utilization 72.6% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	490	225	400	745	245	370
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	533	245	435	810	266	402
RTOR Reduction (vph)	0	156	0	0	0	0
Lane Group Flow (vph)	533	89	435	810	266	402
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Actuated Green, G (s)	28.6	28.6	22.0	79.0	15.4	41.4
Effective Green, g (s)	28.6	28.6	22.0	79.0	15.4	41.4
Actuated g/C Ratio	0.36	0.36	0.28	1.00	0.19	0.52
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	641	573	519	1583	345	1855
v/s Ratio Prot	c0.30		c0.23		c0.15	0.11
v/s Ratio Perm		0.06		0.51		
v/c Ratio	0.83	0.15	0.84	0.51	0.77	0.22
Uniform Delay, d1	23.0	17.0	26.8	0.0	30.1	10.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.0	0.1	11.3	1.2	10.2	0.1
Delay (s)	32.0	17.2	38.1	1.2	40.3	10.2
Level of Service	C	B	D	A	D	B
Approach Delay (s)	27.3		14.1			22.2
Approach LOS	C		B			C

Intersection Summary

HCM Average Control Delay	19.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	79.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

8: Okolani Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	15	90	410	95	70	15	435	105	145	15	30	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	98	446	103	76	16	473	114	158	16	33	16

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	16	98	446	179	16	473	114	158	49	16
Volume Left (vph)	16	0	0	103	0	473	0	0	16	0
Volume Right (vph)	0	0	446	0	16	0	0	158	0	16
Hadj (s)	0.53	0.03	-0.67	0.32	-0.67	0.53	0.03	-0.67	0.20	-0.67
Departure Headway (s)	7.2	6.7	3.2	6.8	5.8	6.1	5.6	3.2	6.5	5.6
Degree Utilization, x	0.03	0.18	0.40	0.34	0.03	0.80	0.18	0.14	0.09	0.03
Capacity (veh/h)	464	501	1114	491	572	578	621	1121	521	594
Control Delay (s)	9.2	9.9	7.1	12.1	7.8	28.3	8.6	5.5	8.9	7.6
Approach Delay (s)	7.6			11.7		20.4			8.6	
Approach LOS	A			B		C			A	

Intersection Summary			
Delay	14.3		
HCM Level of Service	B		
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		

9: Kilohana Dr & South Kihei Rd

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	35	150	500	25	100	490
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	163	543	27	109	533
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1307	557			571	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1307	557			571	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	76	69			89	
cM capacity (veh/h)	157	530			1002	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	201	571	641
Volume Left	38	0	109
Volume Right	163	27	0
cSH	653	1700	1002
Volume to Capacity	0.31	0.34	0.11
Queue Length 95th (ft)	33	0	9
Control Delay (s)	18.6	0.0	2.7
Lane LOS	C		A
Approach Delay (s)	18.6	0.0	2.7
Approach LOS	C		

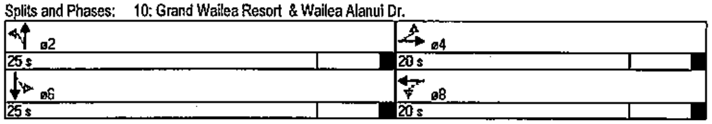
Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✥		✥	↰	↑↱	↰	↑↱
Volume (vph)	105	5	10	15	30	860	60	555
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	25.0	25.0	25.0	25.0
Total Split (%)	44.4%	44.4%	44.4%	44.4%	55.6%	55.6%	55.6%	55.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		9.0		9.0	22.4	22.4	22.4	22.4
Actuated g/C Ratio		0.24		0.24	0.60	0.60	0.60	0.60
v/c Ratio		0.44		0.18	0.07	0.45	0.21	0.32
Control Delay		14.8		7.2	6.8	7.4	8.9	6.2
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		14.8		7.2	6.8	7.4	8.9	6.2
LOS		B		A	A	A	A	A
Approach Delay		14.8		7.2		7.4		6.5
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 45
Actuated Cycle Length: 37.5
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.45
Intersection Signal Delay: 7.6 Intersection LOS: A
Intersection Capacity Utilization 54.2% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥		↰	↑↱		↰	↑↱	
Volume (vph)	105	5	25	10	15	45	30	860	10	60	555	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.98			0.91		1.00	1.00		1.00	0.98	
Flt Protected		0.96			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1748			1688		1770	3533		1770	3483	
Flt Permitted		0.72			0.93		0.40	1.00		0.28	1.00	
Satd. Flow (perm)		1313			1582		737	3533		518	3483	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	5	27	11	16	49	33	935	11	65	603	71
RTOR Reduction (vph)	0	22	0	0	39	0	0	1	0	0	16	0
Lane Group Flow (vph)	0	124	0	0	37	0	33	945	0	65	658	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.5			7.5		21.1	21.1		21.1	21.1	
Effective Green, g (s)		7.5			7.5		21.1	21.1		21.1	21.1	
Actuated g/C Ratio		0.19			0.19		0.55	0.55		0.55	0.55	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		255			307		403	1931		283	1904	
v/s Ratio Prot								c0.27			0.19	
v/s Ratio Perm		c0.09			0.02		0.04			0.13		
v/c Ratio		0.49			0.12		0.08	0.49		0.23	0.35	
Uniform Delay, d1		13.8			12.8		4.2	5.4		4.5	4.9	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.5			0.2		0.1	0.2		0.4	0.1	
Delay (s)		15.3			13.0		4.2	5.6		5.0	5.0	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		15.3			13.0			5.6			5.0	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	6.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	38.6	Sum of lost time (s)	10.0
Intersection Capacity Utilization	54.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis — Austin, Tsutsumi & Associates, Inc.
11: Kaukahi Dr & Wailea Alanui Dr. — 7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	90	25	10	30	15	5	10	530	45	35	420	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	27	11	33	16	5	11	576	49	38	457	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1139	1130	457	1155	1201	576	527			576		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1139	1130	457	1155	1201	576	527			576		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	38	86	98	78	91	99	99			96		
cM capacity (veh/h)	158	194	604	147	176	517	1040			997		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	136	49	5	587	49	38	457	71
Volume Left	98	33	0	11	0	38	0	0
Volume Right	11	0	5	0	49	0	0	71
cSH	175	155	517	1040	1700	997	1700	1700
Volume to Capacity	0.78	0.31	0.01	0.01	0.03	0.04	0.27	0.04
Queue Length 95th (ft)	128	31	1	1	0	3	0	0
Control Delay (s)	74.0	38.4	12.0	0.3	0.0	8.8	0.0	0.0
Lane LOS	F	E	B	A		A		
Approach Delay (s)	74.0	35.8		0.3		0.6		
Approach LOS	F	E						

Intersection Summary			
Average Delay	9.0		
Intersection Capacity Utilization	56.1%	ICU Level of Service	B
Analysis Period (min)	15		

Timings — Austin, Tsutsumi & Associates, Inc.
1: Kilohana Dr & Piilani HWY — 1/13/2010

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	155	20	15	25	155	5	685	5	50	1240	150
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	17.0	17.0	17.0	17.0	17.0	10.0	31.0	31.0	12.0	33.0	33.0
Total Split (%)	28.3%	28.3%	28.3%	28.3%	28.3%	16.7%	51.7%	51.7%	20.0%	55.0%	55.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	Max	Max	None	Max	Max

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 54.9
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY

ø1	ø2	ø4
12 s	31 s	17 s
ø5	ø6	ø8
10 s	33 s	17 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	155	20	10	15	25	155	5	685	5	50	1240	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1770		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.74	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1378	1770		1370	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	168	22	11	16	27	168	5	745	5	54	1348	163
RTOR Reduction (vph)	0	9	0	0	0	143	0	0	2	0	0	66
Lane Group Flow (vph)	168	24	0	16	27	25	5	745	3	54	1348	97
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	8.8	8.8		8.8	8.8	8.8	1.1	32.1	32.1	4.3	35.3	35.3
Effective Green, g (s)	8.8	8.8		8.8	8.8	8.8	1.1	32.1	32.1	4.3	35.3	35.3
Actuated g/C Ratio	0.15	0.15		0.15	0.15	0.15	0.02	0.54	0.54	0.07	0.60	0.60
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	205	263		204	277	235	33	1919	858	129	2110	944
v/s Ratio Prot		0.01			0.01		0.00	0.21		c0.03	c0.38	
v/s Ratio Perm	c0.12			0.01		0.02			0.00			0.06
v/c Ratio	0.82	0.09		0.08	0.10	0.11	0.15	0.39	0.00	0.42	0.64	0.10
Uniform Delay, d1	24.4	21.7		21.7	21.8	21.8	28.6	7.9	6.2	26.3	7.8	5.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	21.9	0.1		0.2	0.2	0.2	2.1	0.6	0.0	2.2	1.5	0.2
Delay (s)	46.3	21.9		21.9	21.9	22.0	30.7	8.5	6.2	28.4	9.3	5.4
Level of Service	D	C		C	C	C	C	A	A	C	A	A
Approach Delay (s)		42.3			22.0			8.6			9.5	
Approach LOS		D			C			A			A	

Intersection Summary			
HCM Average Control Delay	12.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	59.2	Sum of lost time (s)	14.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↑↱		↰↑↱	↰	↑↑↱	↰	↑↑↱
Volume (vph)	185	15	35	20	10	440	35	1055
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	12.0	26.0
Total Split (%)	40.0%	40.0%	40.0%	40.0%	16.7%	40.0%	20.0%	43.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	12.5	12.5		12.5	5.9	23.7	6.6	26.0
Actuated g/C Ratio	0.25	0.25		0.25	0.12	0.47	0.13	0.51
v/c Ratio	0.58	0.10		0.31	0.05	0.30	0.16	0.72
Control Delay	23.6	9.2		9.6	23.4	11.4	22.9	15.6
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	23.6	9.2		9.6	23.4	11.4	22.9	15.6
LOS	C	A		A	C	B	C	B
Approach Delay		21.1		9.6		11.7		15.8
Approach LOS		C		A		B		B

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 50.5
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.72
Intersection Signal Delay: 15.1 — Intersection LOS: B
Intersection Capacity Utilization 58.7% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY

ø1 12 s	ø2 24 s	ø4 24 s
ø5 10 s	ø6 26 s	ø8 24 s

2: Okolani Dr. & Piilani HWY

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✣		↰	↑↱		↰	↑↱	
Volume (vph)	185	15	25	35	20	70	10	440	15	35	1055	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.91			0.92		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1687			1698		1770	3522		1770	3479	
Flt Permitted	0.75	1.00			0.91		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1395	1687			1562		1770	3522		1770	3479	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	201	16	27	38	22	76	11	478	16	38	1147	147
RTOR Reduction (vph)	0	21	0	0	58	0	0	3	0	0	13	0
Lane Group Flow (vph)	201	22	0	0	78	0	11	491	0	38	1281	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	12.5	12.5			12.5		1.0	24.3		2.7	26.0	
Effective Green, g (s)	12.5	12.5			12.5		1.0	24.3		2.7	26.0	
Actuated g/C Ratio	0.23	0.23			0.23		0.02	0.45		0.05	0.49	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	326	394			365		33	1600		89	1691	
v/s Ratio Prot		0.01					0.01	0.14		c0.02	c0.37	
v/s Ratio Perm	c0.14				0.05							
v/c Ratio	0.62	0.06			0.21		0.33	0.31		0.43	0.76	
Uniform Delay, d1	18.4	15.9			16.5		25.9	9.3		24.6	11.2	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.4	0.1			0.3		5.9	0.5		3.3	3.2	
Delay (s)	21.8	16.0			16.8		31.8	9.8		27.9	14.4	
Level of Service	C	B			B		C	A		C	B	
Approach Delay (s)		20.8			16.8			10.2			14.8	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM Average Control Delay	14.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	53.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	58.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

11: Kaukahi Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			↰↑	↱		↰↑	↱	↰	↑	↱
Volume (veh/h)	30	20	5	45	30	35	5	210	5	20	415	140
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	22	5	49	33	38	5	228	5	22	451	152
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	750	734	451	750	886	228	603			228		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	750	734	451	750	886	228	603			228		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	88	94	99	84	88	95	99			98		
cM capacity (veh/h)	279	340	608	304	277	811	974			1340		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	33	27	82	38	234	5	22	451	152
Volume Left	33	0	49	0	5	0	22	0	0
Volume Right	0	5	0	38	0	5	0	0	152
cSH	279	373	293	811	974	1700	1340	1700	1700
Volume to Capacity	0.12	0.07	0.28	0.05	0.01	0.00	0.02	0.27	0.09
Queue Length 95th (ft)	10	6	28	4	0	0	1	0	0
Control Delay (s)	19.6	15.4	22.0	9.7	0.3	0.0	7.7	0.0	0.0
Lane LOS	C	C	C	A	A		A		
Approach Delay (s)	17.7		18.1		0.3		0.3		
Approach LOS	C		C						

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	39.2%	ICU Level of Service	A
Analysis Period (min)	15		

Timings
1: Kilohana Dr & Piilani HWY

Austin, Tsutsumi & Associates, Inc.
1/13/2010

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	175	35	10	30	135	20	1355	15	160	1115	230
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	35.0	35.0	35.0	35.0	35.0	10.0	62.0	62.0	23.0	75.0	75.0
Total Split (%)	29.2%	29.2%	29.2%	29.2%	29.2%	8.3%	51.7%	51.7%	19.2%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	Min	Max	Max	Min	None	None

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 106.6
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY

ø1 23 s	ø2 62 s	ø4 35 s
ø5 10 s / ø6 75 s		ø8 35 s

HCM Signalized Intersection Capacity Analysis
1: Kilohana Dr & Piilani HWY

Austin, Tsutsumi & Associates, Inc.
1/13/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	175	35	10	10	30	135	20	1355	15	160	1115	230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1800		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.73	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1370	1800		1351	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	38	11	11	33	147	22	1473	16	174	1212	250
RTOR Reduction (vph)	0	9	0	0	0	119	0	0	6	0	0	94
Lane Group Flow (vph)	190	40	0	11	33	28	22	1473	10	174	1212	156
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	20.0	20.0		20.0	20.0	20.0	5.9	57.5	57.5	15.0	66.6	66.6
Effective Green, g (s)	20.0	20.0		20.0	20.0	20.0	5.9	57.5	57.5	15.0	66.6	66.6
Actuated g/C Ratio	0.19	0.19		0.19	0.19	0.19	0.06	0.54	0.54	0.14	0.63	0.63
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	257	338		254	350	297	98	1911	855	249	2213	990
v/s Ratio Prot		0.02			0.02		0.01	c0.42		c0.10	0.34	
v/s Ratio Perm	c0.14			0.01		0.02			0.01			0.10
v/c Ratio	0.74	0.12		0.04	0.09	0.09	0.22	0.77	0.01	0.70	0.55	0.16
Uniform Delay, d1	40.8	35.9		35.4	35.8	35.8	48.1	19.3	11.3	43.6	11.4	8.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.6	0.2		0.1	0.1	0.1	1.2	3.1	0.0	8.3	0.3	0.1
Delay (s)	51.4	36.1		35.5	35.9	35.9	49.3	22.4	11.4	51.9	11.6	8.4
Level of Service	D	D		D	D	D	D	C	B	D	B	A
Approach Delay (s)		48.3			35.9			22.7			15.4	
Approach LOS		D			D			C			B	

Intersection Summary

HCM Average Control Delay	21.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	106.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	74.3%	ICU Level of Service	D
Analysis Period (min)	15		

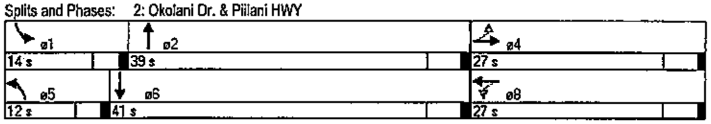
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↑↱		↰↑↱	↰	↑↑↱	↰	↑↑↱
Volume (vph)	250	35	15	20	40	1035	80	765
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	27.0	27.0	27.0	27.0	12.0	39.0	14.0	41.0
Total Split (%)	33.8%	33.8%	33.8%	33.8%	15.0%	48.8%	17.5%	51.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	18.1	18.1		18.1	7.0	36.0	8.4	39.5
Actuated g/C Ratio	0.24	0.24		0.24	0.09	0.48	0.11	0.53
v/c Ratio	0.78	0.16		0.20	0.26	0.68	0.43	0.61
Control Delay	43.0	14.7		13.1	37.2	19.3	39.3	14.9
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	43.0	14.7		13.1	37.2	19.3	39.3	14.9
LOS	D	B		B	D	B	D	B
Approach Delay		37.2		13.1		19.9		16.7
Approach LOS		D		B		B		B

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 74.3
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 20.4 Intersection LOS: C
Intersection Capacity Utilization 66.5% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱			↰↑↱		↰	↑↑↱		↰	↑↑↱	
Volume (vph)	250	35	30	15	20	45	40	1035	40	80	765	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.93			0.92		1.00	0.99		1.00	0.96	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1733			1705		1770	3520		1770	3401	
Flt Permitted	0.77	1.00			0.95		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1436	1733			1633		1770	3520		1770	3401	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	38	33	16	22	49	43	1125	43	87	832	293
RTOR Reduction (vph)	0	25	0	0	37	0	0	3	0	0	38	0
Lane Group Flow (vph)	272	46	0	0	50	0	43	1165	0	87	1087	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	18.1	18.1			18.1		4.4	36.9		7.0	39.5	
Effective Green, g (s)	18.1	18.1			18.1		4.4	36.9		7.0	39.5	
Actuated g/C Ratio	0.24	0.24			0.24		0.06	0.49		0.09	0.52	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	342	413			389		102	1709		163	1768	
v/s Ratio Prot		0.03					0.02	c0.33		c0.05	c0.32	
v/s Ratio Perm	c0.19				0.03							
v/c Ratio	0.80	0.11			0.13		0.42	0.68		0.53	0.61	
Uniform Delay, d1	27.2	22.7			22.7		34.6	15.0		32.9	12.9	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	12.0	0.1			0.1		2.8	2.2		3.3	1.6	
Delay (s)	39.3	22.8			22.9		37.4	17.3		36.3	14.5	
Level of Service	D	C			C		D	B		D	B	
Approach Delay (s)		35.8			22.9			18.0			16.1	
Approach LOS		D			C			B			B	

Intersection Summary

HCM Average Control Delay	19.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	76.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	66.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	90	25	10	30	15	5	10	530	45	35	420	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	27	11	33	16	5	11	576	49	38	457	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1139	1130	457	1155	1201	576	527			576		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1139	1130	457	1155	1201	576	527			576		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	38	86	98	78	91	99	99			96		
cM capacity (veh/h)	158	194	604	147	176	517	1040			997		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	98	38	49	5	587	49	38	457	71
Volume Left	98	0	33	0	11	0	38	0	0
Volume Right	0	11	0	5	0	49	0	0	71
cSH	158	240	155	517	1040	1700	997	1700	1700
Volume to Capacity	0.62	0.16	0.31	0.01	0.01	0.03	0.04	0.27	0.04
Queue Length 95th (ft)	84	14	31	1	1	0	3	0	0
Control Delay (s)	59.0	22.8	38.4	12.0	0.3	0.0	8.8	0.0	0.0
Lane LOS	F	C	E	B	A		A		
Approach Delay (s)	48.9		35.8		0.3		0.6		
Approach LOS	E		E						

Intersection Summary			
Average Delay	6.5		
Intersection Capacity Utilization	54.2%	ICU Level of Service	A
Analysis Period (min)	15		

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2018 WITHOUT Project

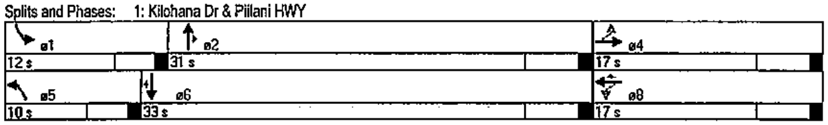
Timings
1: Kilohana Dr & Piilani HWY

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	155	20	15	30	155	5	750	5	50	1390	150
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	17.0	17.0	17.0	17.0	17.0	10.0	31.0	31.0	12.0	33.0	33.0
Total Split (%)	28.3%	28.3%	28.3%	28.3%	28.3%	16.7%	51.7%	51.7%	20.0%	55.0%	55.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	Max	Max	None	Max	Max

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 54.9
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY



HCM Signalized Intersection Capacity Analysis
1: Kilohana Dr & Piilani HWY

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	155	20	10	15	30	155	5	750	5	50	1390	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1770		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.74	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1370	1770		1370	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	168	22	11	16	33	168	5	815	5	54	1511	163
RTOR Reduction (vph)	0	9	0	0	0	143	0	0	2	0	0	66
Lane Group Flow (vph)	168	24	0	16	33	25	5	815	3	54	1511	97
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	8.8	8.8		8.8	8.8	8.8	1.1	32.1	32.1	4.3	35.3	35.3
Effective Green, g (s)	8.8	8.8		8.8	8.8	8.8	1.1	32.1	32.1	4.3	35.3	35.3
Actuated g/C Ratio	0.15	0.15		0.15	0.15	0.15	0.02	0.54	0.54	0.07	0.60	0.60
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	204	263		204	277	235	33	1919	858	129	2110	944
v/s Ratio Prot		0.01			0.02		0.00	0.23		c0.03	c0.43	
v/s Ratio Perm	c0.12			0.01		0.02			0.00			0.06
v/c Ratio	0.82	0.09		0.08	0.12	0.11	0.15	0.42	0.00	0.42	0.72	0.10
Uniform Delay, d1	24.4	21.7		21.7	21.8	21.8	28.6	8.1	6.2	26.3	8.4	5.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	22.8	0.1		0.2	0.2	0.2	2.1	0.7	0.0	2.2	2.1	0.2
Delay (s)	47.2	21.9		21.9	22.0	22.0	30.7	8.7	6.2	28.4	10.5	5.4
Level of Service	D	C		C	C	C	C	A	A	C	B	A
Approach Delay (s)		43.1			22.0			8.9			10.6	
Approach LOS		D			C			A			B	

Intersection Summary

HCM Average Control Delay	13.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	59.2	Sum of lost time (s)	14.0
Intersection Capacity Utilization	65.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✥	↰	↑↱	↰	↑↱
Volume (vph)	185	15	35	20	10	505	35	1205
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	12.0	26.0
Total Split (%)	40.0%	40.0%	40.0%	40.0%	16.7%	40.0%	20.0%	43.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	12.5	12.5		12.5	5.9	23.7	6.6	26.0
Actuated g/C Ratio	0.25	0.25		0.25	0.12	0.47	0.13	0.51
v/c Ratio	0.58	0.10		0.31	0.05	0.34	0.16	0.81
Control Delay	23.6	9.2		9.6	23.4	11.7	22.9	18.2
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	23.6	9.2		9.6	23.4	11.7	22.9	18.2
LOS	C	A		A	C	B	C	B
Approach Delay		21.1		9.6		11.9		18.4
Approach LOS		C		A		B		B

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 50.5
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 16.6 — Intersection LOS: B
Intersection Capacity Utilization 62.9% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY

ø1 12 s	ø2 24 s	ø4 24 s
ø5 10 s	ø6 26 s	ø8 24 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✥		↰	↑↱		↰	↑↱	
Volume (vph)	185	15	25	35	20	70	10	505	15	35	1205	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.91			0.92		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1687			1698		1770	3524		1770	3486	
Flt Permitted	0.75	1.00			0.91		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1395	1687			1562		1770	3524		1770	3486	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	201	16	27	38	22	76	11	549	16	38	1310	147
RTOR Reduction (vph)	0	21	0	0	58	0	0	3	0	0	11	0
Lane Group Flow (vph)	201	22	0	0	78	0	11	562	0	38	1446	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	12.5	12.5			12.5		1.0	24.3		2.7	26.0	
Effective Green, g (s)	12.5	12.5			12.5		1.0	24.3		2.7	26.0	
Actuated g/C Ratio	0.23	0.23			0.23		0.02	0.45		0.05	0.49	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	326	394			365		33	1601		89	1694	
v/s Ratio Prot		0.01					0.01	0.16		c0.02	c0.41	
v/s Ratio Perm	c0.14				0.05							
v/c Ratio	0.62	0.06			0.21		0.33	0.35		0.43	0.85	
Uniform Delay, d1	18.4	15.9			16.5		25.9	9.5		24.6	12.1	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.4	0.1			0.3		5.9	0.6		3.3	5.7	
Delay (s)	21.8	16.0			16.8		31.8	10.1		27.9	17.8	
Level of Service	C	B			B		C	B		C	B	
Approach Delay (s)		20.8			16.8			10.5			18.0	
Approach LOS		C			B			B			B	

Intersection Summary

HCM Average Control Delay	16.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	53.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
4: Wailea Ike Dr. & Kalai Waa St

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	430	60	245	1100	50	115
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	467	65	266	1196	54	125
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			533		1630	266
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			533		1630	266
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			74		21	83
cM capacity (veh/h)			1031		69	732

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	312	221	266	598	598	54	125
Volume Left	0	0	266	0	0	54	0
Volume Right	0	65	0	0	0	0	125
cSH	1700	1700	1031	1700	1700	69	732
Volume to Capacity	0.18	0.13	0.26	0.35	0.35	0.79	0.17
Queue Length 95th (ft)	0	0	26	0	0	93	15
Control Delay (s)	0.0	0.0	9.7	0.0	0.0	155.7	10.9
Lane LOS			A			F	B
Approach Delay (s)	0.0		1.8			54.8	
Approach LOS						F	

Intersection Summary			
Average Delay	5.7		
Intersection Capacity Utilization	40.7%	ICU Level of Service	A
Analysis Period (min)	15		

Timings
7: Wailea Ike Dr. & Wailea Alanui Dr.

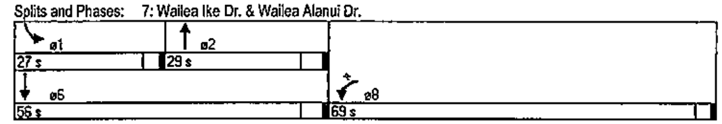
Austin, Tsutsumi & Associates, Inc.
7/31/2009

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	865	200	180	300	175	430
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Detector Phase	8	8	2		1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	69.0	69.0	29.0	0.0	27.0	56.0
Total Split (%)	55.2%	55.2%	23.2%	0.0%	21.6%	44.8%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	None		None	None
Act Effct Green (s)	65.4	65.4	17.0	112.4	16.9	37.9
Actuated g/C Ratio	0.58	0.58	0.15	1.00	0.15	0.34
v/c Ratio	0.91	0.22	0.70	0.21	0.71	0.39
Control Delay	37.3	5.1	59.3	0.3	61.3	28.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.3	5.1	59.3	0.3	61.3	28.8
LOS	D	A	E	A	E	C
Approach Delay	31.3		22.4			38.2
Approach LOS	C		C			D

Intersection Summary

Cycle Length: 125
Actuated Cycle Length: 112.4
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 31.3 Intersection LOS: C
Intersection Capacity Utilization 77.9% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



HCM Signalized Intersection Capacity Analysis
7: Wailea Ike Dr. & Wailea Alanui Dr.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	865	200	180	300	175	430
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	940	217	196	326	190	467
RTOR Reduction (vph)	0	63	0	0	0	0
Lane Group Flow (vph)	940	154	196	326	190	467
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Actuated Green, G (s)	65.4	65.4	17.0	112.3	16.9	37.9
Effective Green, g (s)	65.4	65.4	17.0	112.3	16.9	37.9
Actuated g/C Ratio	0.58	0.58	0.15	1.00	0.15	0.34
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	1031	922	282	1583	266	1194
v/s Ratio Prot	c0.53		c0.11		c0.11	0.13
v/s Ratio Perm		0.10		0.21		
v/c Ratio	0.91	0.17	0.70	0.21	0.71	0.39
Uniform Delay, d1	20.9	10.8	45.2	0.0	45.4	28.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.9	0.1	7.2	0.3	8.8	0.2
Delay (s)	32.8	10.9	52.4	0.3	54.2	28.6
Level of Service	C	B	D	A	D	C
Approach Delay (s)	28.7		19.9			36.0
Approach LOS	C		B			D

Intersection Summary			
HCM Average Control Delay	28.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	112.3	Sum of lost time (s)	13.0
Intersection Capacity Utilization	77.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
8: Okolani Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	10	50	485	105	65	5	220	30	60	10	70	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	54	527	114	71	5	239	33	65	11	76	11

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	11	54	527	185	5	239	33	65	87	11
Volume Left (vph)	11	0	0	114	0	239	0	0	11	0
Volume Right (vph)	0	0	527	0	5	0	0	65	0	11
Hadj (s)	0.53	0.03	-0.67	0.34	-0.67	0.53	0.03	-0.67	0.10	-0.67
Departure Headway (s)	6.3	5.8	3.2	5.9	4.9	5.9	5.4	3.2	5.7	4.9
Degree Utilization, x	0.02	0.09	0.47	0.30	0.01	0.39	0.05	0.06	0.14	0.01
Capacity (veh/h)	532	578	1116	579	683	592	638	1121	604	689
Control Delay (s)	8.2	8.2	7.8	10.3	6.8	11.4	7.5	5.2	8.3	6.8
Approach Delay (s)	7.8			10.2		9.8			8.2	
Approach LOS	A			B		A			A	

Intersection Summary			
Delay	8.8		
HCM Level of Service	A		
Intersection Capacity Utilization	53.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	10	95	270	10	95	520
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	103	293	11	103	565
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1071	299			304	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1071	299			304	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	86			92	
cM capacity (veh/h)	224	741			1256	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	114	304	668
Volume Left	11	0	103
Volume Right	103	11	0
cSH	819	1700	1256
Volume to Capacity	0.14	0.18	0.08
Queue Length 95th (ft)	12	0	7
Control Delay (s)	11.7	0.0	2.1
Lane LOS	B		A
Approach Delay (s)	11.7	0.0	2.1
Approach LOS	B		

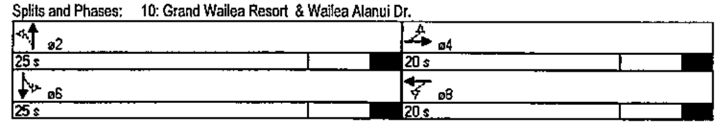
Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✥		✥	↰	↑↱	↰	↑↱
Volume (vph)	35	5	10	5	20	350	180	845
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	25.0	25.0	25.0	25.0
Total Split (%)	44.4%	44.4%	44.4%	44.4%	55.6%	55.6%	55.6%	55.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		6.7		6.6	27.8	27.8	27.8	27.8
Actuated g/C Ratio		0.19		0.19	0.79	0.79	0.79	0.79
v/c Ratio		0.16		0.21	0.05	0.15	0.26	0.37
Control Delay		11.3		7.9	5.4	3.5	6.0	4.5
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		11.3		7.9	5.4	3.5	6.0	4.5
LOS		B		A	A	A	A	A
Approach Delay		11.3		7.9		3.6		4.7
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 45
Actuated Cycle Length: 35
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.37
Intersection Signal Delay: 4.8 Intersection LOS: A
Intersection Capacity Utilization 54.5% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.



HCM Signalized Intersection Capacity Analysis
10: Grand Wailea Resort & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	5	15	10	5	50	20	350	25	180	845	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.96			0.90		1.00	0.99		1.00	0.98	
Flt Protected		0.97			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1739			1656		1770	3504		1770	3483	
Flt Permitted		1.00			0.93		0.27	1.00		0.51	1.00	
Satd. Flow (perm)		1795			1555		511	3504		955	3483	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	5	16	11	5	54	22	380	27	196	918	109
RTOR Reduction (vph)	0	15	0	0	50	0	0	8	0	0	13	0
Lane Group Flow (vph)	0	44	0	0	20	0	22	399	0	196	1014	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		2.9			2.9		23.9	23.9		23.9	23.9	
Effective Green, g (s)		2.9			2.9		23.9	23.9		23.9	23.9	
Actuated g/C Ratio		0.07			0.07		0.62	0.62		0.62	0.62	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		134			116		315	2158		588	2145	
v/s Ratio Prot								0.11			c0.29	
v/s Ratio Perm		c0.02			0.01		0.04			0.21		
v/c Ratio		0.33			0.17		0.07	0.19		0.33	0.47	
Uniform Delay, d1		17.0			16.8		3.0	3.2		3.6	4.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.4			0.7		0.1	0.0		0.3	0.2	
Delay (s)		18.5			17.5		3.1	3.3		3.9	4.2	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		18.5			17.5			3.3			4.2	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	4.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	38.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	54.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
11: Kaukahi Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	30	20	5	50	30	35	5	230	25	20	445	140
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	22	5	54	33	38	5	250	27	22	484	152
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	804	788	484	804	940	250	636			250		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	804	788	484	804	940	250	636			250		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	87	93	99	80	87	95	99			98		
cM capacity (veh/h)	254	316	583	278	258	789	948			1316		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	33	27	54	71	255	27	22	484	152
Volume Left	33	0	54	0	5	0	22	0	0
Volume Right	0	5	0	38	0	27	0	0	152
cSH	254	348	278	404	948	1700	1316	1700	1700
Volume to Capacity	0.13	0.08	0.20	0.17	0.01	0.02	0.02	0.28	0.09
Queue Length 95th (ft)	11	6	18	16	0	0	1	0	0
Control Delay (s)	21.2	16.2	21.1	15.8	0.2	0.0	7.8	0.0	0.0
Lane LOS	C	C	C	C	A		A		
Approach Delay (s)	18.9		18.1		0.2		0.3		
Approach LOS	C		C						

Intersection Summary			
Average Delay	3.2		
Intersection Capacity Utilization	40.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	175	35	10	30	140	20	1510	15	160	1190	230
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	35.0	35.0	35.0	35.0	35.0	10.0	62.0	62.0	23.0	75.0	75.0
Total Split (%)	29.2%	29.2%	29.2%	29.2%	29.2%	8.3%	51.7%	51.7%	19.2%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	Min	Max	Max	Min	None	None

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 106.6
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY

ø1 23 s | ø2 62 s | ø4 35 s
ø5 10 s | ø6 75 s | ø8 35 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	35	10	10	30	140	20	1510	15	160	1190	230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1800		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.73	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1370	1800		1351	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	38	11	11	33	152	22	1641	16	174	1293	250
RTOR Reduction (vph)	0	9	0	0	0	123	0	0	6	0	0	94
Lane Group Flow (vph)	190	40	0	11	33	29	22	1641	10	174	1293	156
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	20.0	20.0		20.0	20.0	20.0	5.9	57.5	57.5	15.0	66.6	66.6
Effective Green, g (s)	20.0	20.0		20.0	20.0	20.0	5.9	57.5	57.5	15.0	66.6	66.6
Actuated g/C Ratio	0.19	0.19		0.19	0.19	0.19	0.06	0.54	0.54	0.14	0.63	0.63
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	257	338		254	350	297	98	1911	855	249	2213	990
v/s Ratio Prot		0.02			0.02		0.01	c0.46		c0.10	0.37	
v/s Ratio Perm	c0.14			0.01		0.02			0.01			0.10
v/c Ratio	0.74	0.12		0.04	0.09	0.10	0.22	0.86	0.01	0.70	0.58	0.16
Uniform Delay, d1	40.8	35.9		35.4	35.8	35.8	48.1	21.0	11.3	43.6	11.8	8.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.6	0.2		0.1	0.1	0.1	1.2	5.3	0.0	8.3	0.4	0.1
Delay (s)	51.4	36.1		35.5	35.9	35.9	49.3	26.3	11.4	51.9	12.2	8.4
Level of Service	D	D		D	D	D	D	C	B	D	B	A
Approach Delay (s)		48.3			35.9			26.5			15.6	
Approach LOS		D			D			C			B	

Intersection Summary

HCM Average Control Delay	23.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	106.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✣	↰	↑↱	↰	↑↱
Volume (vph)	250	35	15	20	40	1190	80	835
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	27.0	27.0	27.0	27.0	12.0	39.0	14.0	41.0
Total Split (%)	33.8%	33.8%	33.8%	33.8%	15.0%	48.8%	17.5%	51.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	18.2	18.2		18.2	7.0	36.0	8.4	39.5
Actuated g/C Ratio	0.24	0.24		0.24	0.09	0.48	0.11	0.53
v/c Ratio	0.78	0.16		0.21	0.26	0.78	0.43	0.65
Control Delay	43.7	14.6		12.6	37.2	22.6	39.4	16.0
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	43.7	14.6		12.6	37.2	22.6	39.4	16.0
LOS	D	B		B	D	C	D	B
Approach Delay		37.7		12.6		23.1		17.5
Approach LOS		D		B		C		B

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 74.4
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 22.1 — Intersection LOS: C
Intersection Capacity Utilization 70.8% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY

ø1 14 s	ø2 39 s	ø4 27 s
ø5 12 s	ø6 41 s	ø8 27 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✣		↰	↑↱		↰	↑↱	
Volume (vph)	250	35	30	15	20	50	40	1190	40	80	835	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.93			0.92		1.00	1.00		1.00	0.96	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1733			1700		1770	3522		1770	3410	
Flt Permitted	0.76	1.00			0.95		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1415	1733			1632		1770	3522		1770	3410	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	38	33	16	22	54	43	1293	43	87	908	293
RTOR Reduction (vph)	0	25	0	0	41	0	0	3	0	0	34	0
Lane Group Flow (vph)	272	46	0	0	51	0	43	1333	0	87	1167	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	18.2	18.2			18.2		4.4	36.8		7.0	39.4	
Effective Green, g (s)	18.2	18.2			18.2		4.4	36.8		7.0	39.4	
Actuated g/C Ratio	0.24	0.24			0.24		0.06	0.48		0.09	0.52	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	339	415			391		102	1705		163	1768	
v/s Ratio Prot		0.03					0.02	c0.38		c0.05	c0.34	
v/s Ratio Perm	c0.19				0.03							
v/c Ratio	0.80	0.11			0.13		0.42	0.78		0.53	0.66	
Uniform Delay, d1	27.2	22.6			22.7		34.6	16.3		32.9	13.4	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	12.8	0.1			0.2		2.8	3.7		3.3	2.0	
Delay (s)	40.0	22.7			22.8		37.4	19.9		36.3	15.3	
Level of Service	D	C			C		D	B		D	B	
Approach Delay (s)		36.4			22.8			20.5			16.8	
Approach LOS		D			C			C			B	

Intersection Summary

HCM Average Control Delay	20.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	76.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	70.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	1065	90	155	740	100	275
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1158	98	168	804	109	299
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1255		1946	628
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1255		1946	628
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			69		0	30
cM capacity (veh/h)			550		39	426

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	772	484	168	402	402	109	299
Volume Left	0	0	168	0	0	109	0
Volume Right	0	98	0	0	0	0	299
cSH	1700	1700	550	1700	1700	39	426
Volume to Capacity	0.45	0.28	0.31	0.24	0.24	2.76	0.70
Queue Length 95th (ft)	0	0	32	0	0	301	132
Control Delay (s)	0.0	0.0	14.4	0.0	0.0	1013.7	31.0
Lane LOS			B			F	D
Approach Delay (s)	0.0		2.5			293.1	
Approach LOS						F	

Intersection Summary			
Average Delay	46.2		
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	515	265	410	775	260	380
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Detector Phase	8	8	2		1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	40.0	40.0	29.0	0.0	21.0	50.0
Total Split (%)	44.4%	44.4%	32.2%	0.0%	23.3%	55.6%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	None		None	None
Act Effct Green (s)	30.0	30.0	22.5	81.8	16.1	42.6
Actuated g/C Ratio	0.37	0.37	0.28	1.00	0.20	0.52
v/c Ratio	0.86	0.38	0.87	0.53	0.81	0.22
Control Delay	39.2	3.9	49.5	1.3	53.4	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.2	3.9	49.5	1.3	53.4	11.8
LOS	D	A	D	A	D	B
Approach Delay	27.2		18.0			28.7
Approach LOS	C		B			C

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 81.8
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 23.4 — Intersection LOS: C
Intersection Capacity Utilization 75.3% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.

ø1 21 s — ø2 29 s
ø6 50 s — ø8 40 s

HCM Signalized Intersection Capacity Analysis | Austin, Tsutsumi & Associates, Inc.
7: Wailea Ike Dr. & Wailea Alanui Dr. | 7/31/2009

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	515	265	410	775	260	380
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	560	288	446	842	283	413
RTOR Reduction (vph)	0	182	0	0	0	0
Lane Group Flow (vph)	560	106	446	842	283	413
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Actuated Green, G (s)	30.0	30.0	22.5	81.6	16.1	42.6
Effective Green, g (s)	30.0	30.0	22.5	81.6	16.1	42.6
Actuated g/C Ratio	0.37	0.37	0.28	1.00	0.20	0.52
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	651	582	514	1583	349	1848
v/s Ratio Prot	c0.32		c0.24		c0.16	0.12
v/s Ratio Perm		0.07		0.53		
v/c Ratio	0.86	0.18	0.87	0.53	0.81	0.22
Uniform Delay, d1	23.9	17.5	28.1	0.0	31.3	10.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.2	0.2	14.4	1.3	13.3	0.1
Delay (s)	35.1	17.6	42.5	1.3	44.6	10.6
Level of Service	D	B	D	A	D	B
Approach Delay (s)	29.1		15.6			24.4
Approach LOS	C		B			C

Intersection Summary			
HCM Average Control Delay	21.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	81.6	Sum of lost time (s)	13.0
Intersection Capacity Utilization	75.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis | Austin, Tsutsumi & Associates, Inc.
8: Okolani Dr & Wailea Alanui Dr. | 7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	15	90	435	95	70	15	485	105	145	15	35	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	98	473	103	76	16	527	114	158	16	38	16

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	16	98	473	179	16	527	114	158	54	16
Volume Left (vph)	16	0	0	103	0	527	0	0	16	0
Volume Right (vph)	0	0	473	0	16	0	0	158	0	16
Hadj (s)	0.53	0.03	-0.67	0.32	-0.67	0.53	0.03	-0.67	0.18	-0.67
Departure Headway (s)	7.4	6.9	3.2	7.0	6.0	6.2	5.7	3.2	6.6	5.7
Degree Utilization, x	0.03	0.19	0.42	0.35	0.03	0.90	0.18	0.14	0.10	0.03
Capacity (veh/h)	463	498	1115	495	567	571	619	1121	517	587
Control Delay (s)	9.4	10.2	7.3	12.5	8.0	40.4	8.7	5.5	9.1	7.7
Approach Delay (s)	7.8			12.1		29.0			8.8	
Approach LOS	A			B		D			A	

Intersection Summary			
Delay	18.6		
HCM Level of Service	C		
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	35	155	545	25	100	515
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	168	592	27	109	560
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1383	606			620	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1383	606			620	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	73	66			89	
cM capacity (veh/h)	140	497			961	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	207	620	668
Volume Left	38	0	109
Volume Right	168	27	0
cSH	609	1700	961
Volume to Capacity	0.34	0.36	0.11
Queue Length 95th (ft)	37	0	10
Control Delay (s)	20.3	0.0	2.8
Lane LOS	C		A
Approach Delay (s)	20.3	0.0	2.8
Approach LOS	C		

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✣		✣	↰	↑↱	↰	↑↱
Volume (vph)	105	5	10	15	30	900	60	585
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	25.0	25.0	25.0	25.0
Total Split (%)	44.4%	44.4%	44.4%	44.4%	55.6%	55.6%	55.6%	55.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		9.2		9.2	22.6	22.6	22.6	22.6
Actuated g/C Ratio		0.23		0.23	0.57	0.57	0.57	0.57
v/c Ratio		0.45		0.19	0.08	0.49	0.23	0.35
Control Delay		15.9		7.5	7.9	8.8	10.8	7.4
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		15.9		7.5	7.9	8.8	10.8	7.4
LOS		B		A	A	A	B	A
Approach Delay		15.9		7.5		8.8		7.7
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 45
Actuated Cycle Length: 39.4
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.49
Intersection Signal Delay: 8.8 Intersection LOS: A
Intersection Capacity Utilization 57.8% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.

ø2	ø4
25 s	20 s
ø6	ø8
25 s	20 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑↱		↰	↑↱		↰	↑↱	
Volume (vph)	105	5	25	10	15	45	30	900	10	60	585	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.98			0.91		1.00	1.00		1.00	0.98	
Flt Protected		0.96			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1748			1688		1770	3533		1770	3486	
Flt Permitted		0.72			0.92		0.38	1.00		0.26	1.00	
Satd. Flow (perm)		1313			1565		713	3533		488	3486	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	5	27	11	16	49	33	978	11	65	636	71
RTOR Reduction (vph)	0	21	0	0	40	0	0	1	0	0	16	0
Lane Group Flow (vph)	0	125	0	0	36	0	33	988	0	65	691	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.7			7.7		21.0	21.0		21.0	21.0	
Effective Green, g (s)		7.7			7.7		21.0	21.0		21.0	21.0	
Actuated g/C Ratio		0.19			0.19		0.52	0.52		0.52	0.52	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		248			296		368	1823		252	1799	
v/s Ratio Prot								c0.28			0.20	
v/s Ratio Perm		c0.10			0.02		0.05			0.13		
v/c Ratio		0.50			0.12		0.09	0.54		0.26	0.38	
Uniform Delay, d1		14.8			13.7		5.0	6.6		5.5	5.9	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.6			0.2		0.1	0.3		0.5	0.1	
Delay (s)		16.4			13.9		5.1	6.9		6.0	6.1	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		16.4			13.9			6.9			6.1	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	7.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	40.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱			↰↑	↱	↰	↑	↱
Volume (veh/h)	95	25	10	45	15	5	10	565	50	35	450	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	103	27	11	49	16	5	11	614	54	38	489	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1209	1201	489	1226	1272	614	560			614		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1209	1201	489	1226	1272	614	560			614		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	26	85	98	62	90	99	99			96		
cM capacity (veh/h)	140	176	579	129	159	492	1011			965		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	103	38	49	22	625	54	38	489	71
Volume Left	103	0	49	0	11	0	38	0	0
Volume Right	0	11	0	5	0	54	0	0	71
cSH	140	219	129	192	1011	1700	965	1700	1700
Volume to Capacity	0.74	0.17	0.38	0.11	0.01	0.03	0.04	0.29	0.04
Queue Length 95th (ft)	108	15	39	9	1	0	3	0	0
Control Delay (s)	81.3	24.8	48.8	26.2	0.3	0.0	8.9	0.0	0.0
Lane LOS	F	C	E	D	A		A		
Approach Delay (s)	66.1		41.8		0.3		0.6		
Approach LOS	F		E						

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	56.3%	ICU Level of Service	B
Analysis Period (min)	15		

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

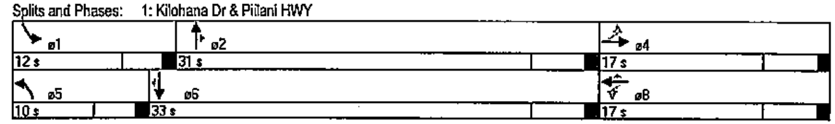
- Base Year 2022 WITHOUT Project

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	160	20	15	30	160	5	800	5	50	1465	155
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	17.0	17.0	17.0	17.0	17.0	10.0	31.0	31.0	12.0	33.0	33.0
Total Split (%)	28.3%	28.3%	28.3%	28.3%	28.3%	16.7%	51.7%	51.7%	20.0%	55.0%	55.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	Max	Max	None	Max	Max

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 57.5
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY



HCM Signalized Intersection Capacity Analysis
1: Kilohana Dr & Piilani HWY

Austin, Tsutsumi & Associates, Inc.
1/13/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	160	20	10	15	30	160	5	800	5	50	1465	155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1770		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.74	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1370	1770		1370	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	174	22	11	16	33	174	5	870	5	54	1592	168
RTOR Reduction (vph)	0	9	0	0	0	143	0	0	2	0	0	72
Lane Group Flow (vph)	174	24	0	16	33	31	5	870	3	54	1592	96
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	10.7	10.7		10.7	10.7	10.7	1.2	31.5	31.5	4.5	34.8	34.8
Effective Green, g (s)	10.7	10.7		10.7	10.7	10.7	1.2	31.5	31.5	4.5	34.8	34.8
Actuated g/C Ratio	0.18	0.18		0.18	0.18	0.18	0.02	0.52	0.52	0.07	0.57	0.57
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	241	312		241	328	279	35	1837	821	131	2029	908
v/s Ratio Prot		0.01			0.02		0.00	0.25		c0.03	c0.45	
v/s Ratio Perm	c0.13			0.01		0.02			0.00			0.06
v/c Ratio	0.72	0.08		0.07	0.10	0.11	0.14	0.47	0.00	0.41	0.78	0.11
Uniform Delay, d1	23.6	20.9		20.8	21.0	21.0	29.2	9.3	7.0	26.8	10.0	5.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.2	0.1		0.1	0.1	0.2	1.9	0.9	0.0	2.1	3.1	0.2
Delay (s)	33.8	21.0		21.0	21.1	21.2	31.1	10.2	7.0	28.9	13.2	6.1
Level of Service	C	C		C	C	C	C	B	A	C	B	A
Approach Delay (s)		31.7			21.1			10.3			13.0	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	14.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	60.7	Sum of lost time (s)	14.0
Intersection Capacity Utilization	65.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Timings
2: Okolani Dr. & Piilani HWY

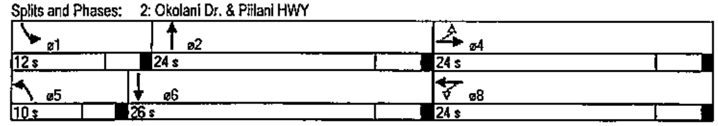
Austin, Tsutsumi & Associates, Inc.
7/31/2009

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✥	↰	↑↱	↰	↑↱
Volume (vph)	185	15	40	25	10	550	35	1275
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	12.0	26.0
Total Split (%)	40.0%	40.0%	40.0%	40.0%	16.7%	40.0%	20.0%	43.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	12.6	12.6		12.6	5.9	23.7	6.6	26.1
Actuated g/C Ratio	0.25	0.25		0.25	0.12	0.47	0.13	0.52
v/c Ratio	0.59	0.10		0.33	0.05	0.37	0.16	0.85
Control Delay	24.3	9.2		10.2	23.5	12.0	23.0	20.2
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	24.3	9.2		10.2	23.5	12.0	23.0	20.2
LOS	C	A		B	C	B	C	C
Approach Delay		21.6		10.2		12.2		20.3
Approach LOS		C		B		B		C

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 50.6
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 17.9 — Intersection LOS: B
Intersection Capacity Utilization 65.0% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY



HCM Signalized Intersection Capacity Analysis
2: Okolani Dr. & Piilani HWY

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			↔		↰	↑↱		↰	↑↱	
Volume (vph)	185	15	25	40	25	70	10	550	15	35	1275	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.91			0.93		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1687			1707		1770	3525		1770	3487	
Flt Permitted	0.73	1.00			0.90		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1357	1687			1558		1770	3525		1770	3487	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	201	16	27	43	27	76	11	598	16	38	1386	152
RTOR Reduction (vph)	0	21	0	0	58	0	0	3	0	0	11	0
Lane Group Flow (vph)	201	22	0	0	88	0	11	611	0	38	1527	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	12.6	12.6			12.6		1.0	24.3		2.7	26.0	
Effective Green, g (s)	12.6	12.6			12.6		1.0	24.3		2.7	26.0	
Actuated g/C Ratio	0.24	0.24			0.24		0.02	0.45		0.05	0.49	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	319	397			366		33	1598		89	1691	
v/s Ratio Prot		0.01					0.01	0.17		c0.02	c0.44	
v/s Ratio Perm	c0.15				0.06							
v/c Ratio	0.63	0.06			0.24		0.33	0.38		0.43	0.90	
Uniform Delay, d1	18.4	15.9			16.6		26.0	9.7		24.7	12.6	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.0	0.1			0.3		5.9	0.7		3.3	8.3	
Delay (s)	22.4	16.0			17.0		31.9	10.4		28.0	21.0	
Level of Service	C	B			B		C	B		C	C	
Approach Delay (s)		21.3			17.0			10.8			21.1	
Approach LOS		C			B			B			C	

Intersection Summary			
HCM Average Control Delay	18.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	53.6	Sum of lost time (s)	9.0
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
4: Wailea Ike Dr. & Kalai Waa St

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	475	60	245	1170	50	120
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	516	65	266	1272	54	130
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			582		1717	291
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			582		1717	291
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			73		8	82
cM capacity (veh/h)			989		59	706

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	344	237	266	636	636	54	130
Volume Left	0	0	266	0	0	54	0
Volume Right	0	65	0	0	0	0	130
cSH	1700	1700	989	1700	1700	59	706
Volume to Capacity	0.20	0.14	0.27	0.37	0.37	0.92	0.18
Queue Length 95th (ft)	0	0	27	0	0	106	17
Control Delay (s)	0.0	0.0	10.0	0.0	0.0	208.1	11.3
Lane LOS			A			F	B
Approach Delay (s)	0.0		1.7			69.1	
Approach LOS						F	

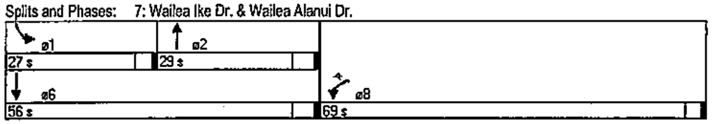
Intersection Summary			
Average Delay	6.7		
Intersection Capacity Utilization	42.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	930	200	195	345	175	455
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Detector Phase	8	8	2		1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	69.0	69.0	29.0	0.0	27.0	56.0
Total Split (%)	55.2%	55.2%	23.2%	0.0%	21.6%	44.8%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	None		None	None
Act Effct Green (s)	65.4	65.4	17.7	113.2	17.0	38.7
Actuated g/C Ratio	0.58	0.58	0.16	1.00	0.15	0.34
v/c Ratio	0.99	0.22	0.73	0.24	0.72	0.41
Control Delay	51.3	5.7	60.7	0.4	61.9	28.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.3	5.7	60.7	0.4	61.9	28.9
LOS	D	A	E	A	E	C
Approach Delay	43.3		22.2			38.1
Approach LOS	D		C			D

Intersection Summary

Cycle Length: 125
Actuated Cycle Length: 113.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.99
Intersection Signal Delay: 36.9 — Intersection LOS: D
Intersection Capacity Utilization 82.3% — ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	930	200	195	345	175	455
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1011	217	212	375	190	495
RTOR Reduction (vph)	0	60	0	0	0	0
Lane Group Flow (vph)	1011	157	212	375	190	495
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Actuated Green, G (s)	65.4	65.4	17.7	113.1	17.0	38.7
Effective Green, g (s)	65.4	65.4	17.7	113.1	17.0	38.7
Actuated g/C Ratio	0.58	0.58	0.16	1.00	0.15	0.34
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	1024	915	292	1583	266	1211
v/s Ratio Prot	c0.57		c0.11		c0.11	0.14
v/s Ratio Perm		0.10		0.24		
v/c Ratio	0.99	0.17	0.73	0.24	0.71	0.41
Uniform Delay, d1	23.4	11.2	45.4	0.0	45.7	28.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	24.8	0.1	8.7	0.4	8.8	0.2
Delay (s)	48.2	11.3	54.1	0.4	54.5	28.7
Level of Service	D	B	D	A	D	C
Approach Delay (s)	41.7		19.8			35.8
Approach LOS	D		B			D

Intersection Summary

HCM Average Control Delay	34.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	113.1	Sum of lost time (s)	13.0
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	10	50	510	105	65	5	240	30	60	10	70	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	54	554	114	71	5	261	33	65	11	76	11

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	11	54	554	185	5	261	33	65	87	11
Volume Left (vph)	11	0	0	114	0	261	0	0	11	0
Volume Right (vph)	0	0	554	0	5	0	0	65	0	11
Hadj (s)	0.53	0.03	-0.67	0.34	-0.67	0.53	0.03	-0.67	0.10	-0.67
Departure Headway (s)	6.4	5.9	3.2	6.0	5.0	5.9	5.4	3.2	5.7	4.9
Degree Utilization, x	0.02	0.09	0.49	0.31	0.01	0.43	0.05	0.06	0.14	0.01
Capacity (veh/h)	524	570	1116	572	673	593	638	1121	600	684
Control Delay (s)	8.3	8.2	8.1	10.4	6.8	12.0	7.5	5.2	8.4	6.8
Approach Delay (s)	8.1			10.3		10.3			8.2	
Approach LOS	A			B		B			A	

Intersection Summary			
Delay	9.1		
HCM Level of Service	A		
Intersection Capacity Utilization	55.0%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	10	95	285	10	100	545
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	103	310	11	109	592
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1125	315			321	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1125	315			321	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	86			91	
cM capacity (veh/h)	207	725			1239	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	114	321	701
Volume Left	11	0	109
Volume Right	103	11	0
cSH	802	1700	1239
Volume to Capacity	0.14	0.19	0.09
Queue Length 95th (ft)	12	0	7
Control Delay (s)	12.0	0.0	2.2
Lane LOS	B		A
Approach Delay (s)	12.0	0.0	2.2
Approach LOS	B		

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		

Timings
10: Grand Wailea Resort & Wailea Alanui Dr.

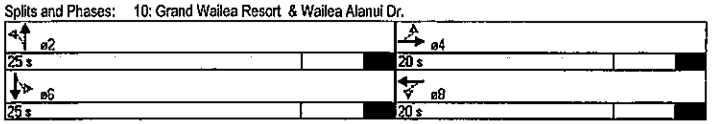
Austin, Tsutsumi & Associates, Inc.
7/31/2009

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↰↑↱		↰↑↱	↰	↑↑↱	↰	↑↑↱
Volume (vph)	35	5	10	5	20	410	180	935
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	25.0	25.0	25.0	25.0
Total Split (%)	44.4%	44.4%	44.4%	44.4%	55.6%	55.6%	55.6%	55.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		6.7		6.6	28.6	28.6	28.6	28.6
Actuated g/C Ratio		0.19		0.18	0.80	0.80	0.80	0.80
v/c Ratio		0.17		0.21	0.06	0.17	0.27	0.40
Control Delay		11.5		8.0	5.6	3.6	6.3	4.7
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		11.5		8.0	5.6	3.6	6.3	4.7
LOS		B		A	A	A	A	A
Approach Delay		11.5		8.0		3.7		5.0
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 45
Actuated Cycle Length: 35.9
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.40
Intersection Signal Delay: 5.0 — Intersection LOS: A
Intersection Capacity Utilization 56.9% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.



HCM Signalized Intersection Capacity Analysis
10: Grand Wailea Resort & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑↱		↰	↑↑↱		↰	↑↑↱	
Volume (vph)	35	5	15	10	5	50	20	410	25	180	935	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.96			0.90		1.00	0.99		1.00	0.99	
Flt Protected		0.97			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1739			1656		1770	3509		1770	3488	
Flt Permitted		1.00			0.93		0.24	1.00		0.48	1.00	
Satd. Flow (perm)		1795			1555		445	3509		896	3488	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	5	16	11	5	54	22	446	27	196	1016	109
RTOR Reduction (vph)	0	15	0	0	50	0	0	6	0	0	12	0
Lane Group Flow (vph)	0	44	0	0	20	0	22	467	0	196	1113	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		3.0			3.0		24.7	24.7		24.7	24.7	
Effective Green, g (s)		3.0			3.0		24.7	24.7		24.7	24.7	
Actuated g/C Ratio		0.08			0.08		0.62	0.62		0.62	0.62	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		136			118		277	2183		557	2170	
v/s Ratio Prot								0.13			c0.32	
v/s Ratio Perm		c0.02			0.01		0.05			0.22		
v/c Ratio		0.33			0.17		0.08	0.21		0.35	0.51	
Uniform Delay, d1		17.4			17.2		3.0	3.3		3.6	4.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.4			0.7		0.1	0.0		0.4	0.2	
Delay (s)		18.8			17.9		3.1	3.3		4.0	4.4	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		18.8			17.9			3.3			4.3	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	5.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	39.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	56.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
11: Kaukahi Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	30	20	5	55	30	35	5	285	25	20	520	145
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	22	5	60	33	38	5	310	27	22	565	158
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	946	929	565	946	1087	310	723			310		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	946	929	565	946	1087	310	723			310		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	84	92	99	73	85	95	99			98		
cM capacity (veh/h)	198	261	524	220	211	730	879			1251		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	33	27	60	71	315	27	22	565	158
Volume Left	33	0	60	0	5	0	22	0	0
Volume Right	0	5	0	38	0	27	0	0	158
cSH	198	290	220	342	879	1700	1251	1700	1700
Volume to Capacity	0.16	0.09	0.27	0.21	0.01	0.02	0.02	0.33	0.09
Queue Length 95th (ft)	14	8	27	19	0	0	1	0	0
Control Delay (s)	26.7	18.7	27.4	18.3	0.2	0.0	7.9	0.0	0.0
Lane LOS	D	C	D	C	A		A		
Approach Delay (s)	23.0		22.4		0.2		0.2		
Approach LOS	C		C						

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	44.0%	ICU Level of Service	A
Analysis Period (min)	15		

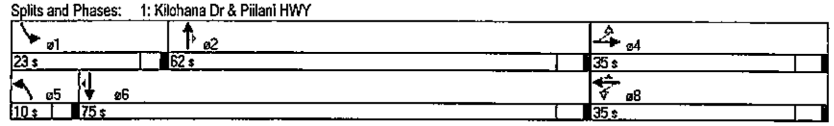
Timings
1: Kilohana Dr & Piilani HWY

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	175	40	10	35	140	20	1580	15	160	1250	230
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	35.0	35.0	35.0	35.0	35.0	10.0	62.0	62.0	23.0	75.0	75.0
Total Split (%)	29.2%	29.2%	29.2%	29.2%	29.2%	8.3%	51.7%	51.7%	19.2%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	Min	Max	Max	Min	None	None

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 106.7
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	175	40	10	10	35	140	20	1580	15	160	1250	230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1806		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.73	1.00		0.72	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1364	1806		1345	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	43	11	11	38	152	22	1717	16	174	1359	250
RTOR Reduction (vph)	0	8	0	0	0	123	0	0	5	0	0	94
Lane Group Flow (vph)	190	46	0	11	38	29	22	1717	11	174	1359	156
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	20.0	20.0		20.0	20.0	20.0	5.9	57.5	57.5	15.0	66.6	66.6
Effective Green, g (s)	20.0	20.0		20.0	20.0	20.0	5.9	57.5	57.5	15.0	66.6	66.6
Actuated g/C Ratio	0.19	0.19		0.19	0.19	0.19	0.06	0.54	0.54	0.14	0.63	0.63
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	256	339		253	350	297	98	1911	855	249	2213	990
v/s Ratio Prot		0.03			0.02		0.01	c0.49		c0.10	0.38	
v/s Ratio Perm	c0.14			0.01		0.02			0.01			0.10
v/c Ratio	0.74	0.14		0.04	0.11	0.10	0.22	0.90	0.01	0.70	0.61	0.16
Uniform Delay, d1	40.8	36.0		35.4	35.9	35.8	48.1	21.9	11.4	43.6	12.1	8.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.0	0.2		0.1	0.1	0.1	1.2	7.2	0.0	8.3	0.5	0.1
Delay (s)	51.8	36.2		35.5	36.0	35.9	49.3	29.1	11.4	51.9	12.6	8.4
Level of Service	D	D		D	D	D	D	C	B	D	B	A
Approach Delay (s)		48.4			35.9			29.2			15.9	
Approach LOS		D			D			C			B	

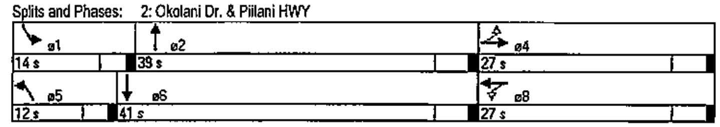
Intersection Summary			
HCM Average Control Delay	24.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	106.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✢	↰	↑↱	↰	↑↱
Volume (vph)	255	35	15	25	40	1255	85	895
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	27.0	27.0	27.0	27.0	12.0	39.0	14.0	41.0
Total Split (%)	33.8%	33.8%	33.8%	33.8%	15.0%	48.8%	17.5%	51.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	18.6	18.6		18.6	7.0	35.8	8.5	39.3
Actuated g/C Ratio	0.25	0.25		0.25	0.09	0.48	0.11	0.53
v/c Ratio	0.80	0.16		0.22	0.26	0.84	0.46	0.69
Control Delay	45.0	14.6		13.2	37.4	25.2	40.0	17.1
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	45.0	14.6		13.2	37.4	25.2	40.0	17.1
LOS	D	B		B	D	C	D	B
Approach Delay		38.8		13.2		25.6		18.6
Approach LOS		D		B		C		B

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 74.6
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 23.7 — Intersection LOS: C
Intersection Capacity Utilization 73.3% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱			✥		↰	↑↑↱		↰	↑↑↱	
Volume (vph)	255	35	30	15	25	50	40	1255	45	85	895	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.93			0.92		1.00	0.99		1.00	0.97	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1733			1709		1770	3521		1770	3416	
Flt Permitted	0.75	1.00			0.95		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1393	1733			1644		1770	3521		1770	3416	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	277	38	33	16	27	54	43	1364	49	92	973	293
RTOR Reduction (vph)	0	25	0	0	41	0	0	3	0	0	31	0
Lane Group Flow (vph)	277	46	0	0	56	0	43	1410	0	92	1235	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	18.6	18.6			18.6		4.4	36.6		7.1	39.3	
Effective Green, g (s)	18.6	18.6			18.6		4.4	36.6		7.1	39.3	
Actuated g/C Ratio	0.24	0.24			0.24		0.06	0.48		0.09	0.52	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	340	422			401		102	1689		165	1759	
v/s Ratio Prot		0.03					0.02	c0.40		c0.05	c0.36	
v/s Ratio Perm	c0.20				0.03							
v/c Ratio	0.81	0.11			0.14		0.42	0.83		0.56	0.70	
Uniform Delay, d1	27.2	22.4			22.6		34.7	17.2		33.1	14.1	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	13.9	0.1			0.2		2.8	5.0		4.0	2.4	
Delay (s)	41.1	22.5			22.7		37.5	22.3		37.1	16.4	
Level of Service	D	C			C		D	C		D	B	
Approach Delay (s)		37.3			22.7			22.7			17.8	
Approach LOS		D			C			C			B	

Intersection Summary			
HCM Average Control Delay	22.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	76.3	Sum of lost time (s)	19.0
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	1130	90	160	795	100	280
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1228	98	174	864	109	304
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1326		2057	663
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1326		2057	663
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			66		0	25
cM capacity (veh/h)			517		32	404

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	819	507	174	432	432	109	304
Volume Left	0	0	174	0	0	109	0
Volume Right	0	98	0	0	0	0	304
cSH	1700	1700	517	1700	1700	32	404
Volume to Capacity	0.48	0.30	0.34	0.25	0.25	3.44	0.75
Queue Length 95th (ft)	0	0	37	0	0	Err	154
Control Delay (s)	0.0	0.0	15.5	0.0	0.0	Err	36.6
Lane LOS			C			F	E
Approach Delay (s)	0.0		2.6			2658.3	
Approach LOS						F	

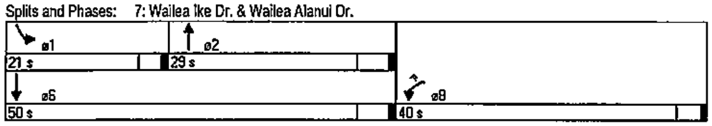
Intersection Summary			
Average Delay	396.3		
Intersection Capacity Utilization	58.5%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	570	265	435	835	265	400
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Detector Phase	8	8	2		1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	40.0	40.0	29.0	0.0	21.0	50.0
Total Split (%)	44.4%	44.4%	32.2%	0.0%	23.3%	55.6%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	None		None	None
Act Effct Green (s)	33.0	33.0	23.5	85.9	16.3	43.8
Actuated g/C Ratio	0.38	0.38	0.27	1.00	0.19	0.51
v/c Ratio	0.91	0.37	0.93	0.57	0.86	0.24
Control Delay	44.8	3.7	58.7	1.5	60.3	12.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.8	3.7	58.7	1.5	60.3	12.7
LOS	D	A	E	A	E	B
Approach Delay	31.8		21.1			31.6
Approach LOS	C		C			C

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 85.9
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.93
Intersection Signal Delay: 26.8 — Intersection LOS: C
Intersection Capacity Utilization 80.0% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑↑
Volume (vph)	570	265	435	835	265	400
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	4.0	4.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	620	288	473	908	288	435
RTOR Reduction (vph)	0	177	0	0	0	0
Lane Group Flow (vph)	620	111	473	908	288	435
Turn Type		Perm		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		Free		
Actuated Green, G (s)	33.0	33.0	23.6	85.8	16.2	43.8
Effective Green, g (s)	33.0	33.0	23.6	85.8	16.2	43.8
Actuated g/C Ratio	0.38	0.38	0.28	1.00	0.19	0.51
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	681	609	512	1583	334	1807
v/s Ratio Prot	c0.35		c0.25		c0.16	0.12
v/s Ratio Perm		0.07		0.57		
v/c Ratio	0.91	0.18	0.92	0.57	0.86	0.24
Uniform Delay, d1	25.0	17.5	30.2	0.0	33.7	11.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	16.4	0.1	22.5	1.5	19.8	0.1
Delay (s)	41.4	17.6	52.7	1.5	53.6	11.8
Level of Service	D	B	D	A	D	B
Approach Delay (s)	33.8		19.0			28.4
Approach LOS	C		B			C

Intersection Summary

HCM Average Control Delay	25.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	85.8	Sum of lost time (s)	13.0
Intersection Capacity Utilization	80.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	15	95	460	100	70	15	510	110	145	15	35	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	103	500	109	76	16	554	120	158	16	38	16

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	16	103	500	185	16	554	120	158	54	16
Volume Left (vph)	16	0	0	109	0	554	0	0	16	0
Volume Right (vph)	0	0	500	0	16	0	0	158	0	16
Hadj (s)	0.53	0.03	-0.67	0.33	-0.67	0.53	0.03	-0.67	0.18	-0.67
Departure Headway (s)	7.5	7.0	3.2	7.1	6.1	6.2	5.7	3.2	6.7	5.8
Degree Utilization, x	0.03	0.20	0.44	0.36	0.03	0.96	0.19	0.14	0.10	0.03
Capacity (veh/h)	461	498	1115	493	565	574	614	1121	513	582
Control Delay (s)	9.5	10.5	7.5	12.9	8.1	50.6	8.8	5.5	9.2	7.8
Approach Delay (s)	8.1			12.5		36.1			8.9	
Approach LOS	A			B		E			A	

Intersection Summary			
Delay	22.1		
HCM Level of Service	C		
Intersection Capacity Utilization	57.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	35	155	570	25	100	540
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	168	620	27	109	587
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1438	633			647	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1438	633			647	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	71	65			88	
cM capacity (veh/h)	130	480			939	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	207	647	696
Volume Left	38	0	109
Volume Right	168	27	0
cSH	588	1700	939
Volume to Capacity	0.35	0.38	0.12
Queue Length 95th (ft)	39	0	10
Control Delay (s)	21.6	0.0	2.9
Lane LOS	C		A
Approach Delay (s)	21.6	0.0	2.9
Approach LOS	C		

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
	↗	→	↙	←	↖	↑	↘	↓
Lane Configurations		✥		✥	↰	↑↱	↰	↑↱
Volume (vph)	105	5	10	15	30	980	60	660
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	25.0	25.0	25.0	25.0
Total Split (%)	44.4%	44.4%	44.4%	44.4%	55.6%	55.6%	55.6%	55.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		9.2		9.2	23.3	23.3	23.3	23.3
Actuated g/C Ratio		0.23		0.23	0.58	0.58	0.58	0.58
v/c Ratio		0.45		0.20	0.09	0.52	0.26	0.39
Control Delay		16.2		8.9	8.0	9.1	11.8	7.7
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		16.2		8.9	8.0	9.1	11.8	7.7
LOS		B		A	A	A	B	A
Approach Delay		16.2		8.9		9.1		8.0
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 45
Actuated Cycle Length: 40.1
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.52
Intersection Signal Delay: 9.1 — Intersection LOS: A
Intersection Capacity Utilization 60.0% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.

ø2	ø4
25 s	20 s
ø6	ø8
25 s	20 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Configurations		✥			✥		↰	↑↱		↰	↑↱	
Volume (vph)	105	5	25	10	15	45	30	980	10	60	660	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.98			0.91		1.00	1.00		1.00	0.99	
Flt Protected		0.96			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1748			1688		1770	3534		1770	3488	
Flt Permitted		0.72			0.92		0.35	1.00		0.23	1.00	
Satd. Flow (perm)		1313			1565		655	3534		426	3488	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	5	27	11	16	49	33	1065	11	65	717	76
RTOR Reduction (vph)	0	21	0	0	29	0	0	1	0	0	15	0
Lane Group Flow (vph)	0	125	0	0	47	0	33	1075	0	65	778	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.7			7.7		21.7	21.7		21.7	21.7	
Effective Green, g (s)		7.7			7.7		21.7	21.7		21.7	21.7	
Actuated g/C Ratio		0.19			0.19		0.52	0.52		0.52	0.52	
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		244			291		343	1852		223	1828	
v/s Ratio Prot								c0.30			0.22	
v/s Ratio Perm		c0.10			0.03		0.05			0.15		
v/c Ratio		0.51			0.16		0.10	0.58		0.29	0.43	
Uniform Delay, d1		15.2			14.1		4.9	6.7		5.5	6.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.8			0.3		0.1	0.5		0.7	0.2	
Delay (s)		17.0			14.4		5.1	7.2		6.3	6.2	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		17.0			14.4			7.1			6.2	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	7.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	41.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
11: Kaukahi Dr & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
9/22/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	95	25	10	45	15	5	10	640	55	35	520	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	103	27	11	49	16	5	11	696	60	38	565	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1367	1359	565	1383	1429	696	636			696		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1367	1359	565	1383	1429	696	636			696		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	3	81	98	50	87	99	99			96		
cM capacity (veh/h)	106	141	524	97	128	442	948			900		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	103	38	49	22	707	60	38	565	71
Volume Left	103	0	49	0	11	0	38	0	0
Volume Right	0	11	0	5	0	60	0	0	71
cSH	106	178	97	155	948	1700	900	1700	1700
Volume to Capacity	0.97	0.21	0.50	0.14	0.01	0.04	0.04	0.33	0.04
Queue Length 95th (ft)	151	20	56	12	1	0	3	0	0
Control Delay (s)	154.4	30.7	75.1	32.0	0.3	0.0	9.2	0.0	0.0
Lane LOS	F	D	F	D	A		A		
Approach Delay (s)	121.1		61.8		0.3		0.5		
Approach LOS	F		F						

Intersection Summary			
Average Delay	13.3		
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2016 WITH Project

Timings
1: Kilohana Dr & Piilani HWY

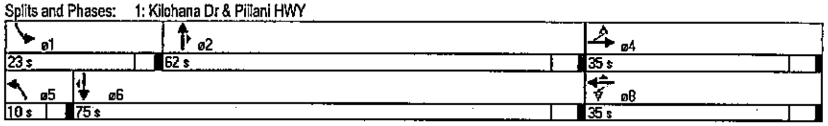
Austin, Tsutsumi & Associates, Inc.
1/13/2010

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	155	20	15	25	155	5	805	5	50	1395	150
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	35.0	35.0	35.0	35.0	35.0	10.0	62.0	62.0	23.0	75.0	75.0
Total Split (%)	29.2%	29.2%	29.2%	29.2%	29.2%	8.3%	51.7%	51.7%	19.2%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Min	Max	Max	Min	Max	Max

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 108.3
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY



HCM Signalized Intersection Capacity Analysis
1: Kilohana Dr & Piilani HWY

Austin, Tsutsumi & Associates, Inc.
1/13/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	155	20	10	15	25	155	5	805	5	50	1395	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1770		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.74	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1378	1770		1370	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	168	22	11	16	27	168	5	875	5	54	1516	163
RTOR Reduction (vph)	0	9	0	0	0	140	0	0	2	0	0	57
Lane Group Flow (vph)	168	24	0	16	27	28	5	875	3	54	1516	106
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	18.3	18.3		18.3	18.3	18.3	5.7	67.2	67.2	8.7	70.2	70.2
Effective Green, g (s)	18.3	18.3		18.3	18.3	18.3	5.7	67.2	67.2	8.7	70.2	70.2
Actuated g/C Ratio	0.17	0.17		0.17	0.17	0.17	0.05	0.62	0.62	0.08	0.65	0.65
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	233	299		232	315	268	93	2198	983	142	2296	1027
v/s Ratio Prot		0.01			0.01		0.00	0.25		c0.03	c0.43	
v/s Ratio Perm	c0.12			0.01		0.02			0.00			0.07
v/c Ratio	0.72	0.08		0.07	0.09	0.11	0.05	0.40	0.00	0.38	0.66	0.10
Uniform Delay, d1	42.5	37.9		37.8	37.9	38.0	48.7	10.3	7.8	47.2	11.7	7.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.5	0.1		0.1	0.1	0.2	0.2	0.5	0.0	1.7	1.5	0.2
Delay (s)	53.0	38.0		37.9	38.0	38.2	48.9	10.9	7.8	48.9	13.2	7.4
Level of Service	D	D		D	D	D	D	B	A	D	B	A
Approach Delay (s)		50.5			38.2			11.1			13.7	
Approach LOS		D			D			B			B	

Intersection Summary

HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	108.2	Sum of lost time (s)	14.0
Intersection Capacity Utilization	65.1%	ICU Level of Service	C
Analysis Period (min)	15		

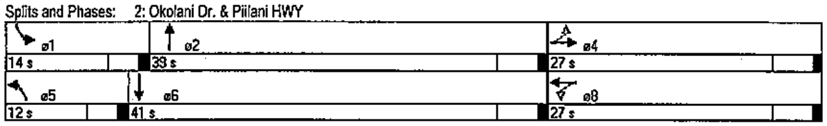
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✥	↰	↑↱	↰	↑↱
Volume (vph)	185	15	35	20	10	560	35	1210
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	27.0	27.0	27.0	27.0	12.0	39.0	14.0	41.0
Total Split (%)	33.8%	33.8%	33.8%	33.8%	15.0%	48.8%	17.5%	51.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 68
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Okolani Dr. & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✥		↰	↑↱		↰	↑↱	
Volume (vph)	185	15	25	35	20	70	10	560	15	35	1210	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.91			0.92		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1687			1698		1770	3526		1770	3486	
Flt Permitted	0.68	1.00			0.91		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1263	1687			1566		1770	3526		1770	3486	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	201	16	27	38	22	76	11	609	16	38	1315	147
RTOR Reduction (vph)	0	21	0	0	59	0	0	2	0	0	8	0
Lane Group Flow (vph)	201	22	0	0	77	0	11	623	0	38	1454	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	15.7	15.7			15.7		1.2	38.4		3.0	40.2	
Effective Green, g (s)	15.7	15.7			15.7		1.2	38.4		3.0	40.2	
Actuated g/C Ratio	0.22	0.22			0.22		0.02	0.54		0.04	0.57	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	279	373			346		30	1904		75	1971	
v/s Ratio Prot		0.01					0.01	0.18		c0.02	c0.42	
v/s Ratio Perm	c0.16				0.05							
v/c Ratio	0.72	0.06			0.22		0.37	0.33		0.51	0.74	
Uniform Delay, d1	25.7	21.9			22.7		34.6	9.1		33.3	11.5	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.8	0.1			0.3		7.4	0.5		5.3	2.5	
Delay (s)	34.5	21.9			23.0		42.0	9.6		38.6	14.0	
Level of Service	C	C			C		D	A		D	B	
Approach Delay (s)		32.3			23.0			10.2			14.7	
Approach LOS		C			C			B			B	

Intersection Summary

HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	71.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	63.0%	ICU Level of Service	B
Analysis Period (min)	15		

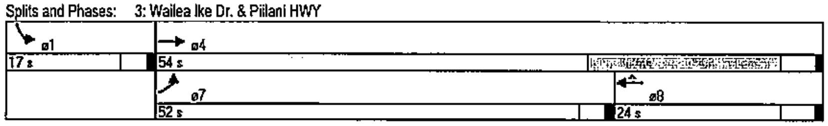
c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰↰	↑	↑	↱	↰	↱
Volume (vph)	525	55	40	110	150	1210
Turn Type	Prot			Perm		Free
Protected Phases	7	4	8		1	
Permitted Phases				8		Free
Detector Phase	7	4	8	8	1	
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	3.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	7.0	
Total Split (s)	52.0	54.0	24.0	24.0	17.0	0.0
Total Split (%)	55.9%	58.1%	25.8%	25.8%	18.3%	0.0%
Yellow Time (s)	3.0	4.0	4.0	4.0	3.0	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	5.0	4.0	4.0
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	None	

Intersection Summary

Cycle Length: 93
Actuated Cycle Length: 38.4
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Wailea Ike Dr. & Piilani HWY



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰↰	↑	↑	↱	↰	↱
Volume (vph)	525	55	40	110	150	1210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	5.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	571	60	43	120	163	1315
RTOR Reduction (vph)	0	0	0	105	0	0
Lane Group Flow (vph)	571	60	43	15	163	1315
Turn Type	Prot			Perm		Free
Protected Phases	7	4	8		1	
Permitted Phases				8		Free
Actuated Green, G (s)	14.2	23.0	4.8	4.8	7.2	39.2
Effective Green, g (s)	14.2	23.0	4.8	4.8	7.2	39.2
Actuated g/C Ratio	0.36	0.59	0.12	0.12	0.18	1.00
Clearance Time (s)	4.0	5.0	5.0	5.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1244	1093	228	194	325	1583
v/s Ratio Prot	0.17	0.03	0.02		0.09	
v/s Ratio Perm				0.01		c0.83
v/c Ratio	0.46	0.05	0.19	0.08	0.50	0.83
Uniform Delay, d1	9.6	3.5	15.5	15.2	14.4	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.0	0.4	0.2	1.2	5.2
Delay (s)	9.8	3.5	15.9	15.4	15.6	5.2
Level of Service	A	A	B	B	B	A
Approach Delay (s)		9.2	15.5		6.4	
Approach LOS		A	B		A	

Intersection Summary

HCM Average Control Delay	7.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	39.2	Sum of lost time (s)	0.0
Intersection Capacity Utilization	37.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	455	25	130	1100	35	80
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	495	27	141	1196	38	87
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				749		
pX, platoon unblocked						
vC, conflicting volume			522		1389	261
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			522		1389	261
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			86		67	88
cM capacity (veh/h)			1041		115	738

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	330	192	141	598	598	38	87
Volume Left	0	0	141	0	0	38	0
Volume Right	0	27	0	0	0	0	87
cSH	1700	1700	1041	1700	1700	115	738
Volume to Capacity	0.19	0.11	0.14	0.35	0.35	0.33	0.12
Queue Length 95th (ft)	0	0	12	0	0	32	10
Control Delay (s)	0.0	0.0	9.0	0.0	0.0	50.8	10.5
Lane LOS			A			F	B
Approach Delay (s)	0.0		1.0			22.8	
Approach LOS						C	

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	40.4%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	860	190	175	320	145	425
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Detector Phase	8	8	2	2 8	1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	30.0	30.0	25.0	55.0	15.0	40.0
Total Split (%)	42.9%	42.9%	35.7%	78.6%	21.4%	57.1%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	Max		None	Max

Intersection Summary

Cycle Length: 70
Actuated Cycle Length: 67.5
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.

ø1 15 s	ø2 25 s	
ø6 40 s		ø8 30 s

HCM Signalized Intersection Capacity Analysis
7: Wailea Ike Dr. & Wailea Alanui Dr.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	860	190	175	320	145	425
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lane Util. Factor	0.97	1.00	1.00	0.88	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1863	2787	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1863	2787	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	935	207	190	348	158	462
RTOR Reduction (vph)	0	136	0	83	0	0
Lane Group Flow (vph)	935	71	190	265	158	462
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Actuated Green, G (s)	23.3	23.3	23.7	52.0	8.3	36.0
Effective Green, g (s)	23.3	23.3	23.7	52.0	8.3	36.0
Actuated g/C Ratio	0.34	0.34	0.35	0.76	0.12	0.53
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	1171	540	646	2122	215	1865
v/s Ratio Prot	c0.27		c0.10	0.10	c0.09	0.13
v/s Ratio Perm		0.04				
v/c Ratio	0.80	0.13	0.29	0.12	0.73	0.25
Uniform Delay, d1	20.4	15.5	16.2	2.1	28.9	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.9	0.1	1.2	0.0	12.2	0.3
Delay (s)	24.3	15.6	17.4	2.2	41.2	9.1
Level of Service	C	B	B	A	D	A
Approach Delay (s)	22.7		7.5			17.3
Approach LOS	C		A			B

Intersection Summary

HCM Average Control Delay	17.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	68.3	Sum of lost time (s)	13.0
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
8: Okolani Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	10	50	450	100	65	5	210	30	55	10	70	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	54	489	109	71	5	228	33	60	11	76	11

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	11	54	489	179	5	228	33	60	87	11
Volume Left (vph)	11	0	0	109	0	228	0	0	11	0
Volume Right (vph)	0	0	489	0	5	0	0	60	0	11
Hadj (s)	0.53	0.03	-0.67	0.34	-0.67	0.53	0.03	-0.67	0.10	-0.67
Departure Headway (s)	6.3	5.8	3.2	5.9	4.9	5.9	5.4	3.2	5.6	4.9
Degree Utilization, x	0.02	0.09	0.43	0.29	0.01	0.37	0.05	0.05	0.14	0.01
Capacity (veh/h)	536	585	1115	583	689	594	641	1121	608	695
Control Delay (s)	8.2	8.1	7.4	10.1	6.7	11.1	7.4	5.2	8.3	6.7
Approach Delay (s)	7.5			10.0		9.6			8.1	
Approach LOS	A			B		A			A	

Intersection Summary

Delay	8.5		
HCM Level of Service	A		
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Kilohana Dr & South Kihei Rd

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↱↑			↰↑
Volume (veh/h)	10	95	260	10	95	485
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	103	283	11	103	527
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1022	288			293	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1022	288			293	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	86			92	
cM capacity (veh/h)	240	751			1268	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	114	293	630
Volume Left	11	0	103
Volume Right	103	11	0
cSH	830	1700	1268
Volume to Capacity	0.14	0.17	0.08
Queue Length 95th (ft)	12	0	7
Control Delay (s)	11.5	0.0	2.1
Lane LOS	B		A
Approach Delay (s)	11.5	0.0	2.1
Approach LOS	B		

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	58.4%	ICU Level of Service	B
Analysis Period (min)	15		

Timings
10: Grand Wailea Resort & Wailea Alanui Dr.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✥		✥	↰	↑↑	↰	↑↑
Volume (vph)	35	5	10	5	20	370	180	840
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (%)	45.5%	45.5%	45.5%	45.5%	54.5%	54.5%	54.5%	54.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min

Intersection Summary

Cycle Length: 44
Actuated Cycle Length: 33.5
Natural Cycle: 45
Control Type: Actuated-Uncoordinated

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.

ø2	ø4
24 s	20 s
ø6	ø8
24 s	20 s

HCM Signalized Intersection Capacity Analysis
10: Grand Wailea Resort & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
10/19/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥		↰	↑↑		↰	↑↑	
Volume (vph)	35	5	15	10	5	50	20	370	25	180	840	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.96			0.90		1.00	0.99		1.00	0.98	
Flt Protected		0.97			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1739			1656		1770	3506		1770	3483	
Flt Permitted		1.00			0.93		0.28	1.00		0.50	1.00	
Satd. Flow (perm)		1795			1555		512	3506		935	3483	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	5	16	11	5	54	22	402	27	196	913	109
RTOR Reduction (vph)	0	15	0	0	50	0	0	7	0	0	13	0
Lane Group Flow (vph)	0	44	0	0	20	0	22	422	0	196	1009	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		2.8			2.8		23.9	23.9		23.9	23.9	
Effective Green, g (s)		2.8			2.8		23.9	23.9		23.9	23.9	
Actuated g/C Ratio		0.08			0.08		0.65	0.65		0.65	0.65	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		137			119		333	2283		609	2268	
v/s Ratio Prot								0.12			c0.29	
v/s Ratio Perm		c0.02			0.01		0.04			0.21		
v/c Ratio		0.32			0.17		0.07	0.18		0.32	0.44	
Uniform Delay, d1		16.1			15.9		2.3	2.5		2.8	3.1	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.4			0.7		0.1	0.0		0.3	0.1	
Delay (s)		17.4			16.5		2.4	2.6		3.1	3.3	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		17.4			16.5			2.6			3.3	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	4.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	36.7	Sum of lost time (s)	10.0
Intersection Capacity Utilization	51.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
11: Kaukahi Dr & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
10/19/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			↰↑	↱	↰	↑	↱
Volume (veh/h)	30	20	5	65	30	40	5	245	25	25	440	140
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	22	5	71	33	43	5	266	27	27	478	152
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	826	810	478	826	962	266	630			266		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	826	810	478	826	962	266	630			266		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	87	93	99	74	87	94	99			98		
cM capacity (veh/h)	242	306	587	267	249	772	952			1298		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	33	27	71	76	272	27	27	478	152
Volume Left	33	0	71	0	5	0	27	0	0
Volume Right	0	5	0	43	0	27	0	0	152
cSH	242	338	267	407	952	1700	1298	1700	1700
Volume to Capacity	0.13	0.08	0.26	0.19	0.01	0.02	0.02	0.28	0.09
Queue Length 95th (ft)	11	7	26	17	0	0	2	0	0
Control Delay (s)	22.2	16.6	23.2	15.9	0.2	0.0	7.8	0.0	0.0
Lane LOS	C	C	C	C	A		A		
Approach Delay (s)	19.6		19.4		0.2		0.3		
Approach LOS	C		C						

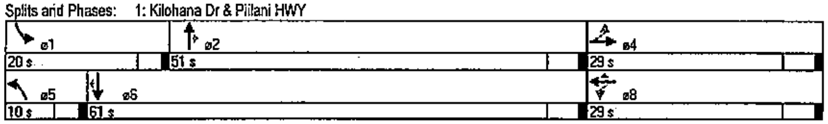
Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	40.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	175	35	10	30	135	20	1650	15	160	1380	230
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	29.0	29.0	29.0	29.0	29.0	10.0	51.0	51.0	20.0	61.0	61.0
Total Split (%)	29.0%	29.0%	29.0%	29.0%	29.0%	10.0%	51.0%	51.0%	20.0%	61.0%	61.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Min	Max	Max	Min	Max	Max

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 93.7
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	35	10	10	30	135	20	1650	15	160	1380	230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1800		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.73	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1370	1800		1351	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	38	11	11	33	147	22	1793	16	174	1500	250
RTOR Reduction (vph)	0	9	0	0	0	119	0	0	6	0	0	100
Lane Group Flow (vph)	190	40	0	11	33	28	22	1793	10	174	1500	150
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	17.6	17.6		17.6	17.6	17.6	5.9	48.7	48.7	13.4	56.2	56.2
Effective Green, g (s)	17.6	17.6		17.6	17.6	17.6	5.9	48.7	48.7	13.4	56.2	56.2
Actuated g/C Ratio	0.19	0.19		0.19	0.19	0.19	0.06	0.52	0.52	0.14	0.60	0.60
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	257	338		254	350	297	111	1839	823	253	2123	949
v/s Ratio Prot		0.02			0.02		0.01	c0.51		c0.10	0.42	
v/s Ratio Perm	c0.14			0.01		0.02			0.01			0.09
v/c Ratio	0.74	0.12		0.04	0.09	0.09	0.20	0.97	0.01	0.69	0.71	0.16
Uniform Delay, d1	35.9	31.6		31.2	31.5	31.5	41.7	21.9	10.9	38.2	13.0	8.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.6	0.2		0.1	0.1	0.1	0.9	15.8	0.0	7.6	2.0	0.4
Delay (s)	46.5	31.8		31.2	31.6	31.6	42.5	37.8	10.9	45.7	15.0	8.6
Level of Service	D	C		C	C	C	D	D	B	D	B	A
Approach Delay (s)		43.5			31.6			37.6			17.0	
Approach LOS		D			C			D			B	

Intersection Summary

HCM Average Control Delay	28.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	93.7	Sum of lost time (s)	14.0
Intersection Capacity Utilization	82.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✣	↰	↑↱	↰	↑↱
Volume (vph)	250	35	15	20	40	1330	80	1030
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	34.0	34.0	34.0	34.0	12.0	52.0	14.0	54.0
Total Split (%)	34.0%	34.0%	34.0%	34.0%	12.0%	52.0%	14.0%	54.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 91.5
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Okolani Dr. & Piilani HWY

ø1	ø2	ø4
14 s	52 s	34 s
ø5	ø6	ø8
12 s	54 s	34 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✣		↰	↑↱		↰	↑↱	
Volume (vph)	250	35	30	15	20	45	40	1330	40	80	1030	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.93			0.92		1.00	1.00		1.00	0.97	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1733			1705		1770	3524		1770	3429	
Flt Permitted	0.73	1.00			0.95		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1363	1733			1635		1770	3524		1770	3429	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	38	33	16	22	49	43	1446	43	87	1120	293
RTOR Reduction (vph)	0	25	0	0	37	0	0	2	0	0	20	0
Lane Group Flow (vph)	272	46	0	0	50	0	43	1487	0	87	1393	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	22.5	22.5			22.5		4.4	49.3		7.3	52.2	
Effective Green, g (s)	22.5	22.5			22.5		4.4	49.3		7.3	52.2	
Actuated g/C Ratio	0.24	0.24			0.24		0.05	0.53		0.08	0.56	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	329	419			395		84	1866		139	1923	
v/s Ratio Prot		0.03					0.02	c0.42		c0.05	c0.41	
v/s Ratio Perm	c0.20				0.03							
v/c Ratio	0.83	0.11			0.13		0.51	0.80		0.63	0.72	
Uniform Delay, d1	33.5	27.5			27.6		43.3	17.8		41.6	15.1	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	15.5	0.1			0.1		5.2	3.6		8.5	2.4	
Delay (s)	49.0	27.6			27.8		48.5	21.5		50.1	17.5	
Level of Service	D	C			C		D	C		D	B	
Approach Delay (s)		44.5			27.8			22.2			19.4	
Approach LOS		D			C			C			B	

Intersection Summary

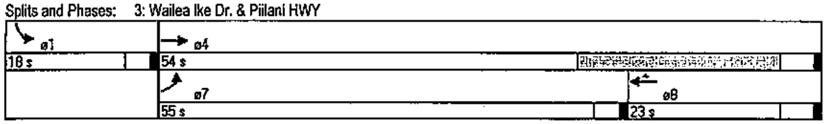
HCM Average Control Delay	23.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	93.1	Sum of lost time (s)	19.0
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰↰	↑	↑	↱	↰	↱
Volume (vph)	1305	80	100	285	255	880
Turn Type	Prot			Perm		Free
Protected Phases	7	4	8		1	
Permitted Phases				8		Free
Detector Phase	7	4	8	8	1	
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	3.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	7.0	
Total Split (s)	55.0	54.0	23.0	23.0	18.0	0.0
Total Split (%)	57.3%	56.3%	24.0%	24.0%	18.8%	0.0%
Yellow Time (s)	3.0	4.0	4.0	4.0	3.0	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	5.0	4.0	4.0
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	None	

Intersection Summary

Cycle Length: 96
Actuated Cycle Length: 75.6
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Wailea Ike Dr. & Piilani HWY



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰↰	↑	↑	↱	↰	↱
Volume (vph)	1305	80	100	285	255	880
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	5.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1418	87	109	310	277	957
RTOR Reduction (vph)	0	0	0	221	0	0
Lane Group Flow (vph)	1418	87	109	89	277	957
Turn Type	Prot			Perm		Free
Protected Phases	7	4	8		1	
Permitted Phases				8		Free
Actuated Green, G (s)	37.1	51.9	10.8	10.8	14.4	75.3
Effective Green, g (s)	37.1	51.9	10.8	10.8	14.4	75.3
Actuated g/C Ratio	0.49	0.69	0.14	0.14	0.19	1.00
Clearance Time (s)	4.0	5.0	5.0	5.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1691	1284	267	227	338	1583
v/s Ratio Prot	c0.41	0.05	0.06		c0.16	
v/s Ratio Perm				0.06		c0.60
v/c Ratio	0.84	0.07	0.41	0.39	0.82	0.60
Uniform Delay, d1	16.5	3.8	29.3	29.3	29.2	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.8	0.0	1.0	1.1	14.3	1.7
Delay (s)	20.3	3.8	30.4	30.4	43.5	1.7
Level of Service	C	A	C	C	D	A
Approach Delay (s)		19.4	30.4		11.1	
Approach LOS		B	C		B	

Intersection Summary

HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	75.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
4: Wailea Ike Dr. & Kalai Waa St

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1110	75	120	830	65	160
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1207	82	130	902	71	174
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				749		
pX, platoon unblocked						
vC, conflicting volume			1288		1959	644
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1288		1959	644
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			76		0	58
cM capacity (veh/h)			534		42	416

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	804	484	130	451	451	71	174
Volume Left	0	0	130	0	0	71	0
Volume Right	0	82	0	0	0	0	174
cSH	1700	1700	534	1700	1700	42	416
Volume to Capacity	0.47	0.28	0.24	0.27	0.27	1.68	0.42
Queue Length 95th (ft)	0	0	24	0	0	181	51
Control Delay (s)	0.0	0.0	13.9	0.0	0.0	542.1	19.8
Lane LOS			B			F	C
Approach Delay (s)	0.0		1.8			170.6	
Approach LOS						F	

Intersection Summary			
Average Delay	17.0		
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		

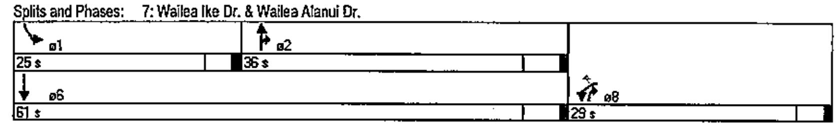
Timings
7: Wailea Ike Dr. & Wailea Alanui Dr.

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	565	240	405	805	255	375
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Detector Phase	8	8	2	2 8	1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	29.0	29.0	36.0	65.0	25.0	61.0
Total Split (%)	32.2%	32.2%	40.0%	72.2%	27.8%	67.8%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	Max		None	Max

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 87.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



HCM Signalized Intersection Capacity Analysis
7: Wailea Ike Dr. & Wailea Alanui Dr.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	565	240	405	805	255	375
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lane Util. Factor	0.97	1.00	1.00	0.88	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1863	2787	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1863	2787	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	614	261	440	875	277	408
RTOR Reduction (vph)	0	194	0	120	0	0
Lane Group Flow (vph)	614	67	440	755	277	408
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Actuated Green, G (s)	22.6	22.6	34.4	62.0	17.7	56.1
Effective Green, g (s)	22.6	22.6	34.4	62.0	17.7	56.1
Actuated g/C Ratio	0.26	0.26	0.39	0.71	0.20	0.64
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	885	408	731	1970	357	2264
v/s Ratio Prot	c0.18		c0.24	0.27	c0.16	0.12
v/s Ratio Perm		0.04				
v/c Ratio	0.69	0.16	0.60	0.38	0.78	0.18
Uniform Delay, d1	29.4	25.2	21.2	5.2	33.1	6.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.4	0.2	3.6	0.1	10.1	0.2
Delay (s)	31.8	25.4	24.9	5.3	43.2	6.6
Level of Service	C	C	C	A	D	A
Approach Delay (s)	29.9		11.8			21.4
Approach LOS	C		B			C

Intersection Summary			
HCM Average Control Delay	19.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	87.7	Sum of lost time (s)	13.0
Intersection Capacity Utilization	62.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
8: Okolani Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	15	90	430	95	70	15	460	105	145	15	30	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	98	467	103	76	16	500	114	158	16	33	16

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	16	98	467	179	16	500	114	158	49	16
Volume Left (vph)	16	0	0	103	0	500	0	0	16	0
Volume Right (vph)	0	0	467	0	16	0	0	158	0	16
Hadj (s)	0.53	0.03	-0.67	0.32	-0.67	0.53	0.03	-0.67	0.20	-0.67
Departure Headway (s)	7.3	6.8	3.2	6.9	5.9	6.1	5.6	3.2	6.5	5.7
Degree Utilization, x	0.03	0.18	0.42	0.34	0.03	0.85	0.18	0.14	0.09	0.03
Capacity (veh/h)	463	499	1115	496	568	580	621	1121	517	588
Control Delay (s)	9.3	10.1	7.3	12.3	7.9	33.4	8.6	5.5	9.0	7.6
Approach Delay (s)	7.8			11.9		24.0			8.6	
Approach LOS	A			B		C			A	

Intersection Summary			
Delay	16.1		
HCM Level of Service	C		
Intersection Capacity Utilization	54.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	35	150	520	25	100	510
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	163	565	27	109	554
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1351	579			592	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1351	579			592	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	74	68			89	
cM capacity (veh/h)	147	515			983	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	201	592	663
Volume Left	38	0	109
Volume Right	163	27	0
cSH	635	1700	983
Volume to Capacity	0.32	0.35	0.11
Queue Length 95th (ft)	34	0	9
Control Delay (s)	19.5	0.0	2.7
Lane LOS	C		A
Approach Delay (s)	19.5	0.0	2.7
Approach LOS	C		

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✥		✥	↰	↑↑	↰	↑↑
Volume (vph)	105	5	10	15	30	930	60	635
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (%)	45.5%	45.5%	45.5%	45.5%	54.5%	54.5%	54.5%	54.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min

Intersection Summary

Cycle Length: 44
Actuated Cycle Length: 37.4
Natural Cycle: 45
Control Type: Actuated-Uncoordinated

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.

ø2 24 s	ø4 20 s
ø6 24 s	ø8 20 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥		↰	↑↑		↰	↑↑	
Volume (vph)	105	5	25	10	15	45	30	930	10	60	635	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.98			0.91		1.00	1.00		1.00	0.99	
Flt Protected		0.96			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1748			1688		1770	3534		1770	3490	
Flt Permitted		0.72			0.93		0.36	1.00		0.25	1.00	
Satd. Flow (perm)		1313			1582		676	3534		461	3490	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	5	27	11	16	49	33	1011	11	65	690	71
RTOR Reduction (vph)	0	22	0	0	38	0	0	1	0	0	14	0
Lane Group Flow (vph)	0	124	0	0	38	0	33	1021	0	65	747	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.5			7.5		21.1	21.1		21.1	21.1	
Effective Green, g (s)		7.5			7.5		21.1	21.1		21.1	21.1	
Actuated g/C Ratio		0.19			0.19		0.55	0.55		0.55	0.55	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		255			307		370	1932		252	1908	
v/s Ratio Prot								c0.29			0.21	
v/s Ratio Perm		c0.09			0.02		0.05			0.14		
v/c Ratio		0.49			0.12		0.09	0.53		0.26	0.39	
Uniform Delay, d1		13.8			12.8		4.2	5.6		4.6	5.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.5			0.2		0.1	0.3		0.5	0.1	
Delay (s)		15.3			13.0		4.3	5.8		5.2	5.2	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		15.3			13.0			5.8			5.2	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	6.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	38.6	Sum of lost time (s)	10.0
Intersection Capacity Utilization	56.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			↰↑	↱	↰	↑	↱
Volume (veh/h)	90	25	10	60	15	15	10	590	80	40	495	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	27	11	65	16	16	11	641	87	43	538	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1296	1288	538	1312	1359	641	609			641		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1296	1288	538	1312	1359	641	609			641		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	16	82	98	41	88	97	99			95		
cM capacity (veh/h)	117	155	543	110	140	475	970			943		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	98	38	65	33	652	87	43	538	71
Volume Left	98	0	65	0	11	0	43	0	0
Volume Right	0	11	0	16	0	87	0	0	71
cSH	117	194	110	216	970	1700	943	1700	1700
Volume to Capacity	0.84	0.20	0.59	0.15	0.01	0.05	0.05	0.32	0.04
Queue Length 95th (ft)	124	18	72	13	1	0	4	0	0
Control Delay (s)	112.5	28.0	77.0	24.6	0.3	0.0	9.0	0.0	0.0
Lane LOS	F	D	F	C	A		A		
Approach Delay (s)	88.8		59.5		0.3		0.6		
Approach LOS	F		F						

Intersection Summary			
Average Delay	11.4		
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		

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APPENDIX C

LEVEL OF SERVICE CALCULATIONS

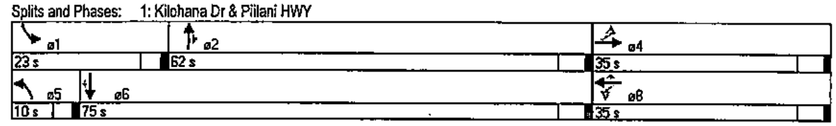
- Future Year 2018 WITH Project

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	155	20	15	30	155	5	970	5	50	1590	150
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	35.0	35.0	35.0	35.0	35.0	10.0	62.0	62.0	23.0	75.0	75.0
Total Split (%)	29.2%	29.2%	29.2%	29.2%	29.2%	8.3%	51.7%	51.7%	19.2%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Min	Max	Max	Min	Max	Max
Act Effct Green (s)	18.5	18.5	18.5	18.5	18.5	5.7	67.2	67.2	8.7	70.2	70.2
Actuated g/C Ratio	0.17	0.17	0.17	0.17	0.17	0.05	0.62	0.62	0.08	0.65	0.65
v/c Ratio	0.72	0.11	0.07	0.10	0.41	0.05	0.48	0.01	0.38	0.75	0.15
Control Delay	59.9	27.9	37.1	37.6	8.9	52.8	13.2	7.0	56.0	16.9	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.9	27.9	37.1	37.6	8.9	52.8	13.2	7.0	56.0	16.9	2.5
LOS	E	C	D	D	A	D	B	A	E	B	A
Approach Delay		54.7		15.3			13.4			16.8	
Approach LOS		D		B			B			B	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 108.4
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 17.9 — Intersection LOS: B
Intersection Capacity Utilization 67.5% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 1: Kilohana Dr & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	155	20	10	15	30	155	5	970	5	50	1590	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1770		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.74	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1370	1770		1370	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	168	22	11	16	33	168	5	1054	5	54	1728	163
RTOR Reduction (vph)	0	9	0	0	0	139	0	0	2	0	0	50
Lane Group Flow (vph)	168	24	0	16	33	29	5	1054	3	54	1728	113
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	18.5	18.5		18.5	18.5	18.5	5.7	67.2	67.2	8.7	70.2	70.2
Effective Green, g (s)	18.5	18.5		18.5	18.5	18.5	5.7	67.2	67.2	8.7	70.2	70.2
Actuated g/C Ratio	0.17	0.17		0.17	0.17	0.17	0.05	0.62	0.62	0.08	0.65	0.65
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	234	302		234	318	270	93	2194	981	142	2292	1025
v/s Ratio Prot		0.01			0.02		0.00	0.30		c0.03	c0.49	
v/s Ratio Perm	c0.12			0.01		0.02			0.00			0.07
v/c Ratio	0.72	0.08		0.07	0.10	0.11	0.05	0.48	0.00	0.38	0.75	0.11
Uniform Delay, d1	42.5	37.8		37.7	38.0	38.0	48.8	11.2	7.8	47.3	13.2	7.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.1	0.1		0.1	0.1	0.2	0.2	0.8	0.0	1.7	2.4	0.2
Delay (s)	52.5	37.9		37.8	38.1	38.1	49.0	11.9	7.9	49.0	15.5	7.5
Level of Service	D	D		D	D	D	D	B	A	D	B	A
Approach Delay (s)		50.1			38.1			12.1			15.8	
Approach LOS		D			D			B			B	

Intersection Summary

HCM Average Control Delay	18.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	108.4	Sum of lost time (s)	14.0
Intersection Capacity Utilization	67.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✣	↰	↑↱	↰	↑↱
Volume (vph)	185	15	35	20	10	725	35	1400
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	27.0	27.0	27.0	27.0	12.0	39.0	14.0	41.0
Total Split (%)	33.8%	33.8%	33.8%	33.8%	15.0%	48.8%	17.5%	51.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	15.7	15.7		15.7	6.1	37.7	7.1	40.2
Actuated g/C Ratio	0.23	0.23		0.23	0.09	0.55	0.10	0.59
v/c Ratio	0.69	0.10		0.32	0.07	0.41	0.21	0.81
Control Delay	36.9	12.4		13.0	32.8	11.8	32.7	17.5
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	36.9	12.4		13.0	32.8	11.8	32.7	17.5
LOS	D	B		B	C	B	C	B
Approach Delay		32.6		13.0		12.1		17.8
Approach LOS		C		B		B		B

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 68
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 17.2 — Intersection LOS: B
Intersection Capacity Utilization 68.2% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY

ø1	ø2	ø4
14 s	39 s	27 s

ø5	ø6	ø8
12 s	41 s	27 s

HCM Signalized Intersection Capacity Analysis
2: Okolani Dr. & Piilani HWY

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	185	15	25	35	20	70	10	725	15	35	1400	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.91			0.92		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1687			1698		1770	3529		1770	3492	
Flt Permitted	0.68	1.00			0.91		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1263	1687			1566		1770	3529		1770	3492	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	201	16	27	38	22	76	11	788	16	38	1522	147
RTOR Reduction (vph)	0	21	0	0	59	0	0	1	0	0	7	0
Lane Group Flow (vph)	201	22	0	0	77	0	11	803	0	38	1662	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	15.7	15.7			15.7		1.2	38.4		3.0	40.2	
Effective Green, g (s)	15.7	15.7			15.7		1.2	38.4		3.0	40.2	
Actuated g/C Ratio	0.22	0.22			0.22		0.02	0.54		0.04	0.57	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	279	373			346		30	1906		75	1974	
v/s Ratio Prot		0.01					0.01	0.23		c0.02	c0.48	
v/s Ratio Perm	c0.16				0.05							
v/c Ratio	0.72	0.06			0.22		0.37	0.42		0.51	0.84	
Uniform Delay, d1	25.7	21.9			22.7		34.6	9.7		33.3	12.8	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.8	0.1			0.3		7.4	0.7		5.3	4.6	
Delay (s)	34.5	21.9			23.0		42.0	10.4		38.6	17.4	
Level of Service	C	C			C		D	B		D	B	
Approach Delay (s)		32.3			23.0			10.8			17.9	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	71.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Timings
3: Wailea Ike Dr. & Piilani HWY

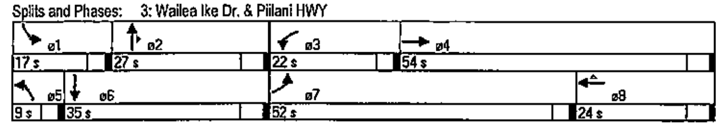
Austin, Tsutsumi & Associates, Inc.
7/31/2009

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	590	70	5	65	120	20	105	5	130	70	1355
Turn Type	Prot		Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4	3	8		5	2		1	6	
Permitted Phases					8			2			Free
Detector Phase	7	4	3	8	8	5	2	2	1	6	
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	7.0	27.0	27.0	7.0	27.0	
Total Split (s)	52.0	54.0	22.0	24.0	24.0	9.0	27.0	27.0	17.0	35.0	0.0
Total Split (%)	43.3%	45.0%	18.3%	20.0%	20.0%	7.5%	22.5%	22.5%	14.2%	29.2%	0.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?											
Recall Mode	None	None	Min	None	None	Min	Min	Min	None	Min	
Act Effct Green (s)	17.1	17.7	10.1	8.0	8.0	5.1	7.7	7.7	8.2	10.8	59.4
Actuated g/C Ratio	0.29	0.30	0.17	0.13	0.13	0.09	0.13	0.13	0.14	0.18	1.00
v/c Ratio	0.65	0.16	0.02	0.28	0.40	0.14	0.25	0.02	0.30	0.22	0.93
Control Delay	22.3	14.0	29.0	28.5	10.1	31.8	27.1	18.0	26.8	24.2	13.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.3	14.0	29.0	28.5	10.1	31.8	27.1	18.0	26.8	24.2	13.5
LOS	C	B	C	C	B	C	C	B	C	C	B
Approach Delay		21.3		16.9			27.5			15.1	
Approach LOS		C		B			C			B	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 59.4
Natural Cycle: 85
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.93
Intersection Signal Delay: 17.5 — Intersection LOS: B
Intersection Capacity Utilization 42.2% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Wailea Ike Dr. & Piilani HWY



HCM Signalized Intersection Capacity Analysis
3: Wailea Ike Dr. & Piilani HWY

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑	↱	↰	↑↑	↱	↰↰	↑	↱
Volume (vph)	590	70	10	5	65	120	20	105	5	130	70	1355
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.95	1.00	0.97	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	1827		1770	1863	1583	1770	3539	1583	3433	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	1827		1770	1863	1583	1770	3539	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	641	76	11	5	71	130	22	114	5	141	76	1473
RTOR Reduction (vph)	0	5	0	0	0	110	0	0	4	0	0	0
Lane Group Flow (vph)	641	82	0	5	71	20	22	114	1	141	76	1473
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8			2			Free
Actuated Green, G (s)	17.1	16.3		10.1	9.3	9.3	5.1	7.7	7.7	8.2	10.8	60.3
Effective Green, g (s)	17.1	16.3		10.1	9.3	9.3	5.1	7.7	7.7	8.2	10.8	60.3
Actuated g/C Ratio	0.28	0.27		0.17	0.15	0.15	0.08	0.13	0.13	0.14	0.18	1.00
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	974	494		296	287	244	150	452	202	467	334	1583
v/s Ratio Prot	0.19	0.04		0.00	0.04		0.01	0.03		0.04	0.04	
v/s Ratio Perm						0.01			0.00			c0.93
v/c Ratio	0.66	0.17		0.02	0.25	0.08	0.15	0.25	0.00	0.30	0.23	0.93
Uniform Delay, d1	19.0	16.8		21.0	22.4	21.8	25.6	23.7	23.0	23.5	21.2	0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.6	0.2		0.0	0.5	0.1	0.5	0.3	0.0	0.4	0.3	11.2
Delay (s)	20.6	17.0		21.0	22.9	22.0	26.0	24.0	23.0	23.8	21.5	11.2
Level of Service	C	B		C	C	C	C	C	C	C	C	B
Approach Delay (s)		20.2			22.3			24.3			12.7	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM Average Control Delay	16.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	60.3	Sum of lost time (s)	0.0
Intersection Capacity Utilization	42.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
4: Wailea Ike Dr. & Kalai Waa St

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	490	60	255	1155	50	120
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	533	65	277	1255	54	130
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				749		
pX, platoon unblocked						
vC, conflicting volume			598		1747	299
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			598		1747	299
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			72		2	81
cM capacity (veh/h)			975		55	697

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	355	243	277	628	628	54	130
Volume Left	0	0	277	0	0	54	0
Volume Right	0	65	0	0	0	0	130
cSH	1700	1700	975	1700	1700	55	697
Volume to Capacity	0.21	0.14	0.28	0.37	0.37	0.98	0.19
Queue Length 95th (ft)	0	0	29	0	0	112	17
Control Delay (s)	0.0	0.0	10.2	0.0	0.0	236.6	11.3
Lane LOS			B			F	B
Approach Delay (s)	0.0		1.8			77.6	
Approach LOS						F	

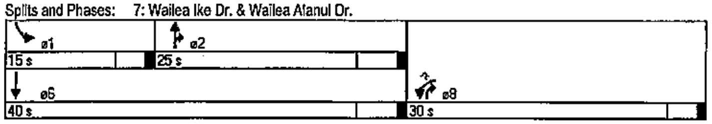
Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	905	215	180	350	190	430
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Detector Phase	8	8	2	2 8	1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	30.0	30.0	25.0	55.0	15.0	40.0
Total Split (%)	42.9%	42.9%	35.7%	78.6%	21.4%	57.1%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	Max		None	Max
Act Effct Green (s)	24.0	24.0	20.6	48.6	10.5	35.1
Actuated g/C Ratio	0.35	0.35	0.30	0.71	0.15	0.52
v/c Ratio	0.81	0.33	0.35	0.18	0.76	0.26
Control Delay	26.2	3.8	21.7	0.8	47.9	10.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.2	3.8	21.7	0.8	47.9	10.1
LOS	C	A	C	A	D	B
Approach Delay	21.9		7.9			21.7
Approach LOS	C		A			C

Intersection Summary

Cycle Length: 70
Actuated Cycle Length: 68.1
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 18.6 — Intersection LOS: B
Intersection Capacity Utilization 56.7% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	905	215	180	350	190	430
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lane Util. Factor	0.97	1.00	1.00	0.88	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1863	2787	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1863	2787	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	984	234	196	380	207	467
RTOR Reduction (vph)	0	152	0	93	0	0
Lane Group Flow (vph)	984	82	196	287	207	467
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Actuated Green, G (s)	24.0	24.0	20.6	49.6	10.5	35.1
Effective Green, g (s)	24.0	24.0	20.6	49.6	10.5	35.1
Actuated g/C Ratio	0.35	0.35	0.30	0.73	0.15	0.52
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	1210	558	564	2030	273	1824
v/s Ratio Prot	c0.29		c0.11	0.10	c0.12	0.13
v/s Ratio Perm		0.05				
v/c Ratio	0.81	0.15	0.35	0.14	0.76	0.26
Uniform Delay, d1	20.0	15.1	18.5	2.8	27.6	9.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.3	0.1	1.7	0.0	11.4	0.3
Delay (s)	24.3	15.2	20.2	2.8	39.0	9.6
Level of Service	C	B	C	A	D	A
Approach Delay (s)	22.6		8.7			18.6
Approach LOS	C		A			B

Intersection Summary

HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	68.1	Sum of lost time (s)	13.0
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	10	50	495	105	65	5	240	30	60	10	70	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	54	538	114	71	5	261	33	65	11	76	11

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	11	54	538	185	5	261	33	65	87	11
Volume Left (vph)	11	0	0	114	0	261	0	0	11	0
Volume Right (vph)	0	0	538	0	5	0	0	65	0	11
Hadj (s)	0.53	0.03	-0.67	0.34	-0.67	0.53	0.03	-0.67	0.10	-0.67
Departure Headway (s)	6.4	5.9	3.2	6.0	5.0	5.9	5.4	3.2	5.7	4.9
Degree Utilization, x	0.02	0.09	0.48	0.31	0.01	0.43	0.05	0.06	0.14	0.01
Capacity (veh/h)	524	570	1116	572	673	593	638	1121	600	684
Control Delay (s)	8.3	8.2	7.9	10.4	6.8	12.0	7.5	5.2	8.4	6.8
Approach Delay (s)	7.9			10.3		10.3			8.2	
Approach LOS	A			B		B			A	

Intersection Summary			
Delay	9.0		
HCM Level of Service	A		
Intersection Capacity Utilization	54.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	10	95	290	10	95	535
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	103	315	11	103	582
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1109	321			326	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1109	321			326	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	86			92	
cM capacity (veh/h)	213	720			1234	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	114	326	685
Volume Left	11	0	103
Volume Right	103	11	0
cSH	796	1700	1234
Volume to Capacity	0.14	0.19	0.08
Queue Length 95th (ft)	12	0	7
Control Delay (s)	12.0	0.0	2.1
Lane LOS	B		A
Approach Delay (s)	12.0	0.0	2.1
Approach LOS	B		

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✥		✥	↰	↑↑	↰	↑↑
Volume (vph)	35	5	10	5	20	400	180	890
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (%)	45.5%	45.5%	45.5%	45.5%	54.5%	54.5%	54.5%	54.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		6.7		6.5	27.2	27.2	27.2	27.2
Actuated g/C Ratio		0.20		0.19	0.81	0.81	0.81	0.81
v/c Ratio		0.16		0.20	0.06	0.16	0.27	0.38
Control Delay		10.7		7.5	4.6	3.0	5.3	3.9
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		10.7		7.5	4.6	3.0	5.3	3.9
LOS		B		A	A	A	A	A
Approach Delay		10.7		7.5		3.1		4.1
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 44
Actuated Cycle Length: 33.6
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.38
Intersection Signal Delay: 4.2 — Intersection LOS: A
Intersection Capacity Utilization 53.2% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.

ø2	ø4
24 s	20 s
ø6	ø8
24 s	20 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥		↰	↑↑		↰	↑↑	
Volume (vph)	35	5	15	10	5	50	20	400	25	180	890	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.96			0.90		1.00	0.99		1.00	0.98	
Flt Protected		0.97			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1739			1656		1770	3508		1770	3485	
Flt Permitted		1.00			0.93		0.26	1.00		0.49	1.00	
Satd. Flow (perm)		1795			1555		477	3508		906	3485	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	5	16	11	5	54	22	435	27	196	967	109
RTOR Reduction (vph)	0	15	0	0	50	0	0	6	0	0	12	0
Lane Group Flow (vph)	0	44	0	0	20	0	22	456	0	196	1064	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		2.8			2.8		24.0	24.0		24.0	24.0	
Effective Green, g (s)		2.8			2.8		24.0	24.0		24.0	24.0	
Actuated g/C Ratio		0.08			0.08		0.65	0.65		0.65	0.65	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		137			118		311	2288		591	2273	
v/s Ratio Prot								0.13			c0.31	
v/s Ratio Perm		c0.02			0.01		0.05			0.22		
v/c Ratio		0.32			0.17		0.07	0.20		0.33	0.47	
Uniform Delay, d1		16.1			15.9		2.3	2.6		2.8	3.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.4			0.7		0.1	0.0		0.3	0.2	
Delay (s)		17.5			16.6		2.4	2.6		3.2	3.4	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		17.5			16.6			2.6			3.3	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	4.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	36.8	Sum of lost time (s)	10.0
Intersection Capacity Utilization	53.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
11: Kaukahi Dr & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
9/22/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↰			↰	↱	↰	↑	↱
Volume (veh/h)	30	20	5	90	30	35	5	275	50	20	485	140
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	22	5	98	33	38	5	299	54	22	527	152
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	897	880	527	897	1033	299	679			299		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	897	880	527	897	1033	299	679			299		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	85	92	99	59	86	95	99			98		
cM capacity (veh/h)	216	279	551	239	227	741	913			1262		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	33	27	65	103	304	54	22	527	152
Volume Left	33	0	65	33	5	0	22	0	0
Volume Right	0	5	0	38	0	54	0	0	152
cSH	216	310	239	311	913	1700	1262	1700	1700
Volume to Capacity	0.15	0.09	0.27	0.33	0.01	0.03	0.02	0.31	0.09
Queue Length 95th (ft)	13	7	27	35	0	0	1	0	0
Control Delay (s)	24.6	17.7	25.7	22.2	0.2	0.0	7.9	0.0	0.0
Lane LOS	C	C	D	C	A		A		
Approach Delay (s)	21.5		23.5		0.2		0.2		
Approach LOS	C		C						

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	43.2%	ICU Level of Service	A
Analysis Period (min)	15		

Timings
1: Kilohana Dr & Piilani HWY

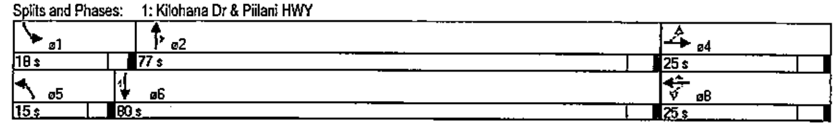
Austin, Tsutsumi & Associates, Inc.
1/13/2010

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	175	35	10	30	140	20	1855	15	160	1540	230
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	25.0	25.0	25.0	25.0	25.0	15.0	77.0	77.0	18.0	80.0	80.0
Total Split (%)	20.8%	20.8%	20.8%	20.8%	20.8%	12.5%	64.2%	64.2%	15.0%	66.7%	66.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Min	Max	Max	Min	Max	Max

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 118.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	175	35	10	10	30	140	20	1855	15	160	1540	230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1800		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.73	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1370	1800		1351	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	38	11	11	33	152	22	2016	16	174	1674	250
RTOR Reduction (vph)	0	8	0	0	0	128	0	0	5	0	0	84
Lane Group Flow (vph)	190	41	0	11	33	24	22	2016	11	174	1674	166
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	18.9	18.9		18.9	18.9	18.9	7.0	72.0	72.0	13.6	78.6	78.6
Effective Green, g (s)	18.9	18.9		18.9	18.9	18.9	7.0	72.0	72.0	13.6	78.6	78.6
Actuated g/C Ratio	0.16	0.16		0.16	0.16	0.16	0.06	0.61	0.61	0.11	0.66	0.66
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	219	287		215	297	252	105	2150	962	203	2347	1050
v/s Ratio Prot		0.02			0.02		0.01	c0.57		c0.10	0.47	
v/s Ratio Perm	c0.14			0.01		0.02			0.01			0.10
v/c Ratio	0.87	0.14		0.05	0.11	0.10	0.21	0.94	0.01	0.86	0.71	0.16
Uniform Delay, d1	48.6	42.8		42.2	42.6	42.5	53.1	21.2	9.2	51.5	12.7	7.5
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	28.3	0.2		0.1	0.2	0.2	1.0	9.4	0.0	28.1	1.9	0.3
Delay (s)	76.9	43.1		42.3	42.8	42.7	54.1	30.6	9.2	79.6	14.6	7.8
Level of Service	E	D		D	D	D	D	C	A	E	B	A
Approach Delay (s)		70.0			42.7			30.7			19.2	
Approach LOS		E			D			C			B	

Intersection Summary			
HCM Average Control Delay	28.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	118.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	88.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✣	↰	↑↱	↰	↑↱
Volume (vph)	250	35	15	20	40	1535	80	1190
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	34.0	34.0	34.0	34.0	12.0	52.0	14.0	54.0
Total Split (%)	34.0%	34.0%	34.0%	34.0%	12.0%	52.0%	14.0%	54.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	22.7	22.7		22.7	7.1	48.5	8.8	52.2
Actuated g/C Ratio	0.25	0.25		0.25	0.08	0.53	0.10	0.57
v/c Ratio	0.82	0.16		0.21	0.31	0.92	0.51	0.80
Control Delay	52.8	17.3		14.5	49.1	32.0	52.9	22.3
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	52.8	17.3		14.5	49.1	32.0	52.9	22.3
LOS	D	B		B	D	C	D	C
Approach Delay		45.4		14.5		32.4		23.9
Approach LOS		D		B		C		C

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 91.7
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 29.4 — Intersection LOS: C
Intersection Capacity Utilization 80.3% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY

ø1 14 s	ø2 52 s	ø4 34 s
ø5 12 s	ø6 54 s	ø8 34 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✥		↰	↑↱		↰	↑↱	
Volume (vph)	250	35	30	15	20	50	40	1535	40	80	1190	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.93			0.92		1.00	1.00		1.00	0.97	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1733			1700		1770	3526		1770	3441	
Flt Permitted	0.72	1.00			0.95		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1342	1733			1634		1770	3526		1770	3441	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	38	33	16	22	54	43	1668	43	87	1293	293
RTOR Reduction (vph)	0	25	0	0	41	0	0	1	0	0	17	0
Lane Group Flow (vph)	272	46	0	0	51	0	43	1710	0	87	1569	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	22.7	22.7			22.7		4.4	49.3		7.3	52.2	
Effective Green, g (s)	22.7	22.7			22.7		4.4	49.3		7.3	52.2	
Actuated g/C Ratio	0.24	0.24			0.24		0.05	0.53		0.08	0.56	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	327	422			398		83	1863		138	1925	
v/s Ratio Prot		0.03					0.02	c0.48		c0.05	c0.46	
v/s Ratio Perm	c0.20				0.03							
v/c Ratio	0.83	0.11			0.13		0.52	0.92		0.63	0.82	
Uniform Delay, d1	33.5	27.4			27.6		43.4	20.1		41.7	16.6	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	16.3	0.1			0.1		5.4	8.7		9.0	3.9	
Delay (s)	49.8	27.6			27.7		48.8	28.9		50.7	20.6	
Level of Service	D	C			C		D	C		D	C	
Approach Delay (s)		45.2			27.7			29.3			22.1	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM Average Control Delay	27.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	93.3	Sum of lost time (s)	19.0
Intersection Capacity Utilization	80.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱	↰	↑	↱	↰	↑↑	↱	↰↰	↑	↱
Volume (vph)	1455	105	5	115	245	15	105	5	225	130	945
Turn Type	Prot		Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4	3	8		5	2		1	6	
Permitted Phases					8			2			Free
Detector Phase	7	4	3	8	8	5	2	2	1	6	
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	7.0	27.0	27.0	7.0	27.0	
Total Split (s)	55.0	54.0	24.0	23.0	23.0	11.0	24.0	24.0	18.0	31.0	0.0
Total Split (%)	45.8%	45.0%	20.0%	19.2%	19.2%	9.2%	20.0%	20.0%	15.0%	25.8%	0.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?											
Recall Mode	None	None	Min	None	None	Min	Min	Min	None	Min	
Act Effct Green (s)	51.2	47.2	18.9	12.3	12.3	6.3	8.7	8.7	12.0	14.5	102.4
Actuated g/C Ratio	0.50	0.46	0.18	0.12	0.12	0.06	0.08	0.08	0.12	0.14	1.00
v/c Ratio	0.92	0.16	0.02	0.56	0.64	0.15	0.38	0.04	0.61	0.54	0.65
Control Delay	35.2	12.5	49.0	52.9	14.0	51.4	49.1	28.0	50.6	49.4	2.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.2	12.5	49.0	52.9	14.0	51.4	49.1	28.0	50.6	49.4	2.1
LOS	D	B	D	D	B	D	D	C	D	D	A
Approach Delay		33.4		26.8			48.6			15.2	
Approach LOS		C		C			D			B	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 102.4
Natural Cycle: 115
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 26.2 — Intersection LOS: C
Intersection Capacity Utilization 71.7% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: Wailea Ike Dr. & Piilani HWY

ø1	ø2	ø3	ø4
18 s	24 s	24 s	54 s

ø5	ø6	ø7	ø8
11 s	31 s	55 s	23 s

HCM Signalized Intersection Capacity Analysis
3: Wailea Ike Dr. & Piilani HWY

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑	↱	↰	↑↑	↱	↰↰	↑	↱
Volume (vph)	1455	105	20	5	115	245	15	105	5	225	130	945
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.95	1.00	0.97	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	1818		1770	1863	1583	1770	3539	1583	3433	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	1818		1770	1863	1583	1770	3539	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1582	114	22	5	125	266	16	114	5	245	141	1027
RTOR Reduction (vph)	0	6	0	0	0	222	0	0	5	0	0	0
Lane Group Flow (vph)	1582	130	0	5	125	44	16	114	0	245	141	1027
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8			2			Free
Actuated Green, G (s)	51.2	45.8		18.9	13.5	13.5	6.3	8.8	8.8	12.0	14.5	103.5
Effective Green, g (s)	51.2	45.8		18.9	13.5	13.5	6.3	8.8	8.8	12.0	14.5	103.5
Actuated g/C Ratio	0.49	0.44		0.18	0.13	0.13	0.06	0.09	0.09	0.12	0.14	1.00
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1698	804		323	243	206	108	301	135	398	261	1583
v/s Ratio Prot	c0.46	0.07		0.00	0.07		0.01	0.03		0.07	0.08	
v/s Ratio Perm						0.03			0.00			c0.65
v/c Ratio	0.93	0.16		0.02	0.51	0.21	0.15	0.38	0.00	0.62	0.54	0.65
Uniform Delay, d1	24.5	17.3		34.7	41.9	40.3	46.1	44.8	43.3	43.6	41.4	0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.7	0.1		0.0	1.8	0.5	0.6	0.8	0.0	2.8	2.3	2.1
Delay (s)	34.3	17.4		34.7	43.8	40.8	46.7	45.6	43.3	46.4	43.7	2.1
Level of Service	C	B		C	D	D	D	D	D	D	D	A
Approach Delay (s)		32.9			41.7			45.6			13.9	
Approach LOS		C			D			D			B	

Intersection Summary			
HCM Average Control Delay	27.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	103.5	Sum of lost time (s)	4.0
Intersection Capacity Utilization	71.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
4: Wailea Ike Dr. & Kalai Waa St

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	1170	90	160	850	100	285
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1272	98	174	924	109	310
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				749		
pX, platoon unblocked						
vC, conflicting volume			1370		2130	685
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1370		2130	685
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			65		0	21
cM capacity (veh/h)			497		28	391

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	848	522	174	462	462	109	310
Volume Left	0	0	174	0	0	109	0
Volume Right	0	98	0	0	0	0	310
cSH	1700	1700	497	1700	1700	28	391
Volume to Capacity	0.50	0.31	0.35	0.27	0.27	3.93	0.79
Queue Length 95th (ft)	0	0	39	0	0	Err	171
Control Delay (s)	0.0	0.0	16.1	0.0	0.0	Err	41.5
Lane LOS			C			F	E
Approach Delay (s)	0.0		2.5			2627.9	
Approach LOS						F	

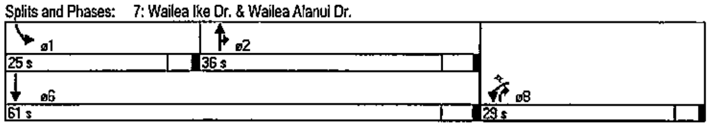
Intersection Summary			
Average Delay	382.0		
Intersection Capacity Utilization	59.6%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	605	290	410	855	285	380
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Detector Phase	8	8	2	2 8	1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	29.0	29.0	36.0	65.0	25.0	61.0
Total Split (%)	32.2%	32.2%	40.0%	72.2%	27.8%	67.8%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	Max		None	Max
Act Effct Green (s)	23.3	23.3	33.2	60.4	18.9	56.0
Actuated g/C Ratio	0.26	0.26	0.38	0.68	0.21	0.63
v/c Ratio	0.73	0.49	0.64	0.46	0.82	0.18
Control Delay	34.9	5.9	29.0	4.8	51.6	7.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.9	5.9	29.0	4.8	51.6	7.2
LOS	C	A	C	A	D	A
Approach Delay	25.5		12.7			26.2
Approach LOS	C		B			C

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 88.3
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 19.9 — Intersection LOS: B
Intersection Capacity Utilization 65.5% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	605	290	410	855	285	380
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lane Util. Factor	0.97	1.00	1.00	0.88	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1863	2787	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1863	2787	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	658	315	446	929	310	413
RTOR Reduction (vph)	0	232	0	103	0	0
Lane Group Flow (vph)	658	83	446	826	310	413
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Actuated Green, G (s)	23.3	23.3	33.2	61.5	18.9	56.1
Effective Green, g (s)	23.3	23.3	33.2	61.5	18.9	56.1
Actuated g/C Ratio	0.26	0.26	0.38	0.70	0.21	0.63
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	905	417	700	1939	378	2246
v/s Ratio Prot	c0.19		c0.24	0.30	c0.18	0.12
v/s Ratio Perm		0.05				
v/c Ratio	0.73	0.20	0.64	0.43	0.82	0.18
Uniform Delay, d1	29.7	25.3	22.7	5.8	33.1	6.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.9	0.2	4.4	0.2	13.3	0.2
Delay (s)	32.6	25.5	27.1	6.0	46.4	6.9
Level of Service	C	C	C	A	D	A
Approach Delay (s)	30.3		12.8			23.8
Approach LOS	C		B			C

Intersection Summary

HCM Average Control Delay	20.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	88.4	Sum of lost time (s)	13.0
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
8: Okolani Dr & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	15	90	460	95	70	15	510	105	145	15	35	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	98	500	103	76	16	554	114	158	16	38	16

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	16	98	500	179	16	554	114	158	54	16
Volume Left (vph)	16	0	0	103	0	554	0	0	16	0
Volume Right (vph)	0	0	500	0	16	0	0	158	0	16
Hadj (s)	0.53	0.03	-0.67	0.32	-0.67	0.53	0.03	-0.67	0.18	-0.67
Departure Headway (s)	7.5	7.0	3.2	7.1	6.1	6.2	5.7	3.2	6.6	5.8
Degree Utilization, x	0.03	0.19	0.44	0.35	0.03	0.95	0.18	0.14	0.10	0.03
Capacity (veh/h)	463	499	1115	495	567	577	618	1121	518	588
Control Delay (s)	9.5	10.4	7.5	12.7	8.1	49.1	8.7	5.5	9.2	7.7
Approach Delay (s)	8.0			12.3		35.2			8.8	
Approach LOS	A			B		E			A	

Intersection Summary			
Delay	21.7		
HCM Level of Service	C		
Intersection Capacity Utilization	57.2%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Kilohana Dr & South Kihei Rd

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	35	155	570	25	100	540
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	168	620	27	109	587
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1438	633			647	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1438	633			647	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	71	65			88	
cM capacity (veh/h)	130	480			939	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	207	647	696
Volume Left	38	0	109
Volume Right	168	27	0
cSH	588	1700	939
Volume to Capacity	0.35	0.38	0.12
Queue Length 95th (ft)	39	0	10
Control Delay (s)	21.6	0.0	2.9
Lane LOS	C		A
Approach Delay (s)	21.6	0.0	2.9
Approach LOS	C		

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

Timings
10: Grand Wailea Resort & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✥		✥	↰	↑↑	↰	↑↑
Volume (vph)	105	5	10	15	30	980	60	675
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (%)	45.5%	45.5%	45.5%	45.5%	54.5%	54.5%	54.5%	54.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		9.0		9.0	23.1	23.1	23.1	23.1
Actuated g/C Ratio		0.24		0.24	0.61	0.61	0.61	0.61
v/c Ratio		0.44		0.19	0.09	0.50	0.25	0.38
Control Delay		15.1		8.0	7.0	7.8	10.3	6.6
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		15.1		8.0	7.0	7.8	10.3	6.6
LOS		B		A	A	A	B	A
Approach Delay		15.1		8.0		7.8		6.9
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 44
Actuated Cycle Length: 38.1
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.50
Intersection Signal Delay: 7.9 — Intersection LOS: A
Intersection Capacity Utilization 57.5% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.

ø2 24 s	ø4 20 s
ø6 24 s	ø8 20 s

HCM Signalized Intersection Capacity Analysis
10: Grand Wailea Resort & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥		↰	↑↑		↰	↑↑	
Volume (vph)	105	5	25	10	15	45	30	980	10	60	675	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.98			0.91		1.00	1.00		1.00	0.99	
Flt Protected		0.96			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1748			1688		1770	3534		1770	3492	
Flt Permitted		0.72			0.93		0.34	1.00		0.23	1.00	
Satd. Flow (perm)		1313			1581		636	3534		426	3492	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	5	27	11	16	49	33	1065	11	65	734	71
RTOR Reduction (vph)	0	22	0	0	32	0	0	1	0	0	13	0
Lane Group Flow (vph)	0	124	0	0	44	0	33	1075	0	65	792	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.5			7.5		21.7	21.7		21.7	21.7	
Effective Green, g (s)		7.5			7.5		21.7	21.7		21.7	21.7	
Actuated g/C Ratio		0.19			0.19		0.55	0.55		0.55	0.55	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		251			302		352	1956		236	1933	
v/s Ratio Prot								c0.30			0.23	
v/s Ratio Perm		c0.09			0.03		0.05			0.15		
v/c Ratio		0.49			0.15		0.09	0.55		0.28	0.41	
Uniform Delay, d1		14.2			13.2		4.1	5.6		4.6	5.1	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.5			0.2		0.1	0.3		0.6	0.1	
Delay (s)		15.7			13.4		4.2	5.9		5.2	5.2	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		15.7			13.4			5.9			5.2	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	6.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	39.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	57.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	95	25	10	85	15	5	10	645	100	35	540	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	103	27	11	92	16	5	11	701	109	38	587	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1394	1386	587	1410	1457	701	658			701		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1394	1386	587	1410	1457	701	658			701		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	80	98	0	87	99	99			96		
cM capacity (veh/h)	101	135	510	92	123	439	930			896		

Direction, Lane #	EB1	EB2	WB1	WB2	NB1	NB2	SB1	SB2	SB3
Volume Total	103	38	92	22	712	109	38	587	71
Volume Left	103	0	92	0	11	0	38	0	0
Volume Right	0	11	0	5	0	109	0	0	71
cSH	101	171	92	150	930	1700	896	1700	1700
Volume to Capacity	1.02	0.22	1.00	0.15	0.01	0.06	0.04	0.35	0.04
Queue Length 95th (ft)	159	20	148	12	1	0	3	0	0
Control Delay (s)	172.7	31.9	177.6	33.1	0.3	0.0	9.2	0.0	0.0
Lane LOS	F	D	F	D	A		A		
Approach Delay (s)	134.8		150.0		0.3		0.5		
Approach LOS	F		F						

Intersection Summary			
Average Delay	20.7		
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

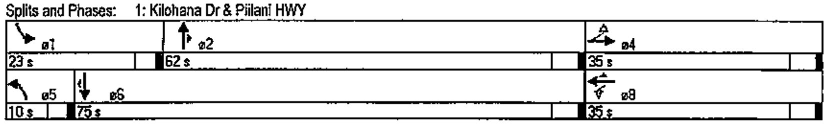
- Future Year 2022 WITH Project

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	160	20	15	30	160	5	1090	5	50	1705	155
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	35.0	35.0	35.0	35.0	35.0	10.0	62.0	62.0	23.0	75.0	75.0
Total Split (%)	29.2%	29.2%	29.2%	29.2%	29.2%	8.3%	51.7%	51.7%	19.2%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Min	Max	Max	Min	Max	Max

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 109
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	160	20	10	15	30	160	5	1090	5	50	1705	155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1770		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.74	1.00		0.74	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1370	1770		1370	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	174	22	11	16	33	174	5	1185	5	54	1853	168
RTOR Reduction (vph)	0	9	0	0	0	144	0	0	2	0	0	48
Lane Group Flow (vph)	174	24	0	16	33	30	5	1185	3	54	1853	120
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	19.0	19.0		19.0	19.0	19.0	5.7	67.2	67.2	8.7	70.2	70.2
Effective Green, g (s)	19.0	19.0		19.0	19.0	19.0	5.7	67.2	67.2	8.7	70.2	70.2
Actuated g/C Ratio	0.17	0.17		0.17	0.17	0.17	0.05	0.62	0.62	0.08	0.64	0.64
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	239	309		239	325	276	93	2184	977	141	2281	1020
v/s Ratio Prot		0.01			0.02		0.00	0.33		c0.03	c0.52	
v/s Ratio Perm	c0.13			0.01		0.02			0.00			0.08
v/c Ratio	0.73	0.08		0.07	0.10	0.11	0.05	0.54	0.00	0.38	0.81	0.12
Uniform Delay, d1	42.5	37.6		37.5	37.8	37.8	49.0	12.0	8.0	47.6	14.4	7.4
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.5	0.1		0.1	0.1	0.2	0.2	1.0	0.0	1.7	3.3	0.2
Delay (s)	53.0	37.7		37.7	37.9	38.0	49.3	13.0	8.0	49.3	17.7	7.7
Level of Service	D	D		D	D	D	D	B	A	D	B	A
Approach Delay (s)		50.6			38.0			13.1			17.7	
Approach LOS		D			D			B			B	

Intersection Summary

HCM Average Control Delay	19.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	108.9	Sum of lost time (s)	14.0
Intersection Capacity Utilization	71.0%	ICU Level of Service	C
Analysis Period (min)	15		

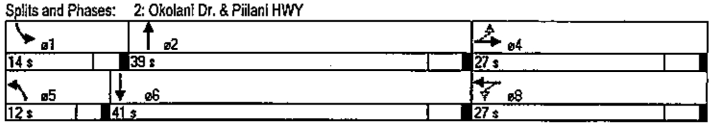
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✥	↰	↑↱	↰	↑↱
Volume (vph)	185	15	40	25	10	840	35	1515
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	27.0	27.0	27.0	27.0	12.0	39.0	14.0	41.0
Total Split (%)	33.8%	33.8%	33.8%	33.8%	15.0%	48.8%	17.5%	51.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	15.9	15.9		15.9	6.1	37.1	7.1	41.8
Actuated g/C Ratio	0.23	0.23		0.23	0.09	0.53	0.10	0.60
v/c Ratio	0.73	0.11		0.36	0.07	0.49	0.21	0.86
Control Delay	41.0	12.8		15.6	33.6	13.9	33.9	19.6
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	41.0	12.8		15.6	33.6	13.9	33.9	19.6
LOS	D	B		B	C	B	C	B
Approach Delay		36.0		15.6		14.1		19.9
Approach LOS		D		B		B		B

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 69.8
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 19.2 — Intersection LOS: B
Intersection Capacity Utilization 71.6% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✥		↰	↑↱		↰	↑↱	
Volume (vph)	185	15	25	40	25	70	10	840	15	35	1515	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.91			0.93		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1687			1707		1770	3530		1770	3494	
Flt Permitted	0.65	1.00			0.90		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1217	1687			1561		1770	3530		1770	3494	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	201	16	27	43	27	76	11	913	16	38	1647	152
RTOR Reduction (vph)	0	21	0	0	52	0	0	1	0	0	7	0
Lane Group Flow (vph)	201	22	0	0	94	0	11	928	0	38	1792	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	15.9	15.9			15.9		1.3	38.6		4.5	41.8	
Effective Green, g (s)	15.9	15.9			15.9		1.3	38.6		4.5	41.8	
Actuated g/C Ratio	0.22	0.22			0.22		0.02	0.53		0.06	0.57	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	265	367			340		32	1867		109	2001	
v/s Ratio Prot		0.01					0.01	0.26		c0.02	c0.51	
v/s Ratio Perm	c0.17				0.06							
v/c Ratio	0.76	0.06			0.28		0.34	0.50		0.35	0.90	
Uniform Delay, d1	26.8	22.6			23.8		35.4	11.0		32.8	13.7	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	11.7	0.1			0.4		6.3	0.9		1.9	6.7	
Delay (s)	38.5	22.7			24.2		41.8	11.9		34.8	20.4	
Level of Service	D	C			C		D	B		C	C	
Approach Delay (s)		35.7			24.2			12.3			20.7	
Approach LOS		D			C			B			C	

Intersection Summary

HCM Average Control Delay	19.5	HCM Level of Service		B
HCM Volume to Capacity ratio	0.86			
Actuated Cycle Length (s)	73.0	Sum of lost time (s)		14.0
Intersection Capacity Utilization	71.6%	ICU Level of Service		C
Analysis Period (min)	15			

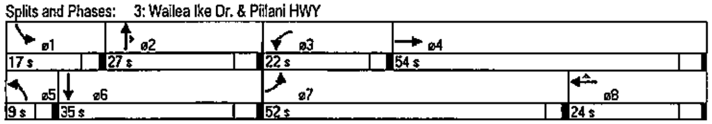
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	635	85	5	95	190	20	105	5	175	70	1425
Turn Type	Prot		Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4	3	8		5	2		1	6	
Permitted Phases					8			2			Free
Detector Phase	7	4	3	8	8	5	2	2	1	6	
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	7.0	27.0	27.0	7.0	27.0	
Total Split (s)	52.0	54.0	22.0	24.0	24.0	9.0	27.0	27.0	17.0	35.0	0.0
Total Split (%)	43.3%	45.0%	18.3%	20.0%	20.0%	7.5%	22.5%	22.5%	14.2%	29.2%	0.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?											
Recall Mode	None	None	Min	None	None	Min	Min	Min	None	Min	
Act Effct Green (s)	19.2	20.8	10.7	9.5	9.5	5.1	7.9	7.9	9.5	12.2	64.5
Actuated g/C Ratio	0.30	0.32	0.17	0.15	0.15	0.08	0.12	0.12	0.15	0.19	1.00
v/c Ratio	0.68	0.17	0.02	0.38	0.51	0.16	0.26	0.03	0.38	0.22	0.98
Control Delay	24.1	14.4	32.4	31.6	9.7	35.6	30.3	19.8	29.2	25.6	21.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.1	14.4	32.4	31.6	9.7	35.6	30.3	19.8	29.2	25.6	21.3
LOS	C	B	C	C	A	D	C	B	C	C	C
Approach Delay		22.8		17.2			30.7			22.3	
Approach LOS		C		B			C			C	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 64.5
Natural Cycle: 85
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 22.3 — Intersection LOS: C
Intersection Capacity Utilization 44.9% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Wailea Ike Dr. & Piilani HWY



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	635	85	10	5	95	190	20	105	5	175	70	1425
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.95	1.00	0.97	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	1833		1770	1863	1583	1770	3539	1583	3433	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	1833		1770	1863	1583	1770	3539	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	690	92	11	5	103	207	22	114	5	190	76	1549
RTOR Reduction (vph)	0	4	0	0	0	173	0	0	4	0	0	0
Lane Group Flow (vph)	690	99	0	5	103	34	22	114	1	190	76	1549
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8			2			Free
Actuated Green, G (s)	19.2	19.2		10.7	10.7	10.7	5.1	7.9	7.9	9.5	12.3	65.3
Effective Green, g (s)	19.2	19.2		10.7	10.7	10.7	5.1	7.9	7.9	9.5	12.3	65.3
Actuated g/C Ratio	0.29	0.29		0.16	0.16	0.16	0.08	0.12	0.12	0.15	0.19	1.00
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1009	539		290	305	259	138	428	192	499	351	1583
v/s Ratio Prot	0.20	0.05		0.00	0.06		0.01	0.03		0.06	0.04	
v/s Ratio Perm						0.02			0.00			c0.98
v/c Ratio	0.68	0.18		0.02	0.34	0.13	0.16	0.27	0.00	0.38	0.22	0.98
Uniform Delay, d1	20.4	17.2		22.9	24.2	23.3	28.1	26.1	25.2	25.2	22.4	0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.2		0.0	0.7	0.2	0.5	0.3	0.0	0.5	0.3	18.1
Delay (s)	22.3	17.4		22.9	24.8	23.6	28.6	26.4	25.2	25.7	22.7	18.1
Level of Service	C	B		C	C	C	C	C	C	C	C	B
Approach Delay (s)		21.7			24.0			26.7			19.1	
Approach LOS		C			C			C			B	

Intersection Summary

HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	65.3	Sum of lost time (s)	0.0
Intersection Capacity Utilization	44.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	555	60	255	1255	50	120
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	603	65	277	1364	54	130
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				749		
pX, platoon unblocked						
vC, conflicting volume			668		1872	334
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			668		1872	334
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			70		0	80
cM capacity (veh/h)			917		44	662

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	402	266	277	682	682	54	130
Volume Left	0	0	277	0	0	54	0
Volume Right	0	65	0	0	0	0	130
cSH	1700	1700	917	1700	1700	44	662
Volume to Capacity	0.24	0.16	0.30	0.40	0.40	1.22	0.20
Queue Length 95th (ft)	0	0	32	0	0	130	18
Control Delay (s)	0.0	0.0	10.6	0.0	0.0	354.2	11.8
Lane LOS			B			F	B
Approach Delay (s)	0.0		1.8			112.5	
Approach LOS						F	

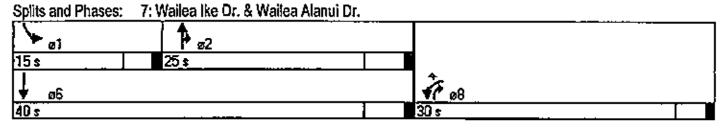
Intersection Summary			
Average Delay	9.5		
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	1000	225	195	405	195	455
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Detector Phase	8	8	2	2 8	1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	30.0	30.0	25.0	55.0	15.0	40.0
Total Split (%)	42.9%	42.9%	35.7%	78.6%	21.4%	57.1%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	Max		None	Max
Act Effct Green (s)	25.2	25.2	20.4	49.6	10.6	35.0
Actuated g/C Ratio	0.36	0.36	0.29	0.72	0.15	0.51
v/c Ratio	0.87	0.33	0.39	0.21	0.78	0.28
Control Delay	29.8	3.8	22.5	1.2	50.5	10.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.8	3.8	22.5	1.2	50.5	10.5
LOS	C	A	C	A	D	B
Approach Delay	25.0		8.1			22.5
Approach LOS	C		A			C

Intersection Summary

Cycle Length: 70
Actuated Cycle Length: 69.2
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 20.3 — Intersection LOS: C
Intersection Capacity Utilization 60.4% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.



7: Wailea Ike Dr. & Wailea Alanui Dr.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	1000	225	195	405	195	455
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lane Util. Factor	0.97	1.00	1.00	0.88	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1863	2787	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1863	2787	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1087	245	212	440	212	495
RTOR Reduction (vph)	0	156	0	88	0	0
Lane Group Flow (vph)	1087	89	212	352	212	495
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Actuated Green, G (s)	25.2	25.2	20.4	50.6	10.6	35.0
Effective Green, g (s)	25.2	25.2	20.4	50.6	10.6	35.0
Actuated g/C Ratio	0.36	0.36	0.29	0.73	0.15	0.51
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	1250	576	549	2038	271	1790
v/s Ratio Prot	c0.32		c0.11	0.13	c0.12	0.14
v/s Ratio Perm		0.06				
v/c Ratio	0.87	0.15	0.39	0.17	0.78	0.28
Uniform Delay, d1	20.5	14.8	19.4	2.9	28.2	9.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.7	0.1	2.0	0.0	13.7	0.4
Delay (s)	27.2	15.0	21.5	2.9	41.8	10.2
Level of Service	C	B	C	A	D	B
Approach Delay (s)	24.9		8.9			19.7
Approach LOS	C		A			B

Intersection Summary			
HCM Average Control Delay	19.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	69.2	Sum of lost time (s)	13.0
Intersection Capacity Utilization	60.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

8: Okolani Dr & Wailea Alanui Dr.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	10	50	525	105	65	5	260	30	60	10	70	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	54	571	114	71	5	283	33	65	11	76	11

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	11	54	571	185	5	283	33	65	87	11
Volume Left (vph)	11	0	0	114	0	283	0	0	11	0
Volume Right (vph)	0	0	571	0	5	0	0	65	0	11
Hadj (s)	0.53	0.03	-0.67	0.34	-0.67	0.53	0.03	-0.67	0.10	-0.67
Departure Headway (s)	6.4	5.9	3.2	6.1	5.1	5.9	5.4	3.2	5.7	5.0
Degree Utilization, x	0.02	0.09	0.51	0.31	0.01	0.46	0.05	0.06	0.14	0.01
Capacity (veh/h)	517	562	1116	565	663	593	637	1121	596	679
Control Delay (s)	8.4	8.3	8.2	10.6	6.9	12.7	7.5	5.2	8.4	6.8
Approach Delay (s)	8.3			10.5		10.9			8.3	
Approach LOS	A			B		B			A	

Intersection Summary			
Delay	9.4		
HCM Level of Service	A		
Intersection Capacity Utilization	56.0%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Kilohana Dr & South Kihei Rd

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	10	95	310	10	100	565
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	103	337	11	109	614
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1174	342			348	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1174	342			348	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	94	85			91	
cM capacity (veh/h)	193	700			1211	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	114	348	723
Volume Left	11	0	109
Volume Right	103	11	0
cSH	774	1700	1211
Volume to Capacity	0.15	0.20	0.09
Queue Length 95th (ft)	13	0	7
Control Delay (s)	12.3	0.0	2.2
Lane LOS	B		A
Approach Delay (s)	12.3	0.0	2.2
Approach LOS	B		

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		

Timings
10: Grand Wailea Resort & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✥		✥	↰	↑↑	↰	↑↑
Volume (vph)	35	5	10	5	20	470	180	1000
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (%)	45.5%	45.5%	45.5%	45.5%	54.5%	54.5%	54.5%	54.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		6.7		6.5	28.1	28.1	28.1	28.1
Actuated g/C Ratio		0.19		0.19	0.81	0.81	0.81	0.81
v/c Ratio		0.17		0.21	0.07	0.19	0.29	0.42
Control Delay		10.9		7.6	4.8	3.1	5.7	4.2
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		10.9		7.6	4.8	3.1	5.7	4.2
LOS		B		A	A	A	A	A
Approach Delay		10.9		7.6		3.1		4.4
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 44
Actuated Cycle Length: 34.7
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.42
Intersection Signal Delay: 4.3 — Intersection LOS: A
Intersection Capacity Utilization 56.2% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.

ø2 — 24 s	ø4 — 20 s
ø6 — 24 s	ø8 — 20 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑↱		↰	↑↑		↰	↑↑	
Volume (vph)	35	5	16	10	5	50	20	470	25	180	1000	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.96			0.90		1.00	0.99		1.00	0.99	
Flt Protected		0.97			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1739			1656		1770	3513		1770	3491	
Flt Permitted		1.00			0.93		0.22	1.00		0.45	1.00	
Satd. Flow (perm)		1795			1555		405	3513		841	3491	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	5	16	11	5	54	22	511	27	196	1087	109
RTOR Reduction (vph)	0	15	0	0	50	0	0	5	0	0	10	0
Lane Group Flow (vph)	0	44	0	0	20	0	22	533	0	196	1186	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		2.9			2.9		24.9	24.9		24.9	24.9	
Effective Green, g (s)		2.9			2.9		24.9	24.9		24.9	24.9	
Actuated g/C Ratio		0.08			0.08		0.66	0.66		0.66	0.66	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		138			119		267	2314		554	2300	
v/s Ratio Prot								0.15			c0.34	
v/s Ratio Perm		c0.02			0.01		0.05			0.23		
v/c Ratio		0.32			0.17		0.08	0.23		0.35	0.52	
Uniform Delay, d1		16.5			16.3		2.3	2.6		2.9	3.3	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.3			0.7		0.1	0.1		0.4	0.2	
Delay (s)		17.9			17.0		2.5	2.6		3.3	3.5	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		17.9			17.0			2.6			3.5	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	4.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	37.8	Sum of lost time (s)	10.0
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱			↰↑	↱		↰↑	↱	↰	↑	↱
Volume (veh/h)	30	20	5	90	30	35	5	345	50	20	590	145
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	22	5	98	33	38	5	375	54	22	641	158
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1087	1071	641	1087	1228	375	799			375		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1087	1071	641	1087	1228	375	799			375		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	79	90	99	44	81	94	99			98		
cM capacity (veh/h)	153	215	475	173	174	671	824			1183		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	33	27	130	38	380	54	22	641	158
Volume Left	33	0	98	0	5	0	22	0	0
Volume Right	0	5	0	38	0	54	0	0	158
cSH	153	242	173	671	824	1700	1183	1700	1700
Volume to Capacity	0.21	0.11	0.75	0.06	0.01	0.03	0.02	0.38	0.09
Queue Length 95th (ft)	19	9	120	4	0	0	1	0	0
Control Delay (s)	34.7	21.8	70.7	10.7	0.2	0.0	8.1	0.0	0.0
Lane LOS	D	C	F	B	A		A		
Approach Delay (s)	28.8		57.2		0.2		0.2		
Approach LOS	D		F						

Intersection Summary			
Average Delay	7.8		
Intersection Capacity Utilization	50.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱↑	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	175	40	10	35	140	20	1965	15	160	1665	230
Turn Type	Perm		Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4		8		5	2		1	6	
Permitted Phases	4		8		8			2			6
Detector Phase	4	4	8	8	8	5	2	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	25.0	25.0	25.0	25.0	25.0	15.0	77.0	77.0	18.0	80.0	80.0
Total Split (%)	20.8%	20.8%	20.8%	20.8%	20.8%	12.5%	64.2%	64.2%	15.0%	66.7%	66.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Min	Max	Max	Min	Max	Max

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 118.6
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kilohana Dr & Piilani HWY

ø1 18 s	ø2 77 s	ø4 25 s
ø5 15 s	ø6 80 s	ø8 25 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱↑		↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Volume (vph)	175	40	10	10	35	140	20	1965	15	160	1665	230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1806		1770	1863	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.73	1.00		0.72	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1364	1806		1345	1863	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	43	11	11	38	152	22	2136	16	174	1810	250
RTOR Reduction (vph)	0	8	0	0	0	128	0	0	5	0	0	78
Lane Group Flow (vph)	190	46	0	11	38	24	22	2136	11	174	1810	172
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	18.9	18.9		18.9	18.9	18.9	7.0	72.0	72.0	13.6	78.6	78.6
Effective Green, g (s)	18.9	18.9		18.9	18.9	18.9	7.0	72.0	72.0	13.6	78.6	78.6
Actuated g/C Ratio	0.16	0.16		0.16	0.16	0.16	0.06	0.61	0.61	0.11	0.66	0.66
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	218	288		215	297	252	105	2150	962	203	2347	1050
v/s Ratio Prot		0.03			0.02		0.01	c0.60		c0.10	0.51	
v/s Ratio Perm	c0.14			0.01		0.02			0.01			0.11
v/c Ratio	0.87	0.16		0.05	0.13	0.10	0.21	0.99	0.01	0.86	0.77	0.16
Uniform Delay, d1	48.6	43.0		42.2	42.7	42.5	53.1	23.0	9.2	51.5	13.8	7.5
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	29.4	0.3		0.1	0.2	0.2	1.0	17.9	0.0	28.1	2.5	0.3
Delay (s)	78.0	43.2		42.3	42.9	42.7	54.1	41.0	9.2	79.6	16.3	7.9
Level of Service	E	D		D	D	D	D	D	A	E	B	A
Approach Delay (s)		70.3			42.7			40.9			20.3	
Approach LOS		E			D			D			C	

Intersection Summary

HCM Average Control Delay	32.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	118.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱		✣	↰	↑↱	↰	↑↱
Volume (vph)	255	35	15	25	40	1640	85	1310
Turn Type	Perm		Perm		Prot		Prot	
Protected Phases		4		8	5	2	1	6
Permitted Phases	4		8					
Detector Phase	4	4	8	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	10.0	24.0	10.0	24.0
Total Split (s)	34.0	34.0	34.0	34.0	12.0	52.0	14.0	54.0
Total Split (%)	34.0%	34.0%	34.0%	34.0%	12.0%	52.0%	14.0%	54.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	4.0	5.0	4.0	5.0
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	23.2	23.2		23.2	7.1	48.3	8.9	52.1
Actuated g/C Ratio	0.25	0.25		0.25	0.08	0.52	0.10	0.57
v/c Ratio	0.83	0.15		0.21	0.31	0.99	0.54	0.87
Control Delay	54.1	17.2		15.1	49.3	43.6	54.2	26.3
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	54.1	17.2		15.1	49.3	43.6	54.2	26.3
LOS	D	B		B	D	D	D	C
Approach Delay		46.6		15.1		43.8		27.7
Approach LOS		D		B		D		C

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 92.1
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.99
Intersection Signal Delay: 36.3 — Intersection LOS: D
Intersection Capacity Utilization 83.9% — ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 2: Okolani Dr. & Piilani HWY

ø1 14 s	ø2 52 s	ø4 34 s
ø5 12 s	ø6 54 s	ø8 34 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			✣		↰	↑↱		↰	↑↱	
Volume (vph)	255	35	30	15	25	50	40	1640	45	85	1310	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.93			0.92		1.00	1.00		1.00	0.97	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1733			1709		1770	3525		1770	3449	
Flt Permitted	0.71	1.00			0.96		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1323	1733			1646		1770	3525		1770	3449	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	277	38	33	16	27	54	43	1783	49	92	1424	293
RTOR Reduction (vph)	0	25	0	0	41	0	0	2	0	0	15	0
Lane Group Flow (vph)	277	46	0	0	56	0	43	1830	0	92	1702	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	23.2	23.2			23.2		4.4	49.2		7.3	52.1	
Effective Green, g (s)	23.2	23.2			23.2		4.4	49.2		7.3	52.1	
Actuated g/C Ratio	0.25	0.25			0.25		0.05	0.53		0.08	0.56	
Clearance Time (s)	5.0	5.0			5.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	328	429			408		83	1851		138	1918	
v/s Ratio Prot		0.03					0.02	c0.52		c0.05	c0.49	
v/s Ratio Perm	c0.21				0.03							
v/c Ratio	0.84	0.11			0.14		0.52	0.99		0.67	0.89	
Uniform Delay, d1	33.5	27.2			27.5		43.6	22.0		42.0	18.2	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	17.7	0.1			0.2		5.4	18.4		11.5	6.5	
Delay (s)	51.2	27.4			27.6		49.0	40.4		53.5	24.8	
Level of Service	D	C			C		D	D		D	C	
Approach Delay (s)		46.4			27.6			40.6			26.2	
Approach LOS		D			C			D			C	

Intersection Summary

HCM Average Control Delay	34.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	93.7	Sum of lost time (s)	19.0
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	1520	130	5	135	285	16	105	5	290	130	1005
Turn Type	Prot		Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4	3	8		5	2		1	6	
Permitted Phases					8			2			Free
Detector Phase	7	4	3	8	8	5	2	2	1	6	
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	7.0	27.0	27.0	7.0	27.0	
Total Split (s)	55.0	54.0	24.0	23.0	23.0	11.0	24.0	24.0	18.0	31.0	0.0
Total Split (%)	45.8%	45.0%	20.0%	19.2%	19.2%	9.2%	20.0%	20.0%	15.0%	25.8%	0.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?											
Recall Mode	None	None	Min	None	None	Min	Min	Min	None	Min	
Act Effct Green (s)	51.2	58.6	5.9	13.3	13.3	6.3	8.8	8.8	13.2	15.8	104.6
Actuated g/C Ratio	0.49	0.56	0.06	0.13	0.13	0.06	0.08	0.08	0.13	0.15	1.00
v/c Ratio	0.98	0.16	0.05	0.62	0.73	0.15	0.38	0.04	0.72	0.50	0.69
Control Delay	46.2	11.5	50.4	55.4	20.9	52.1	50.0	28.0	55.2	48.3	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.2	11.5	50.4	55.4	20.9	52.1	50.0	28.0	55.2	48.3	2.5
LOS	D	B	D	E	C	D	D	C	E	D	A
Approach Delay		43.1		32.2			49.4			17.4	
Approach LOS		D		C			D			B	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 104.6
Natural Cycle: 135
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 32.0 — Intersection LOS: C
Intersection Capacity Utilization 77.1% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 3: Wailea Ike Dr. & Piilani HWY

ø1	ø2	ø3	ø4
18 s	24 s	24 s	54 s

ø5	ø6	ø7	ø8
11 s	31 s	55 s	23 s

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1520	130	20	5	135	285	15	105	5	290	130	1005
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.95	1.00	0.97	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	1825		1770	1863	1583	1770	3539	1583	3433	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	1825		1770	1863	1583	1770	3539	1583	3433	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1652	141	22	5	147	310	16	114	5	315	141	1092
RTOR Reduction (vph)	0	4	0	0	0	222	0	0	5	0	0	0
Lane Group Flow (vph)	1652	159	0	5	147	88	16	114	0	315	141	1092
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8			2			Free
Actuated Green, G (s)	51.2	58.6		5.9	13.3	13.3	6.3	8.9	8.9	13.2	15.8	104.6
Effective Green, g (s)	51.2	58.6		5.9	13.3	13.3	6.3	8.9	8.9	13.2	15.8	104.6
Actuated g/C Ratio	0.49	0.56		0.06	0.13	0.13	0.06	0.09	0.09	0.13	0.15	1.00
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1680	1022		100	237	201	107	301	135	433	281	1583
v/s Ratio Prot	c0.48	0.09		0.00	0.08		0.01	0.03		0.09	0.08	
v/s Ratio Perm						0.06			0.00			c0.69
v/c Ratio	0.98	0.16		0.05	0.62	0.44	0.15	0.38	0.00	0.73	0.50	0.69
Uniform Delay, d1	26.3	11.1		46.7	43.3	42.2	46.6	45.2	43.8	44.0	40.8	0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	18.0	0.1		0.2	5.0	1.5	0.6	0.8	0.0	6.0	1.4	2.5
Delay (s)	44.3	11.2		46.9	48.2	43.7	47.3	46.0	43.8	50.0	42.2	2.5
Level of Service	D	B		D	D	D	D	D	D	D	D	A
Approach Delay (s)		41.3			45.2			46.1			15.8	
Approach LOS		D			D			D			B	

Intersection Summary

HCM Average Control Delay	31.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	104.6	Sum of lost time (s)	4.0
Intersection Capacity Utilization	77.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰	↱
Volume (veh/h)	1265	90	165	925	100	290
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1375	98	179	1005	109	315
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				749		
pX, platoon unblocked						
vC, conflicting volume			1473		2285	736
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1473		2285	736
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			60		0	13
cM capacity (veh/h)			454		20	361

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	917	556	179	503	503	109	315
Volume Left	0	0	179	0	0	109	0
Volume Right	0	98	0	0	0	0	315
cSH	1700	1700	454	1700	1700	20	361
Volume to Capacity	0.54	0.33	0.40	0.30	0.30	5.40	0.87
Queue Length 95th (ft)	0	0	47	0	0	Err	209
Control Delay (s)	0.0	0.0	18.0	0.0	0.0	Err	55.1
Lane LOS			C			F	F
Approach Delay (s)	0.0		2.7			2604.8	
Approach LOS						F	

Intersection Summary			
Average Delay	359.4		
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	675	295	435	940	295	400
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Detector Phase	8	8	2	2 8	1	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	22.0	22.0	24.0		10.0	24.0
Total Split (s)	29.0	29.0	36.0	65.0	25.0	61.0
Total Split (%)	32.2%	32.2%	40.0%	72.2%	27.8%	67.8%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	Max		None	Max
Act Effct Green (s)	24.0	24.0	32.8	60.8	19.2	56.1
Actuated g/C Ratio	0.27	0.27	0.37	0.68	0.22	0.63
v/c Ratio	0.79	0.48	0.69	0.51	0.84	0.20
Control Delay	37.4	5.8	31.2	5.6	53.6	7.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.4	5.8	31.2	5.6	53.6	7.4
LOS	D	A	C	A	D	A
Approach Delay	27.8		13.7			27.0
Approach LOS	C		B			C

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 89.1
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 21.3 — Intersection LOS: C
Intersection Capacity Utilization 69.3% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 7: Wailea Ike Dr. & Wailea Alanui Dr.

ø1 25 s | ø2 36 s
ø6 61 s | ø8 29 s

HCM Signalized Intersection Capacity Analysis
7: Wailea Ike Dr. & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↱	↑	↱↱	↰	↑↑
Volume (vph)	675	295	435	940	295	400
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lane Util. Factor	0.97	1.00	1.00	0.88	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1863	2787	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1863	2787	1770	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	734	321	473	1022	321	435
RTOR Reduction (vph)	0	234	0	97	0	0
Lane Group Flow (vph)	734	87	473	925	321	435
Turn Type		Perm		pt+ov	Prot	
Protected Phases	8		2	2 8	1	6
Permitted Phases		8				
Actuated Green, G (s)	24.0	24.0	32.8	61.8	19.2	56.0
Effective Green, g (s)	24.0	24.0	32.8	61.8	19.2	56.0
Actuated g/C Ratio	0.27	0.27	0.37	0.69	0.22	0.63
Clearance Time (s)	4.0	4.0	5.0		4.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	926	427	687	1935	382	2227
v/s Ratio Prot	c0.21		c0.25	0.33	c0.18	0.12
v/s Ratio Perm		0.05				
v/c Ratio	0.79	0.20	0.69	0.48	0.84	0.20
Uniform Delay, d1	30.2	25.1	23.8	6.2	33.4	7.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.7	0.2	5.6	0.2	15.2	0.2
Delay (s)	34.9	25.3	29.3	6.4	48.7	7.2
Level of Service	C	C	C	A	D	A
Approach Delay (s)	32.0		13.7			24.8
Approach LOS	C		B			C

Intersection Summary			
HCM Average Control Delay	22.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	89.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
8: Okolani Dr & Wailea Alanui Dr.

Austin, Tsutsumi & Associates, Inc.
7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱		↰↑	↱	↰	↑	↱		↰↑	↱
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	15	95	490	100	70	15	535	110	145	15	35	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	103	533	109	76	16	582	120	158	16	38	16

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total (vph)	16	103	533	185	16	582	120	158	54	16
Volume Left (vph)	16	0	0	109	0	582	0	0	16	0
Volume Right (vph)	0	0	533	0	16	0	0	158	0	16
Hadj (s)	0.53	0.03	-0.67	0.33	-0.67	0.53	0.03	-0.67	0.18	-0.67
Departure Headway (s)	7.6	7.1	3.2	7.2	6.2	6.2	5.7	3.2	6.7	5.9
Degree Utilization, x	0.03	0.20	0.47	0.37	0.03	1.00	0.19	0.14	0.10	0.03
Capacity (veh/h)	461	497	1116	493	565	582	614	1121	513	582
Control Delay (s)	9.6	10.7	7.8	13.1	8.2	62.0	8.9	5.5	9.3	7.9
Approach Delay (s)	8.3			12.7		44.3			9.0	
Approach LOS	A			B		E			A	

Intersection Summary			
Delay	26.2		
HCM Level of Service	D		
Intersection Capacity Utilization	58.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↱			↰↑
Volume (veh/h)	35	155	600	25	100	570
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	168	652	27	109	620
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1503	666			679	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1503	666			679	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	68	63			88	
cM capacity (veh/h)	118	460			913	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	207	679	728
Volume Left	38	0	109
Volume Right	168	27	0
cSH	431	1700	913
Volume to Capacity	0.48	0.40	0.12
Queue Length 95th (ft)	63	0	10
Control Delay (s)	20.8	0.0	2.9
Lane LOS	C		A
Approach Delay (s)	20.8	0.0	2.9
Approach LOS	C		

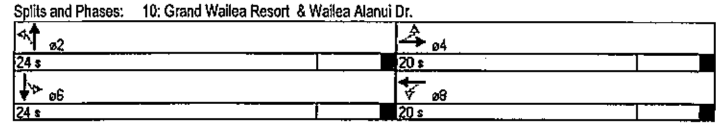
Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	82.0%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		✥		✥	↰	↑↑	↰	↑↑
Volume (vph)	105	5	10	15	30	1085	60	765
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (s)	20.0	20.0	20.0	20.0	24.0	24.0	24.0	24.0
Total Split (%)	45.5%	45.5%	45.5%	45.5%	54.5%	54.5%	54.5%	54.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		9.0		9.0	23.6	23.6	23.6	23.6
Actuated g/C Ratio		0.23		0.23	0.61	0.61	0.61	0.61
v/c Ratio		0.45		0.20	0.10	0.55	0.30	0.43
Control Delay		15.3		9.5	7.2	8.4	12.4	7.0
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0
Total Delay		15.3		9.5	7.2	8.4	12.4	7.0
LOS		B		A	A	A	B	A
Approach Delay		15.3		9.5		8.4		7.3
Approach LOS		B		A		A		A

Intersection Summary

Cycle Length: 44
Actuated Cycle Length: 38.8
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.55
Intersection Signal Delay: 8.4 — Intersection LOS: A
Intersection Capacity Utilization 60.4% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 10: Grand Wailea Resort & Wailea Alanui Dr.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥		↰	↑↑		↰	↑↑	
Volume (vph)	105	5	25	10	15	45	30	1085	10	60	765	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frt		0.98			0.91		1.00	1.00		1.00	0.99	
Flt Protected		0.96			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1748			1688		1770	3534		1770	3495	
Flt Permitted		0.72			0.93		0.29	1.00		0.19	1.00	
Satd. Flow (perm)		1313			1582		549	3534		355	3495	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	5	27	11	16	49	33	1179	11	65	832	76
RTOR Reduction (vph)	0	22	0	0	22	0	0	1	0	0	12	0
Lane Group Flow (vph)	0	124	0	0	54	0	33	1189	0	65	896	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.6			7.6		22.3	22.3		22.3	22.3	
Effective Green, g (s)		7.6			7.6		22.3	22.3		22.3	22.3	
Actuated g/C Ratio		0.19			0.19		0.56	0.56		0.56	0.56	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		250			301		307	1975		198	1953	
v/s Ratio Prot								c0.34			0.26	
v/s Ratio Perm		c0.09			0.03		0.06			0.18		
v/c Ratio		0.50			0.18		0.11	0.60		0.33	0.46	
Uniform Delay, d1		14.4			13.5		4.1	5.8		4.8	5.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.6			0.3		0.2	0.5		1.0	0.2	
Delay (s)		16.0			13.8		4.3	6.4		5.7	5.4	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		16.0			13.8			6.3			5.4	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	6.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	39.9	Sum of lost time (s)	10.0
Intersection Capacity Utilization	60.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱			↰↑	↱		↰↑	↱	↰	↑	↱
Volume (veh/h)	95	25	10	85	15	5	10	740	100	35	625	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	103	27	11	92	16	5	11	804	109	38	679	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1590	1582	679	1606	1652	804	750			804		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1590	1582	679	1606	1652	804	750			804		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	73	98	0	82	99	99			95		
cM capacity (veh/h)	71	102	451	63	93	383	859			820		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	103	38	109	5	815	109	38	679	71
Volume Left	103	0	92	0	11	0	38	0	0
Volume Right	0	11	0	5	0	109	0	0	71
cSH	71	131	66	383	859	1700	820	1700	1700
Volume to Capacity	1.46	0.29	1.64	0.01	0.01	0.06	0.05	0.40	0.04
Queue Length 95th (ft)	214	28	240	1	1	0	4	0	0
Control Delay (s)	367.9	43.2	452.2	14.5	0.3	0.0	9.6	0.0	0.0
Lane LOS	F	E	F	B	A		A		
Approach Delay (s)	280.5		431.4		0.3		0.5		
Approach LOS	F		F						

Intersection Summary			
Average Delay	45.5		
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		

Timings
11: Kaukahi Dr & Wailea Alanui Dr.

7/31/2009

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↰	↱		↰	↱	↰	↑	↱
Volume (vph)	30	20	90	30	5	345	50	20	590	145
Turn Type	Perm		Perm		Perm		Perm	Perm		Perm
Protected Phases		4		8		2			6	
Permitted Phases	4		8		2		2	6		6
Detector Phase	4	4	8	8	2	2	2	6	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	24.0	24.0	24.0	24.0	36.0	36.0	36.0	36.0	36.0	36.0
Total Split (%)	40.0%	40.0%	40.0%	40.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	Min	Min	Min	Min	Min	Min

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 43.5
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 11: Kaukahi Dr & Wailea Alanui Dr.

ø2 36 s	ø4 24 s
ø6 36 s	ø8 24 s

HCM Signalized Intersection Capacity Analysis
11: Kaukahi Dr & Wailea Alanui Dr.

7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			↰	↱	↰	↑	↱
Volume (vph)	30	20	5	90	30	35	5	345	50	20	590	145
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	0.92			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1811		1770	1713			1862	1583	1770	1863	1583
Flt Permitted	0.71	1.00		0.74	1.00			0.99	1.00	0.54	1.00	1.00
Satd. Flow (perm)	1324	1811		1378	1713			1848	1583	999	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	22	5	98	33	38	5	375	54	22	641	158
RTOR Reduction (vph)	0	4	0	0	32	0	0	0	23	0	0	68
Lane Group Flow (vph)	33	23	0	98	39	0	0	380	31	22	641	90
Turn Type	Perm			Perm			Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	7.2	7.2		7.2	7.2			25.6	25.6	25.6	25.6	25.6
Effective Green, g (s)	7.2	7.2		7.2	7.2			25.6	25.6	25.6	25.6	25.6
Actuated g/C Ratio	0.16	0.16		0.16	0.16			0.57	0.57	0.57	0.57	0.57
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	213	291		221	275			1056	905	571	1065	905
v/s Ratio Prot		0.01			0.02						c0.34	
v/s Ratio Perm	0.02			c0.07				0.21	0.02	0.02		0.06
v/c Ratio	0.15	0.08		0.44	0.14			0.36	0.03	0.04	0.60	0.10
Uniform Delay, d1	16.2	16.0		17.0	16.1			5.2	4.2	4.2	6.3	4.4
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.1		1.4	0.2			0.2	0.0	0.0	1.0	0.0
Delay (s)	16.5	16.1		18.4	16.4			5.4	4.2	4.2	7.2	4.4
Level of Service	B	B		B	B			A	A	A	A	A
Approach Delay (s)		16.3			17.6			5.2			6.6	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	7.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	44.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Timings
11: Kaukahi Dr & Wailea Alanui Dr.

7/31/2009

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱	↰	↑↱		↰↑	↱	↰	↑	↱
Volume (vph)	95	25	85	15	10	740	100	35	625	65
Turn Type	Perm		Perm		Perm		Perm	Perm		Perm
Protected Phases		4		8		2			6	
Permitted Phases	4		8		2		2	6		6
Detector Phase	4	4	8	8	2	2	2	6	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	24.0	24.0	24.0	24.0	36.0	36.0	36.0	36.0	36.0	36.0
Total Split (%)	40.0%	40.0%	40.0%	40.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	Min	Min	Min	Min	Min	Min

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 48.9
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 11: Kaukahi Dr & Wailea Alanui Dr.

ø2 36 s	ø4 24 s
ø6 36 s	ø8 24 s

HCM Signalized Intersection Capacity Analysis
11: Kaukahi Dr & Wailea Alanui Dr.

7/31/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱			↰↑	↱	↰	↑	↱
Volume (vph)	95	25	10	85	15	5	10	740	100	35	625	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96		1.00	0.96			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1782		1770	1796			1861	1583	1770	1863	1583
Flt Permitted	0.74	1.00		0.73	1.00			0.99	1.00	0.24	1.00	1.00
Satd. Flow (perm)	1385	1782		1364	1796			1844	1583	447	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	103	27	11	92	16	5	11	804	109	38	679	71
RTOR Reduction (vph)	0	9	0	0	4	0	0	0	31	0	0	28
Lane Group Flow (vph)	103	29	0	92	17	0	0	815	78	38	679	43
Turn Type	Perm			Perm			Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	7.5	7.5		7.5	7.5			30.7	30.7	30.7	30.7	30.7
Effective Green, g (s)	7.5	7.5		7.5	7.5			30.7	30.7	30.7	30.7	30.7
Actuated g/C Ratio	0.15	0.15		0.15	0.15			0.61	0.61	0.61	0.61	0.61
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	207	266		204	268			1128	968	273	1139	968
v/s Ratio Prot		0.02			0.01						0.36	
v/s Ratio Perm	c0.07			0.07				c0.44	0.05	0.08		0.03
v/c Ratio	0.50	0.11		0.45	0.06			0.72	0.08	0.14	0.60	0.04
Uniform Delay, d1	19.6	18.5		19.5	18.3			6.8	4.0	4.1	6.0	3.9
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.2		1.6	0.1			2.3	0.0	0.2	0.8	0.0
Delay (s)	21.5	18.6		21.1	18.4			9.1	4.0	4.4	6.8	3.9
Level of Service	C	B		C	B			A	A	A	A	A
Approach Delay (s)		20.7			20.6			8.5			6.4	
Approach LOS		C			C			A			A	

Intersection Summary

HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	50.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Project Accesses Along Piilani Highway Extension

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	40	10	5	90	75	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	43	11	5	98	82	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	196	87	92			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	196	87	92			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	99	100			
cM capacity (veh/h)	790	972	1502			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	54	5	98	92
Volume Left	43	5	0	0
Volume Right	11	0	0	11
cSH	821	1502	1700	1700
Volume to Capacity	0.07	0.00	0.06	0.05
Queue Length 95th (ft)	5	0	0	0
Control Delay (s)	9.7	7.4	0.0	0.0
Lane LOS	A	A		
Approach Delay (s)	9.7	0.4		0.0
Approach LOS	A			

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	14.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↑↱		↰	↑
Volume (veh/h)	5	5	90	5	5	80
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	5	98	5	5	87
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	198	101			103	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	198	101			103	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			100	
cM capacity (veh/h)	787	955			1489	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	11	103	5	87
Volume Left	5	0	5	0
Volume Right	5	5	0	0
cSH	863	1700	1489	1700
Volume to Capacity	0.01	0.06	0.00	0.05
Queue Length 95th (ft)	1	0	0	0
Control Delay (s)	9.2	0.0	7.4	0.0
Lane LOS	A		A	
Approach Delay (s)	9.2	0.0	0.4	
Approach LOS	A			

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	15.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		↰	↑	↑↱	
Volume (veh/h)	25	10	5	70	75	10
Sign Control	Stop			Free	Free	
Grade	0%			-0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	11	5	76	82	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	174	87	92			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	174	87	92			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	99	100			
cM capacity (veh/h)	813	972	1502			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	38	5	76	92
Volume Left	27	5	0	0
Volume Right	11	0	0	11
cSH	853	1502	1700	1700
Volume to Capacity	0.04	0.00	0.04	0.05
Queue Length 95th (ft)	3	0	0	0
Control Delay (s)	9.4	7.4	0.0	0.0
Lane LOS	A	A		
Approach Delay (s)	9.4	0.5		0.0
Approach LOS	A			

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	14.6%	ICU Level of Service	A
Analysis Period (min)	15		

4: Kaukahi Street Extension & Piilani Highway Extension

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	35	15	15	40	35	50
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	16	16	43	38	54
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	141	65	92			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	141	65	92			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	98	99			
cM capacity (veh/h)	842	999	1502			
Direction, Lane #	**EB 1**	**NB 1**	**NB 2**	**SB 1**		
Volume Total	54	16	43	92		
Volume Left	38	16	0	0		
Volume Right	16	0	0	54		
cSH	884	1502	1700	1700		
Volume to Capacity	0.06	0.01	0.03	0.05		
Queue Length 95th (ft)	5	1	0	0		
Control Delay (s)	9.3	7.4	0.0	0.0		
Lane LOS	A	A				
Approach Delay (s)	9.3	2.0		0.0		
Approach LOS	A					
Intersection Summary						
Average Delay			3.0			
Intersection Capacity Utilization			17.5%	ICU Level of Service		A
Analysis Period (min)			15			

5: South Access & Piilani Highway Extension

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	35	5	5	5	5	10	5	10	5	15	10	25
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	5	5	5	5	11	5	11	5	16	11	27
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	92	84	24	76	95	14	38			16		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	92	84	24	76	95	14	38			16		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	99	99	99	99	99	100			99		
cM capacity (veh/h)	869	795	1052	895	784	1066	1572			1601		
Direction, Lane #	**EB 1**	**WB 1**	**NB 1**	**NB 2**	**SB 1**	**SB 2**						
Volume Total	49	22	5	16	16	38						
Volume Left	38	5	5	0	16	0						
Volume Right	5	11	0	5	0	27						
cSH	877	937	1572	1700	1601	1700						
Volume to Capacity	0.06	0.02	0.00	0.01	0.01	0.02						
Queue Length 95th (ft)	4	2	0	0	1	0						
Control Delay (s)	9.3	8.9	7.3	0.0	7.3	0.0						
Lane LOS	A	A	A		A							
Approach Delay (s)	9.3	8.9	1.8		2.2							
Approach LOS	A	A										
Intersection Summary												
Average Delay			5.5									
Intersection Capacity Utilization			20.7%		ICU Level of Service				A			
Analysis Period (min)			15									

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		↰	↑	↱	
Volume (veh/h)	40	10	10	115	125	30
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	43	11	11	125	136	33
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	299	152	168			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	299	152	168			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	99	99			
cM capacity (veh/h)	687	894	1409			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	54	11	125	168
Volume Left	43	11	0	0
Volume Right	11	0	0	33
cSH	720	1409	1700	1700
Volume to Capacity	0.08	0.01	0.07	0.10
Queue Length 95th (ft)	6	1	0	0
Control Delay (s)	10.4	7.6	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	10.4	0.6		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	18.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱		↰	↑
Volume (veh/h)	5	5	120	5	5	130
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	5	130	5	5	141
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	285	133			136	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	285	133			136	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			100	
cM capacity (veh/h)	702	916			1448	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	11	136	5	141
Volume Left	5	0	5	0
Volume Right	5	5	0	0
cSH	795	1700	1448	1700
Volume to Capacity	0.01	0.08	0.00	0.08
Queue Length 95th (ft)	1	0	0	0
Control Delay (s)	9.6	0.0	7.5	0.0
Lane LOS	A		A	
Approach Delay (s)	9.6	0.0	0.3	
Approach LOS	A			

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	16.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		↰	↑	↱	
Volume (veh/h)	25	10	10	115	110	25
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	11	11	125	120	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	280	133	147			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	280	133	147			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	99	99			
cM capacity (veh/h)	705	916	1435			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	38	11	125	147
Volume Left	27	11	0	0
Volume Right	11	0	0	27
cSH	754	1435	1700	1700
Volume to Capacity	0.05	0.01	0.07	0.09
Queue Length 95th (ft)	4	1	0	0
Control Delay (s)	10.0	7.5	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	10.0	0.6		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	18.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		↰	↑	↱	
Volume (veh/h)	50	15	25	75	65	55
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	54	16	27	82	71	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	236	101	130			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	236	101	130			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	98	98			
cM capacity (veh/h)	738	955	1455			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	71	27	82	130
Volume Left	54	27	0	0
Volume Right	16	0	0	60
cSH	779	1455	1700	1700
Volume to Capacity	0.09	0.02	0.05	0.08
Queue Length 95th (ft)	7	1	0	0
Control Delay (s)	10.1	7.5	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	10.1	1.9		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	18.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇹			⇹		↰	↱		↰	↱	
Volume (veh/h)	60	5	5	5	5	15	5	25	5	10	30	40
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	65	5	5	5	5	16	5	27	5	11	33	43
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	133	120	54	103	139	30	76			33		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	133	120	54	103	139	30	76			33		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	92	99	99	99	99	98	100			99		
cM capacity (veh/h)	814	763	1013	861	745	1045	1523			1579		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	76	27	5	33	11	76
Volume Left	65	5	5	0	11	0
Volume Right	5	16	0	5	0	43
cSH	822	930	1523	1700	1579	1700
Volume to Capacity	0.09	0.03	0.00	0.02	0.01	0.04
Queue Length 95th (ft)	8	2	0	0	1	0
Control Delay (s)	9.8	9.0	7.4	0.0	7.3	0.0
Lane LOS	A	A	A		A	
Approach Delay (s)	9.8	9.0	1.1		0.9	
Approach LOS	A	A				

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	24.4%	ICU Level of Service	A
Analysis Period (min)	15		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*  10:11:09         08+048 PIILANI EXT+NORTH ACCESS FY 2022                11  *
*                                                                              *
********************************************************************************
*                                              *                               *
* E     (m)     5.00   5.00   5.00             * TIME PERIOD     min      90  *
* L'    (m)    10.00  10.00  10.00             * TIME SLICE      min      15  *
* V     (m)     3.70   3.70   3.70             * RESULTS PERIOD min  15 75  *
* RAD   (m)    20.00  20.00  20.00             * TIME COST      $/hr  15.00  *
* PHI   (d)    30.00  30.00  30.00             * FLOW PERIOD     min  15 75  *
* DIA   (m)    37.00  37.00  37.00             * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP        0      0      0              * FLOW PEAK am/op/pm     AM  *
*                                              *                               *
********************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO    *FLOW TIME*
*          *    *                            *    *  *                *         *
*SB PII    *1.05*   10    75     0           *1.00*75*0.75 1.125 0.75*15 45 75 *
*NB PII    *1.05*   90     5     0           *1.00*75*0.75 1.125 0.75*15 45 75 *
*EB NA     *1.05*   10    40     0           *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
********************************************************************************
*                                                       *                      *
* FLOW       veh       85     95     50                 *                      *
* CAPACITY   veh     1181   1160   1201                 * AVDEL s       3.2 *
* AVE DELAY  mins    0.05   0.06   0.05                 * L  O  S         A *
* MAX DELAY  mins    0.07   0.07   0.06                 * VEH HRS       0.2 *
* AVE QUEUE  veh        0      0      0                 * COST  $       3.1 *
* MAX QUEUE  veh        0      0      0                 *                      *
*                                                       *                      *
********************************************************************************
```

```
*****************************************************************************
*                                                                           *
*  10:11:09        08+048 PIILANI EXT+NORTH ACCESS FY 2022              10  *
*                                                                           *
*****************************************************************************
*                                                *                          *
* E      (m)     5.00   5.00   5.00              * TIME PERIOD    min    90  *
* L'     (m)    10.00  10.00  10.00              * TIME SLICE     min    15  *
* V      (m)     3.70   3.70   3.70              * RESULTS PERIOD min  15 75  *
* RAD    (m)    20.00  20.00  20.00              * TIME COST     $/hr  15.00  *
* PHI    (d)    30.00  30.00  30.00              * FLOW PERIOD    min  15 75  *
* DIA    (m)    37.00  37.00  37.00              * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP          0      0      0              * FLOW PEAK am/op/pm     PM  *
*                                                *                          *
*****************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *        *
*SB PII    *1.05*   30  125    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*NB PII    *1.05*  115   10    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*EB NA     *1.05*   10   40    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *        *
*          *    *                            *    *  *               *        *
*          *    *                            *    *  *               *        *
*          *    *                            *    *  *               *        *
*****************************************************************************
*                                                      *                    *
* FLOW        veh      155    125     50               *                    *
* CAPACITY    veh     1181   1131   1198               * AVDEL s       3.4  *
* AVE DELAY  mins     0.06   0.06   0.05               * L  O  S         A  *
* MAX DELAY  mins     0.07   0.07   0.06               * VEH HRS       0.3  *
* AVE QUEUE   veh        0      0      0               * COST  $       4.7  *
* MAX QUEUE   veh        0      0      0               *                    *
*                                                      *                    *
*****************************************************************************
```

```
*****************************************************************************
*                                                                           *
*  19:11:09        08+048 PIILANI EXT+fire station FY 2022              15  *
*                                                                           *
*****************************************************************************
*                                                *                          *
* E      (m)     5.00   5.00   5.00              * TIME PERIOD    min    90  *
* L'     (m)    10.00  10.00  10.00              * TIME SLICE     min    15  *
* V      (m)     3.70   3.70   3.70              * RESULTS PERIOD min  15 75  *
* RAD    (m)    20.00  20.00  20.00              * TIME COST     $/hr  15.00  *
* PHI    (d)    30.00  30.00  30.00              * FLOW PERIOD    min  15 75  *
* DIA    (m)    37.00  37.00  37.00              * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP          0      0      0              * FLOW PEAK am/op/pm     AM  *
*                                                *                          *
*****************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *        *
*SB PII    *1.05*   75    5    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*WB FS     *1.05*    5    5    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*NB PII    *1.05*    5   90    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *        *
*          *    *                            *    *  *               *        *
*          *    *                            *    *  *               *        *
*          *    *                            *    *  *               *        *
*****************************************************************************
*                                                      *                    *
* FLOW        veh       80     10     95               *                    *
* CAPACITY    veh     1151   1201   1201               * AVDEL s       3.2  *
* AVE DELAY  mins     0.05   0.05   0.05               * L  O  S         A  *
* MAX DELAY  mins     0.07   0.06   0.07               * VEH HRS       0.2  *
* AVE QUEUE   veh        0      0      0               * COST  $       2.5  *
* MAX QUEUE   veh        0      0      0               *                    *
*                                                      *                    *
*****************************************************************************
```

```
*******************************************************************************
*                                                                             *
*  19:11:09         08+048 PIILANI EXT+fire station FY 2022              16  *
*                                                                             *
*******************************************************************************
*                                                 *                           *
* E     (m)      5.00   5.00   5.00               * TIME PERIOD    min     90 *
* L'    (m)     10.00  10.00  10.00               * TIME SLICE     min     15 *
* V     (m)      3.70   3.70   3.70               * RESULTS PERIOD min  15 75 *
* RAD   (m)     20.00  20.00  20.00               * TIME COST     $/hr 15.00 *
* PHI   (d)     30.00  30.00  30.00               * FLOW PERIOD    min  15 75 *
* DIA   (m)     37.00  37.00  37.00               * FLOW TYPE  pcu/veh    VEH *
* GRAD SEP         0      0      0                * FLOW PEAK am/op/pm     PM *
*                                                 *                           *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO     *FLOW TIME*
*          *    *                            *    *  *                *         *
*SB PII    *1.05*  125    5    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*wB FS     *1.05*    5    5    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*NB PII    *1.05*    5  115    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*******************************************************************************
*                                                           *                 *
* FLOW         veh      130     10    120                   *                 *
* CAPACITY     veh     1137   1201   1201                   * AVDEL s     3.4 *
* AVE DELAY   mins     0.06   0.05   0.05                   * L  O  S       A *
* MAX DELAY   mins     0.07   0.06   0.07                   * VEH HRS     0.2 *
* AVE QUEUE    veh        0      0      0                   * COST  $     3.6 *
* MAX QUEUE    veh        0      0      0                   *                 *
*                                                           *                 *
*******************************************************************************
```

```
*******************************************************************************
*                                                                             *
*  10:11:09         08+048 PIILANI EXT+south ACCESS FY 2022               8  *
*                                                                             *
*******************************************************************************
*                                                 *                           *
* E     (m)      5.00   5.00   5.00               * TIME PERIOD    min     90 *
* L'    (m)     10.00  10.00  10.00               * TIME SLICE     min     15 *
* V     (m)      3.70   3.70   3.70               * RESULTS PERIOD min  15 75 *
* RAD   (m)     20.00  20.00  20.00               * TIME COST     $/hr 15.00 *
* PHI   (d)     30.00  30.00  30.00               * FLOW PERIOD    min  15 75 *
* DIA   (m)     37.00  37.00  37.00               * FLOW TYPE  pcu/veh    VEH *
* GRAD SEP         0      0      0                * FLOW PEAK am/op/pm     AM *
*                                                 *                           *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO     *FLOW TIME*
*          *    *                            *    *  *                *         *
*SB PII    *1.05*   10   75    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*NB PII    *1.05*   70    5    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*eB NA     *1.05*   10   25    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*******************************************************************************
*                                                           *                 *
* FLOW         veh       85     75     35                   *                 *
* CAPACITY     veh     1189   1160   1201                   * AVDEL s     3.2 *
* AVE DELAY   mins     0.05   0.05   0.05                   * L  O  S       A *
* MAX DELAY   mins     0.07   0.07   0.06                   * VEH HRS     0.2 *
* AVE QUEUE    veh        0      0      0                   * COST  $     2.6 *
* MAX QUEUE    veh        0      0      0                   *                 *
*                                                           *                 *
*******************************************************************************
```

```
*******************************************************************************
*                                                                             *
*  10:11:09         08+048 PIILANI EXT+sMüth ACCESS FY 2022              9  *
*                                                                             *
*******************************************************************************
*                                              *                              *
* E     (m)     5.00   5.00   5.00             * TIME PERIOD     min      90  *
* L'    (m)    10.00  10.00  10.00             * TIME SLICE      min      15  *
* V     (m)     3.70   3.70   3.70             * RESULTS PERIOD min  15 75   *
* RAD   (m)    20.00  20.00  20.00             * TIME COST      $/hr  15.00  *
* PHI   (d)    30.00  30.00  30.00             * FLOW PERIOD     min   15 75  *
* DIA   (m)    37.00  37.00  37.00             * FLOW TYPE  pcu/veh     VEH  *
* GRAD SEP         0      0      0             * FLOW PEAK am/op/pm      PM  *
*                                              *                              *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO    *FLOW TIME*
*          *    *                            *    *  *                *         *
*SB PII    *1.05*   25  110    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*NB PII    *1.05*  115   10    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*eB NA     *1.05*   10   25    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*******************************************************************************
*                                                      *                      *
* FLOW        veh     135    125     35                *                      *
* CAPACITY    veh    1189   1139   1198                * AVDEL s       3.4  *
* AVE DELAY  mins    0.06   0.06   0.05                * L  O  S         A  *
* MAX DELAY  mins    0.07   0.07   0.06                * VEH HRS       0.3  *
* AVE QUEUE   veh       0      0      0                * COST  $       4.1  *
* MAX QUEUE   veh       0      0      0                *                      *
*                                                      *                      *
*******************************************************************************
```

```
*******************************************************************************
*                                                                             *
*  10:11:09         08+048 PIILANI EXT+kaukahi fy 2022                  11  *
*                                                                             *
*******************************************************************************
*                                              *                              *
* E     (m)     5.00   5.00   5.00             * TIME PERIOD     min      90  *
* L'    (m)    10.00  10.00  10.00             * TIME SLICE      min      15  *
* V     (m)     3.70   3.70   3.70             * RESULTS PERIOD min  15 75   *
* RAD   (m)    20.00  20.00  20.00             * TIME COST      $/hr  15.00  *
* PHI   (d)    30.00  30.00  30.00             * FLOW PERIOD     min   15 75  *
* DIA   (m)    37.00  37.00  37.00             * FLOW TYPE  pcu/veh     VEH  *
* GRAD SEP         0      0      0             * FLOW PEAK am/op/pm      AM  *
*                                              *                              *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO    *FLOW TIME*
*          *    *                            *    *  *                *         *
*SB PII    *1.05*   50   35    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*NB PII    *1.05*   40   15    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*EB NA     *1.05*   15   35    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*******************************************************************************
*                                                      *                      *
* FLOW        veh      85     55     50                *                      *
* CAPACITY    veh    1184   1184   1195                * AVDEL s       3.1  *
* AVE DELAY  mins    0.05   0.05   0.05                * L  O  S         A  *
* MAX DELAY  mins    0.07   0.07   0.06                * VEH HRS       0.2  *
* AVE QUEUE   veh       0      0      0                * COST  $       2.5  *
* MAX QUEUE   veh       0      0      0                *                      *
*                                                      *                      *
*******************************************************************************
```

```
*****************************************************************************
*                                                                           *
*  10:11:09          08+048 PIILANI EXT+kaukahi fy 2022               10   *
*                                                                           *
*****************************************************************************
*                                                   *                       *
* E     (m)     5.00   5.00   5.00                  * TIME PERIOD     min     90  *
* L'    (m)    10.00  10.00  10.00                  * TIME SLICE      min     15  *
* V     (m)     3.70   3.70   3.70                  * RESULTS PERIOD min  15 75  *
* RAD   (m)    20.00  20.00  20.00                  * TIME COST      $/hr  15.00  *
* PHI   (d)    30.00  30.00  30.00                  * FLOW PERIOD    min  15 75  *
* DIA   (m)    37.00  37.00  37.00                  * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP         0      0      0                  * FLOW PEAK am/op/pm     PM  *
*                                                   *                       *
*****************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
*SB PII    *1.05*   55   65    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*NB PII    *1.05*   75   25    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*EB NA     *1.05*   15   50    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*****************************************************************************
*                                                        *                  *
* FLOW         veh      120    100     65                *                  *
* CAPACITY     veh     1175   1166   1189                * AVDEL s      3.3 *
* AVE DELAY   mins     0.06   0.06   0.05                * L  O  S        A *
* MAX DELAY   mins     0.07   0.07   0.07                * VEH HRS      0.3 *
* AVE QUEUE    veh        0      0      0                * COST  $      3.9 *
* MAX QUEUE    veh        0      0      0                *                  *
*                                                        *                  *
*****************************************************************************
```

```
*****************************************************************************
*                                                                           *
*  10:11:09          08-048 piilani ext-southacces fy 2022            19   *
*                                                                           *
*****************************************************************************
*                                                   *                       *
* E     (m)     5.00   5.00   5.00   5.00           * TIME PERIOD     min     90  *
* L'    (m)    10.00  10.00  10.00  10.00           * TIME SLICE      min     15  *
* V     (m)     3.70   3.70   3.70   3.70           * RESULTS PERIOD min  15 75  *
* RAD   (m)    20.00  20.00  20.00  20.00           * TIME COST      $/hr  15.00  *
* PHI   (d)    30.00  30.00  30.00  30.00           * FLOW PERIOD    min  15 75  *
* DIA   (m)    37.00  37.00  37.00  37.00           * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP         0      0      0      0           * FLOW PEAK am/op/pm     AM  *
*                                                   *                       *
*****************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
*sb pii    *1.05*   25   10   15    0        *1.00*75*0.75 1.125 0.75*15 45 75 *
*wb sa     *1.05*   10    5    5    0        *1.00*75*0.75 1.125 0.75*15 45 75 *
*nb pii    *1.05*    5   10    5    0        *1.00*75*0.75 1.125 0.75*15 45 75 *
*eb sa     *1.05*    5    5   35    0        *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*****************************************************************************
*                                                        *                  *
* FLOW         veh       50     20     20     45         *                  *
* CAPACITY     veh     1178   1169   1189   1192         * AVDEL s      3.1 *
* AVE DELAY   mins     0.05   0.05   0.05   0.05         * L  O  S        A *
* MAX DELAY   mins     0.07   0.06   0.06   0.06         * VEH HRS      0.1 *
* AVE QUEUE    veh        0      0      0      0         * COST  $      1.7 *
* MAX QUEUE    veh        0      0      0      0         *                  *
*                                                        *                  *
*****************************************************************************
```

APPENDIX D

LEVEL OF SERVICE SUMMARY TABLE

```
*******************************************************************************
*                                                                             *
*  10:11:09          08-048 piilani ext-smosth acces fy 2022               1  *
*                                                                             *
*******************************************************************************
*                                                     *                       *
* E    (m)     5.00   5.00   5.00   5.00              * TIME PERIOD    min     90  *
* L'   (m)    10.00  10.00  10.00  10.00              * TIME SLICE     min     15  *
* V    (m)     3.70   3.70   3.70   3.70              * RESULTS PERIOD min  15 75  *
* RAD  (m)    20.00  20.00  20.00  20.00              * TIME COST     $/hr  15.00  *
* PHI  (d)    30.00  30.00  30.00  30.00              * FLOW PERIOD    min  15 75  *
* DIA  (m)    37.00  37.00  37.00  37.00              * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP        0      0      0      0              * FLOW PEAK am/op/pm     PM  *
*                                                     *                       *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO    *FLOW TIME*
*          *    *                            *    *  *                *          *
*sb pii    *1.05*   40   30   10  0          *1.00*75*0.75 1.125 0.75*15 45 75 *
*wb sa     *1.05*   15    5    5  0          *1.00*75*0.75 1.125 0.75*15 45 75 *
*nb pii    *1.05*    5   25    5  0          *1.00*75*0.75 1.125 0.75*15 45 75 *
*eb sa     *1.05*    5    5   60  0          *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *                *          *
*          *    *                            *    *  *                *          *
*          *    *                            *    *  *                *          *
*******************************************************************************
*                                                       *                     *
* FLOW         veh      80     25     35     70         *                     *
* CAPACITY     veh    1163   1145   1192   1184         * AVDEL s        3.2  *
* AVE DELAY   mins    0.05   0.05   0.05   0.05         * L  O  S          A  *
* MAX DELAY   mins    0.07   0.07   0.06   0.07         * VEH HRS        0.2  *
* AVE QUEUE    veh       0      0      0      0         * COST  $        2.8  *
* MAX QUEUE    veh       0      0      0      0         *                     *
*                                                       *                     *
*******************************************************************************
```

Table D-1: LOS Summary for Year 2016

Intersection	Existing 2008						Base Year 2016 without Project without Mitigative Measures						Base Year 2016 without Project with Recommended Mitigative Measures						Future Year 2016 with Project No Mititative Measures Recommended					
	AM			PM			AM			PM			AM			PM			AM			PM		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
7: Wailea Alanui Drive & Wailea Ike Drive																								
WB LT	14.9	0.76	B	17.8	0.66	B	27.3	0.88	C	32	0.83	C	27.3	0.88	C	32	0.83	C	24.3	0.8	C	31.8	0.69	C
WB RT	7.3	0.08	A	11.9	0.09	B	10	0.15	A	17.2	0.15	B	10	0.15	A	17.2	0.15	B	15.6	0.13	B	25.4	0.16	C
NB TH	17	0.34	B	18.1	0.59	B	47.4	0.65	D	38.1	0.84	D	47.4	0.65	D	38.1	0.84	D	17.4	0.29	B	24.9	0.6	C
NB RT	0.1	0.11	A	0.6	0.38	A	0.3	0.2	A	1.2	0.51	A	0.3	0.2	A	1.2	0.51	A	2.2	0.12	A	5.3	0.38	A
SB LT	26.3	0.57	C	27.3	0.68	C	47.8	0.82	D	40.3	0.77	D	47.8	0.82	D	40.3	0.77	D	41.2	0.73	D	43.2	0.78	D
SB TH	10.7	0.23	B	6.3	0.15	A	27.6	0.39	C	10.2	0.22	B	27.6	0.39	C	10.2	0.22	B	9.1	0.25	A	6.6	0.18	A
Overall	12.4	0.63	B	10.8	0.64	B	25.1	0.8	C	19.9	0.82	B	25.1	0.8	C	19.9	0.82	B	17.7	0.67	B	19.6	0.67	B
8: Wailea Alanui Drive & Okolani Drive																								
EB TH	7.2	-	A	8	-	A	8.1	-	A	9.9	-	A	8.1	-	A	9.9	-	A	8.1	-	A	10.1	-	B
EB RT	6.1	-	A	5.9	-	A	7.3	-	A	7.1	-	A	7.3	-	A	7.1	-	A	7.4	-	A	7.3	-	A
WB LT/TH	8	-	A	8.6	-	A	10.1	-	B	12.1	-	B	10.1	-	B	12.1	-	B	10.1	-	B	12.3	-	B
WB RT	6.2	-	A	6.9	-	A	6.7	-	A	7.8	-	A	6.7	-	A	7.8	-	A	6.7	-	A	7.9	-	A
NB LT	8.3	-	A	12	-	B	10.8	-	B	26.3	-	D	10.8	-	B	26.3	-	D	11.1	-	B	33.4	-	D
NB TH	6.9	-	A	7.6	-	A	7.4	-	A	8.6	-	A	7.4	-	A	8.6	-	A	7.4	-	A	8.8	-	A
NB RT	5.1	-	A	5.2	-	A	5.2	-	A	5.5	-	A	5.2	-	A	5.5	-	A	5.2	-	A	5.5	-	A
SB LT/TH	7.4	-	A	7.6	-	A	8.3	-	A	8.9	-	A	8.3	-	A	8.9	-	A	8.3	-	A	9	-	A
SB RT	6.1	-	A	6.5	-	A	6.7	-	A	7.6	-	A	6.7	-	A	7.6	-	A	6.7	-	A	7.6	-	A
9: South Kihei Road & Kilohana Drive																								
WB LT	9.5	0.07	A	12.3	0.2	B	11.4	0.14	B	18.6	0.31	C	11.4	0.14	B	18.6	0.31	C	11.5	0.14	B	19.5	0.32	C
WB RT	9.5	0.07	A	12.3	0.2	B	11.4	0.14	B	18.6	0.31	C	11.4	0.14	B	18.6	0.31	C	11.5	0.14	B	19.5	0.32	C
NB TH/RT	0	0.08	A	0	0.21	A	0	0.17	A	0	0.34	A	0	0.17	A	0	0.34	A	0	0.17	A	0	0.35	A
SB LT/TH	2.1	0.06	A	2.1	0.06	A	2.1	0.08	A	2.7	0.11	A	2.1	0.08	A	2.7	0.11	A	2.1	0.08	A	2.7	0.11	A
10: Wailea Alanui Drive & Grand Wailea																								
EB LT/TH/RT	21.2	0.33	C	16.1	0.35	B	17.6	0.33	B	15.3	0.49	B	18.3	0.33	B	18.2	0.5	B	17.4	0.32	B	15.3	0.49	B
WB LT/TH/RT	17.8	0.06	B	14.8	0.11	B	16.7	0.17	B	13	0.12	B	17.4	0.17	B	13.8	0.12	B	16.5	0.17	B	13	0.12	B
NB LT	1.7	0.01	A	2.5	0.02	A	2.4	0.06	A	4.2	0.08	A	3.1	0.07	A	5.1	0.09	A	2.4	0.07	A	4.3	0.09	A
NB TH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.6	0.18	A	5.8	0.53	A
NB TH/RT	1.8	0.09	A	3.1	0.31	A	2.5	0.17	A	5.6	0.49	A	3.3	0.18	A	6.8	0.52	A	-	-	-	-	-	-
SB LT	1.7	0.03	A	2.6	0.04	A	3.1	0.31	A	5	0.23	A	3.9	0.33	A	5.9	0.24	A	3.1	0.32	A	5.2	0.26	A
SB TH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	0.44	A	5.2	0.39	A
SB TH/RT	2.1	0.29	A	2.8	0.2	A	3.2	0.43	A	5	0.35	A	4.2	0.46	A	6	0.37	A	-	-	-	-	-	-
Overall	2.5	0.29	A	3.9	0.31	A	4.1	0.42	A	6.4	0.49	A	4.9	0.45	A	7.5	0.52	A	4.1	0.43	A	6.5	0.52	A
11: Wailea Alanui Drive & Kaukahi Street													RESTRIPE EB AND WB APPROACHES											
EB LT	-	-	-	-	-	-	-	-	-	-	-	-	19.6	0.12	C	59	0.62	F	22.2	0.13	C	112.5	0.84	F
EB TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	15.4	0.07	C	22.8	0.16	C	16.6	0.08	C	28	0.2	D
EB LT/TH/RT	11.9	0.09	B	17.7	0.31	C	19.1	0.19	C	74	0.78	F	-	-	-	-	-	-	-	-	-	-	-	-
WB LT	-	-	-	-	-	-	-	-	-	-	-	-	18.1	0.16	C	36.4	0.22	E	23.2	0.26	C	77	0.59	F
WB LT/TH	12.9	0.13	B	15.7	0.1	C	22	0.28	C	36.4	0.31	E	-	-	-	-	-	-	-	-	-	-	-	-
WB TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	15	0.16	C	24.1	0.1	C	15.9	0.19	C	24.6	0.15	C
WB RT	8.7	0.03	A	10	0.01	A	9.7	0.05	A	12	0.01	B	-	-	-	-	-	-	-	-	-	-	-	-
NB LT/TH	0.2	0	A	0.2	0	A	0.3	0.01	A	0.3	0.01	A	0.3	0.01	A	0.3	0.01	A	0.2	0.01	A	0.3	0.01	A
NB RT	0	0	A	0	0.02	A	0	0	A	0	0.03	A	0	0	A	0	0.03	A	0	0.02	A	0	0.05	A
SB LT	7.4	0.02	A	7.9	0.02	A	7.7	0.02	A	8.8	0.04	A	7.7	0.02	A	8.8	0.04	A	7.8	0.02	A	9	0.05	A
SB TH	0	0.13	A	0	0.13	A	0	0.27	A	0	0.27	A	0	0.27	A	0	0.27	A	0	0.28	A	0	0.32	A
SB RT	0	0.09	A	0	0.04	A	0	0.09	A	0	0.04	A	0	0.09	A	0	0.04	A	0	0.09	A	0	0.04	A

Table D-1: LOS Summary for Year 2016

Intersection	Existing 2008						Base Year 2016 without Project without Mitigative Measures						Base Year 2016 without Project with Recommended Mitigative Measures						Future Year 2016 with Project No Mititative Measures Recommended					
	AM			PM			AM			PM			AM			PM			AM			PM		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Piilani Highway & Kilohana Drive													PIILANI HIGHWAY WIDENING											
EB LT	33.6	0.59	C	36.7	0.59	D	124	1.08	F	45	0.75	D	46.3	0.82	D	51.4	0.74	D	53	0.72	D	46.5	0.74	D
EB TH/RT	25.6	0.11	C	30.5	0.14	C	25	0.12	C	29.3	0.12	C	21.9	0.09	C	36.1	0.12	D	37.9	0.08	D	31.6	0.12	C
WB LT/TH	26.6	0.26	C	30.6	0.15	C	25.7	0.23	C	29.4	0.13	C	-	-	-	-	-	-	-	-	-	-	-	-
WB LT	-	-	-	-	-	-	-	-	-	-	-	-	21.9	0.08	C	35.5	0.04	D	37.9	0.07	D	31.2	0.04	C
WB TH	-	-	-	-	-	-	-	-	-	-	-	-	21.9	0.1	C	35.9	0.09	D	36	0.09	D	31.6	0.09	C
WB RT	25.6	0.1	C	30.2	0.09	C	25	0.11	C	28.1	0.09	C	22	0.11	C	35.9	0.09	D	38.2	0.11	D	31.6	0.09	C
NB LT	30.3	0.06	C	35.1	0.06	D	32	0.15	C	38.7	0.18	D	30.7	0.15	C	49.3	0.22	D	48.9	0.05	D	42.5	0.2	D
NB TH	-	-	-	-	-	-	-	-	-	-	-	-	8.5	0.39	A	22.4	0.77	C	10.9	0.4	B	37.6	0.97	D
NB TH/RT	6.1	0.28	A	27.1	0.88	C	11.9	0.68	B	270.1	1.54	F	-	-	-	-	-	-	-	-	-	-	-	-
NB RT	-	-	-	-	-	-	-	-	-	-	-	-	6.2	0	A	11.4	0.01	B	7.8	0	A	10.9	0.01	B
SB LT	30.3	0.46	C	43.3	0.71	D	30.9	0.46	C	46	0.74	D	28.4	0.42	C	51.9	0.7	D	48.9	0.38	D	45.7	0.69	D
SB TH	9.5	0.69	A	11.2	0.53	B	79.9	1.13	E	82.6	1.11	F	9.3	0.64	A	11.6	0.55	B	13.2	0.66	B	15	0.71	B
SB RT	3.8	0.08	A	6.9	0.09	A	4.6	0.1	A	8.8	0.18	A	5.4	0.1	A	8.4	0.16	A	7.4	0.1	A	8.6	0.16	A
Overall	12.4	0.88	B	23.6	0.8	C	53.5	1.12	D	147.9	1.34	F	12.6	0.66	B	21.8	0.75	C	17.1	0.66	B	28.2	0.87	C
2: Piilani Highway & Okolani Drive													PIILANI HIGHWAY WIDENING											
EB LT	-	-	-	-	-	-	28.4	0.66	C	51.1	0.85	D	21.8	0.62	C	38.3	0.8	D	34.5	0.72	C	49	0.83	D
EB LT/TH	23.9	0.18	C	141.7	0.95	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EB TH/RT	-	-	-	-	-	-	19.3	0.06	B	27.5	0.12	C	16	0.06	B	22.8	0.11	C	21.9	0.06	C	27.6	0.11	C
WB LT/TH	17.8	0.26	C	27.7	0.26	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WB LT/TH/RT	-	-	-	-	-	-	20.2	0.22	C	27.6	0.13	C	16.8	0.21	B	22.9	0.13	C	23	0.22	C	27.6	0.13	C
NB LT	9.1	0	A	8.3	0.01	A	5.3	0.09	A	7.7	0.16	A	31.8	0.33	C	37.4	0.42	D	42	0.37	D	46.5	0.51	D
NB TH	0	0.13	A	0	0.43	A	6.5	0.42	A	30	0.94	C	-	-	-	-	-	-	-	-	-	-	-	-
NB TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	9.8	0.31	A	17.3	0.68	B	9.6	0.33	A	21.5	0.8	C
NB RT	0	0.01	A	0	0.02	A	4.7	0.01	A	5.9	0.03	A	-	-	-	-	-	-	-	-	-	-	-	-
SB LT	7.7	0.02	A	9.5	0.09	A	4.9	0.07	A	120.1	1.02	F	27.9	0.43	C	36.3	0.53	D	36.6	0.51	D	50.1	0.63	D
SB TH	0	0.43	A	0	0.28	A	38	1	D	13.7	0.7	B	-	-	-	-	-	-	-	-	-	-	-	-
SB TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	14.4	0.78	B	14.5	0.61	B	14	0.74	B	17.5	0.72	B
SB RT	0	0.04	A	0	0.02	A	5	0.09	A	6.9	0.19	A	-	-	-	-	-	-	-	-	-	-	-	-
Overall	-	-	-	-	-	-	-	-	-	-	-	-	14.5	0.64	B	19.5	0.75	B	15.7	0.66	B	23.4	0.83	C
3: Piilani Highway & Wailea Ike Drive																								
EB LT	To be constructed with Project only						To be constructed with Project only						To be constructed with Project only						9.6	0.46	A	20.3	0.64	C
EB TH																			3.5	0.05	A	3.8	0.07	A
WB TH																			15.9	0.19	B	30.4	0.41	C
WB RT																			15.4	0.08	B	30.4	0.39	C
SB LT																			15.6	0.5	B	43.5	0.62	D
SB RT																			5.2	0.63	A	1.7	0.6	A
Overall																			7.6	0.63	A	17.6	0.78	B
4: Wailea Ike Drive & Kalai Waa Street																								
EB TH/RT	0	0.04	A	0	0.14	A	0	0.1	A	0	0.27	A	0	0.1	A	0	0.27	A	0	0.11	A	0	0.28	A
WB LT	7.9	0.08	A	9.4	0.08	A	8.8	0.12	A	12.9	0.21	B	8.8	0.12	A	12.9	0.21	B	9	0.14	A	13.8	0.24	B
WB TH	0	0.21	A	0	0.13	A	0	0.34	A	0	0.23	A	0	0.34	A	0	0.23	A	0	0.35	A	0	0.26	A
NB LT	17.7	0.02	C	23.6	0.05	C	42.6	0.29	E	326.3	1.26	F	42.6	0.29	E	326.3	1.26	F	50.8	0.33	F	542.1	1.68	F
NB RT	9	0.04	A	12	0.21	B	10.2	0.1	B	17.8	0.37	C	10.2	0.1	B	17.8	0.37	C	10.5	0.12	B	19.8	0.42	C

Table D-2: LOS Summary for Year 2018

Intersection	Existing 2008 AM HCM Delay	Existing 2008 AM v/c Ratio	Existing 2008 AM LOS	Existing 2008 PM HCM Delay	Existing 2008 PM v/c Ratio	Existing 2008 PM LOS	Base Year 2018 without Project, No Mititative Measures Recommended AM HCM Delay	AM v/c Ratio	AM LOS	PM HCM Delay	PM v/c Ratio	PM LOS	Future Year 2018 with Project, No Mititative Measures Recommended AM HCM Delay	AM v/c Ratio	AM LOS	PM HCM Delay	PM v/c Ratio	PM LOS
7: Wailea Alanui Drive & Wailea Ike Drive																		
WB LT	14.9	0.76	B	17.8	0.68	B	32.8	0.81	C	35.1	0.86	D	24.3	0.81	C	32.8	0.73	C
WB RT	7.3	0.08	A	11.9	0.09	B	10.9	0.17	B	17.6	0.18	B	15.2	0.15	B	25.5	0.2	C
NB TH	17	0.34	B	16.1	0.59	B	52.4	0.7	D	42.5	0.87	D	20.2	0.35	C	27.1	0.64	C
NB RT	0.1	0.11	A	0.6	0.36	A	0.3	0.21	A	1.3	0.53	A	2.8	0.14	A	6	0.43	A
SB LT	26.3	0.57	C	27.3	0.68	C	54.2	0.71	D	44.6	0.81	D	39	0.76	D	46.4	0.82	D
SB TH	10.7	0.23	B	6.3	0.15	A	28.8	0.39	C	10.6	0.22	B	9.6	0.26	A	6.9	0.18	A
Overall	12.4	0.63	B	10.8	0.64	B	26.8	0.64	C	21.8	0.85	C	18.2	0.63	B	20.9	0.71	C
8: Wailea Alanui Drive & Okolani Drive																		
EB TH	7.2	-	A	6	-	A	8.2	-	A	10.2	-	B	8.2	-	A	10.4	-	B
EB RT	6.1	-	A	5.9	-	A	7.6	-	A	7.3	-	A	7.9	-	A	7.5	-	A
WB LT/TH	8	-	A	8.6	-	A	10.3	-	B	12.5	-	B	10.4	-	B	12.7	-	B
WB RT	6.2	-	A	6.9	-	A	6.8	-	A	8	-	A	6.8	-	A	8.1	-	A
NB LT	8.3	-	A	12	-	B	11.4	-	B	40.4	-	E	12	-	B	49.1	-	E
NB TH	6.9	-	A	7.6	-	A	7.5	-	A	8.7	-	A	7.5	-	A	8.7	-	A
NB RT	5.1	-	A	5.2	-	A	5.2	-	A	5.5	-	A	5.2	-	A	5.6	-	A
SB LT/TH	7.4	-	A	7.6	-	A	8.3	-	A	9.1	-	A	8.4	-	A	9.2	-	A
SB RT	6.1	-	A	6.5	-	A	6.8	-	A	7.7	-	A	6.8	-	A	7.7	-	A
9: South Kihei Road & Kilohana Drive																		
WB LT	9.5	0.07	A	12.3	0.2	B	11.7	0.14	B	20.3	0.34	C	12	0.14	B	21.6	0.35	C
WB RT	9.5	0.07	A	12.3	0.2	B	11.7	0.14	B	20.3	0.34	C	12	0.14	B	21.6	0.35	C
NB TH/RT	0	0.08	A	0	0.21	A	0	0.18	A	0	0.36	A	0	0.19	A	0	0.38	A
SB LT/TH	2.1	0.06	A	2.1	0.06	A	2.1	0.08	A	2.8	0.11	A	2.1	0.08	A	2.9	0.12	A
10: Wailea Alanui Drive & Grand Wailea																		
EB LT/TH/RT	21.2	0.33	C	15.1	0.35	B	16.5	0.33	B	16.4	0.5	B	17.6	0.32	B	15.7	0.49	B
WB LT/TH/RT	17.8	0.06	B	14.8	0.11	B	17.5	0.17	B	13.9	0.12	B	16.6	0.17	B	13.4	0.15	B
NB LT	1.7	0.01	A	2.5	0.02	A	3.1	0.07	A	5.1	0.09	A	2.4	0.07	A	4.2	0.09	A
NB TH	-	-	-	-	-	-	-	-	-	-	-	-	2.6	0.2	A	5.9	0.55	A
NB TH/RT	1.8	0.09	A	3.1	0.31	A	3.3	0.19	A	6.9	0.54	A	-	-	-	-	-	-
SB LT	1.7	0.03	A	2.5	0.04	A	3.9	0.33	A	6	0.26	A	3.2	0.33	A	5.2	0.26	A
SB TH	-	-	-	-	-	-	-	-	-	-	-	-	3.4	0.47	A	5.2	0.41	A
SB TH/RT	2.1	0.29	A	2.8	0.2	A	4.2	0.47	A	6.1	0.38	A	-	-	-	-	-	-
Overall	2.5	0.29	A	3.9	0.31	A	4.9	0.48	A	7.6	0.63	A	4.1	0.45	A	6.5	0.54	A
11: Wailea Alanui Drive & Kaukahi Street																		
EB LT	-	-	-	-	-	-	21.2	0.13	C	81.3	0.74	F	24.6	0.15	C	172.7	1.02	F
EB TH/RT	-	-	-	-	-	-	16.2	0.08	C	24.8	0.17	C	17.7	0.09	C	31.9	0.22	D
EB LT/TH/RT	11.9	0.09	B	17.7	0.31	C	-	-	-	-	-	-	-	-	-	-	-	-
WB LT	-	-	-	-	-	-	21.1	0.2	C	48.6	0.38	E	25.7	0.27	D	177.6	1	F
WB LT/TH	12.9	0.13	B	15.7	0.1	C	-	-	-	-	-	-	-	-	-	-	-	-
WB TH/RT	-	-	-	-	-	-	15.8	0.17	C	26.2	0.11	D	22.2	0.33	C	33.1	0.15	D
WB RT	8.7	0.03	A	10	0.01	A	-	-	-	-	-	-	-	-	-	-	-	-
NB LT/TH	0.2	0	A	0.2	0	A	0.2	0.01	A	0.3	0.01	A	0.2	0.01	A	0.3	0.01	A
NB RT	0	0	A	0	0.02	A	0	0.02	A	0	0.03	A	0	0.03	A	0	0.08	A
SB LT	7.4	0.02	A	7.9	0.02	A	7.8	0.02	A	8.9	0.04	A	7.9	0.02	A	9.2	0.04	A
SB TH	0	0.13	A	0	0.13	A	0	0.28	A	0	0.29	A	0	0.31	A	0	0.35	A
SB RT	0	0.09	A	0	0.04	A	0	0.09	A	0	0.04	A	0	0.09	A	0	0.04	A

Table D-2: LOS Summary for Year 2018

Intersection	Existing 2008 AM HCM Delay	Existing 2008 AM v/c Ratio	Existing 2008 AM LOS	Existing 2008 PM HCM Delay	Existing 2008 PM v/c Ratio	Existing 2008 PM LOS	Base Year 2018 without Project, No Mititative Measures Recommended AM HCM Delay	AM v/c Ratio	AM LOS	PM HCM Delay	PM v/c Ratio	PM LOS	Future Year 2018 with Project, No Mititative Measures Recommended AM HCM Delay	AM v/c Ratio	AM LOS	PM HCM Delay	PM v/c Ratio	PM LOS
1: Piilani Highway & Kilohana Drive																		
EB LT	33.6	0.59	C	36.7	0.59	D	47.2	0.82	D	51.4	0.74	D	62.6	0.72	D	76.9	0.67	E
EB TH/RT	25.6	0.11	C	30.5	0.14	C	21.9	0.09	C	36.1	0.12	D	37.9	0.08	D	43.1	0.14	D
WB LT/TH	26.8	0.28	C	30.6	0.15	C	-	-	-	-	-	-	-	-	-	-	-	-
WB LT	-	-	-	-	-	-	21.9	0.08	C	35.6	0.04	D	37.8	0.07	D	42.3	0.05	D
WB TH	-	-	-	-	-	-	22	0.12	C	35.9	0.09	D	38.1	0.1	D	42.8	0.11	D
WB RT	25.8	0.1	C	30.2	0.09	C	22	0.11	C	35.9	0.1	D	38.1	0.11	D	42.7	0.1	D
NB LT	30.3	0.06	C	36.1	0.08	D	30.7	0.15	C	49.3	0.22	D	49	0.05	D	54.1	0.21	D
NB TH	-	-	-	-	-	-	8.7	0.42	A	26.3	0.66	C	11.9	0.48	B	30.6	0.94	C
NB TH/RT	6.1	0.28	A	27.1	0.88	C	-	-	-	-	-	-	-	-	-	-	-	-
NB RT	-	-	-	-	-	-	6.2	0	A	11.4	0.01	B	7.9	0	A	9.2	0.01	A
SB LT	30.3	0.46	C	43.3	0.71	D	28.4	0.42	C	51.9	0.7	D	49	0.38	D	79.6	0.86	E
SB TH	9.5	0.59	A	11.2	0.53	B	10.5	0.72	B	12.2	0.58	B	15.5	0.75	B	14.8	0.71	B
SB RT	3.8	0.08	A	6.9	0.09	A	5.4	0.1	A	8.4	0.16	A	7.5	0.11	A	7.8	0.16	A
Overall	12.4	0.68	B	23.6	0.6	C	13.2	0.74	B	23.5	0.81	C	18	0.73	B	28	0.91	C
2: Piilani Highway & Okolani Drive																		
EB LT	-	-	-	-	-	-	21.8	0.82	C	40	0.8	D	34.6	0.72	C	49.8	0.83	D
EB LT/TH	23.9	0.18	C	141.7	0.95	F	-	-	-	-	-	-	-	-	-	-	-	-
EB TH/RT	-	-	-	-	-	-	15	0.06	B	22.7	0.11	C	21.9	0.06	C	27.5	0.11	C
WB LT/TH	17.8	0.26	C	27.7	0.26	D	-	-	-	-	-	-	-	-	-	-	-	-
WB LT/TH/RT	-	-	-	-	-	-	16.8	0.21	B	22.6	0.13	C	23	0.22	C	27.7	0.13	C
NB LT	9.1	0	A	8.3	0.01	A	31.8	0.33	C	37.4	0.42	D	42	0.37	D	46.8	0.52	D
NB TH	0	0.13	A	0	0.43	A	-	-	-	-	-	-	-	-	-	-	-	-
NB TH/RT	-	-	-	-	-	-	10.1	0.35	B	19.9	0.78	B	10.4	0.42	B	28.9	0.92	C
NB RT	0	0.01	A	0	0.02	A	-	-	-	-	-	-	-	-	-	-	-	-
SB LT	7.7	0.02	A	9.5	0.09	A	27.9	0.43	C	36.3	0.53	D	38.6	0.51	D	50.7	0.83	D
SB TH	0	0.43	A	0	0.28	A	-	-	-	-	-	-	-	-	-	-	-	-
SB TH/RT	-	-	-	-	-	-	17.8	0.85	B	15.3	0.86	B	17.4	0.84	B	20.6	0.82	C
SB RT	0	0.04	A	0	0.02	A	-	-	-	-	-	-	-	-	-	-	-	-
Overall	3	0	A	11.9	0	B	16.5	0.7	B	20.8	0.82	C	17.3	0.75	B	27.5	0.92	C
3: Piilani Highway & Wailea Ike Drive																		
EB LT	To be constructed with Project only						To be constructed with Project only						20.6	0.66	C	34.3	0.93	C
EB TH/RT	To be constructed with Project only						To be constructed with Project only						17	0.17	B	17.4	0.16	B
WB LT	To be constructed with Project only						To be constructed with Project only						21	0.02	C	34.7	0.02	C
WB TH	To be constructed with Project only						To be constructed with Project only						22.9	0.25	C	43.8	0.51	D
WB RT	To be constructed with Project only						To be constructed with Project only						22	0.08	C	40.8	0.21	D
NB LT	To be constructed with Project only						To be constructed with Project only						26	0.15	C	45.7	0.15	D
NB TH	To be constructed with Project only						To be constructed with Project only						24	0.25	C	45.6	0.38	D
NB RT	To be constructed with Project only						To be constructed with Project only						23	0	C	43.3	0	D
SB LT	To be constructed with Project only						To be constructed with Project only						23.8	0.3	C	46.4	0.62	D
SB TH	To be constructed with Project only						To be constructed with Project only						21.5	0.23	C	43.7	0.54	D
SB RT	To be constructed with Project only						To be constructed with Project only						11.2	0.93	B	2.1	0.85	A
Overall	To be constructed with Project only						To be constructed with Project only						16	0.93	B	27	0.79	C
4: Wailea Ike Drive & Kalai Waa Street																		
EB TH/RT	0	0.04	A	0	0.14	A	0	0.13	A	0	0.28	A	0	0.14	A	0	0.31	A
WB LT	7.9	0.09	A	9.4	0.08	A	9.7	0.26	A	14.4	0.31	B	10.2	0.28	B	16.1	0.35	C
WB TH	0	0.21	A	0	0.13	A	0	0.35	A	0	0.24	A	0	0.37	A	0	0.27	A
NB LT	17.7	0.02	C	23.6	0.05	C	155.7	0.79	F	1013.7	2.76	F	236.6	0.98	F	Err	3.93	F
NB RT	9	0.04	A	12	0.21	B	10.9	0.17	B	31	0.7	D	11.3	0.19	B	41.6	0.79	E

Table D-3: LOS Summary for Year 2022

Intersection	Existing 2008						Base Year 2022 without Project No Mititative Measures Recommended						Future Year 2022 with Project without Mititative Measures						Future Year 2022 with Project with Mititative Measures					
	AM			PM			AM			PM			AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
7: Wailea Alanui Drive & Wailea Ike Drive																								
WB LT	14.9	0.76	B	17.8	0.68	B	48.2	0.99	D	41.4	0.91	D	27.2	0.87	C	34.9	0.79	C	27.2	0.87	C	34.9	0.79	C
WB RT	7.3	0.08	A	11.9	0.09	B	11.3	0.17	B	17.6	0.18	B	15	0.15	B	25.3	0.2	C	15	0.15	B	25.3	0.2	C
NB TH	17	0.34	B	18.1	0.59	B	54.1	0.73	D	62.7	0.92	D	21.5	0.39	C	29.3	0.89	C	21.5	0.39	C	29.3	0.89	C
NB RT	0.1	0.11	A	0.8	0.38	A	0.4	0.24	A	1.5	0.57	A	2.9	0.17	A	6.4	0.48	A	2.9	0.17	A	6.4	0.48	A
SB LT	28.3	0.57	C	27.3	0.68	C	54.5	0.71	D	53.6	0.86	D	41.8	0.78	D	48.7	0.84	D	41.8	0.78	D	48.7	0.84	D
SB TH	10.7	0.23	B	6.3	0.15	A	28.7	0.41	C	11.8	0.24	B	10.2	0.28	B	7.2	0.2	A	10.2	0.28	B	7.2	0.2	A
Overall	12.4	0.63	B	10.8	0.64	B	34.8	0.9	C	25.8	0.9	C	19.7	0.68	B	22.1	0.76	C	19.7	0.68	B	22.1	0.76	C
8: Wailea Alanui Drive & Okolani Drive																								
EB TH	7.2	-	A	8	-	A	8.2	-	A	10.5	-	B	8.3	-	A	10.7	-	B	8.3	-	A	10.7	-	B
EB RT	6.1	-	A	5.9	-	A	8.1	-	A	7.5	-	A	8.2	-	A	7.6	-	A	8.2	-	A	7.8	-	A
WB LT/TH	8	-	A	8.6	-	A	10.4	-	B	12.8	-	B	10.6	-	B	13.1	-	B	10.8	-	B	13.1	-	B
WB RT	6.2	-	A	6.9	-	A	6.6	-	A	8.1	-	A	6.9	-	A	28.2	-	D	9.4	-	A	28.2	-	D
NB LT	8.3	-	A	12	-	B	12	-	B	50.8	-	F	12.7	-	B	62	-	F	12.7	-	B	62	-	F
NB TH	6.9	-	A	7.8	-	A	7.5	-	A	8.6	-	A	7.5	-	A	8.9	-	A	7.5	-	A	8.9	-	A
NB RT	5.1	-	A	5.2	-	A	5.2	-	A	5.5	-	A	5.2	-	A	5.5	-	A	5.2	-	A	5.5	-	A
SB LT/TH	7.4	-	A	7.6	-	A	8.4	-	A	9.2	-	A	8.4	-	A	8.3	-	A	8.4	-	A	9.3	-	A
SB RT	6.1	-	A	6.5	-	A	8.8	-	A	7.8	-	A	8.8	-	A	7.9	-	A	6.8	-	A	7.9	-	A
9: South Kihei Road & Kilohana Drive																								
WB LT	9.5	0.07	A	12.3	0.2	B	12	0.14	B	21.6	0.35	C	12.3	0.15	B	20.8	0.48	C	12.3	0.15	B	20.8	0.48	C
WB RT	9.5	0.07	A	12.3	0.2	B	12	0.14	B	21.6	0.35	C	12.3	0.15	B	20.8	0.48	C	12.3	0.15	B	20.8	0.48	C
NB TH/RT	0	0.08	A	0	0.21	A	0	0.18	A	0	0.38	A	0	0.2	A	0	0.4	A	0	0.2	A	0	0.4	A
SB LT/TH	2.1	0.06	A	2.1	0.06	A	2.2	0.09	A	2.9	0.12	A	2.2	0.09	A	2.9	0.12	A	2.2	0.09	A	2.9	0.12	A
10: Wailea Alanui Drive & Grand Wailea																								
EB LT/TH/RT	21.2	0.33	C	18.1	0.35	B	18.8	0.33	B	17	0.51	B	17.9	0.32	B	18	0.5	B	17.9	0.32	B	18	0.5	B
WB LT/TH/RT	17.8	0.06	B	14.8	0.11	B	17.9	0.17	B	14.4	0.18	B	17	0.17	B	13.8	0.18	B	17	0.17	B	13.8	0.18	B
NB LT	1.7	0.01	A	2.5	0.02	A	3.1	0.08	A	5.1	0.1	A	2.5	0.08	A	4.3	0.11	A	2.5	0.08	A	4.3	0.11	A
NB TH	-	-	-	-	-	-	-	-	-	-	-	-	2.8	0.23	A	6.4	0.6	A	2.8	0.23	A	6.4	0.6	A
NB TH/RT	1.8	0.09	A	3.1	0.31	A	3.3	0.21	A	7.2	0.58	A	-	-	-	-	-	-	-	-	-	-	-	-
SB LT	1.7	0.03	A	2.5	0.04	A	4	0.35	A	8.3	0.28	A	3.3	0.35	A	5.7	0.33	A	3.3	0.35	A	5.7	0.33	A
SB TH	-	-	-	-	-	-	-	-	-	-	-	-	3.5	0.52	A	5.4	0.46	A	3.5	0.52	A	5.4	0.46	A
SB TH/RT	2.1	0.29	A	2.8	0.2	A	4.4	0.51	A	8.2	0.43	A	-	-	-	-	-	-	-	-	-	-	-	-
Overall	2.5	0.29	A	3.9	0.31	A	5	0.49	A	7.7	0.58	A	4.1	0.5	A	6.8	0.58	A	4.1	0.5	A	6.8	0.58	A
11: Wailea Alanui Drive & Kaukahi Street																			SIGNALIZE INTERSECTION					
EB LT	-	-	-	-	-	-	26.7	0.18	D	154.4	0.97	F	34.7	0.21	D	367.9	1.46	F	16.5	0.15	B	21.5	0.5	C
EB TH/RT	-	-	-	-	-	-	18.7	0.09	C	30.7	0.21	D	21.8	0.11	C	43.2	0.28	E	16.1	0.08	B	18.8	0.11	B
EB LT/TH/RT	11.9	0.09	B	17.7	0.31	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WB LT	-	-	-	-	-	-	27.4	0.27	D	75.1	0.5	F	49.8	0.56	E	369	1.47	F	18.4	0.44	B	21.1	0.45	C
WB LT/TH	12.9	0.13	B	15.7	0.1	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WB TH/RT	-	-	-	-	-	-	18.3	0.21	C	32	0.14	D	21.4	0.24	C	43.7	0.19	E	16.4	0.14	B	18.4	0.06	B
WB RT	8.7	0.03	A	10	0.01	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NB LT/TH	0.2	0	A	0.2	0	A	0.2	0.01	A	0.3	0.01	A	0.2	0.01	A	0.3	0.01	A	5.4	0.36	A	8.1	0.72	A
NB RT	0	0	A	0	0.02	A	0	0.02	A	0	0.04	A	0	0.03	A	0	0.06	A	4.2	0.03	A	4	0.08	A
SB LT	7.4	0.02	A	7.9	0.02	A	7.8	0.02	A	9.2	0.04	A	8.1	0.02	A	9.8	0.05	A	4.2	0.04	A	4.4	0.14	A
SB TH	0	0.13	A	0	0.13	A	0	0.33	A	0	0.33	A	0	0.38	A	0	0.4	A	7.2	0.6	A	6.8	0.6	A
SB RT	0	0.09	A	0	0.04	A	0	0.09	A	0	0.04	A	0	0.09	A	0	0.04	A	4.4	0.1	A	3.9	0.04	A
Overall	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.9	0.57	A	8.2	0.68	A

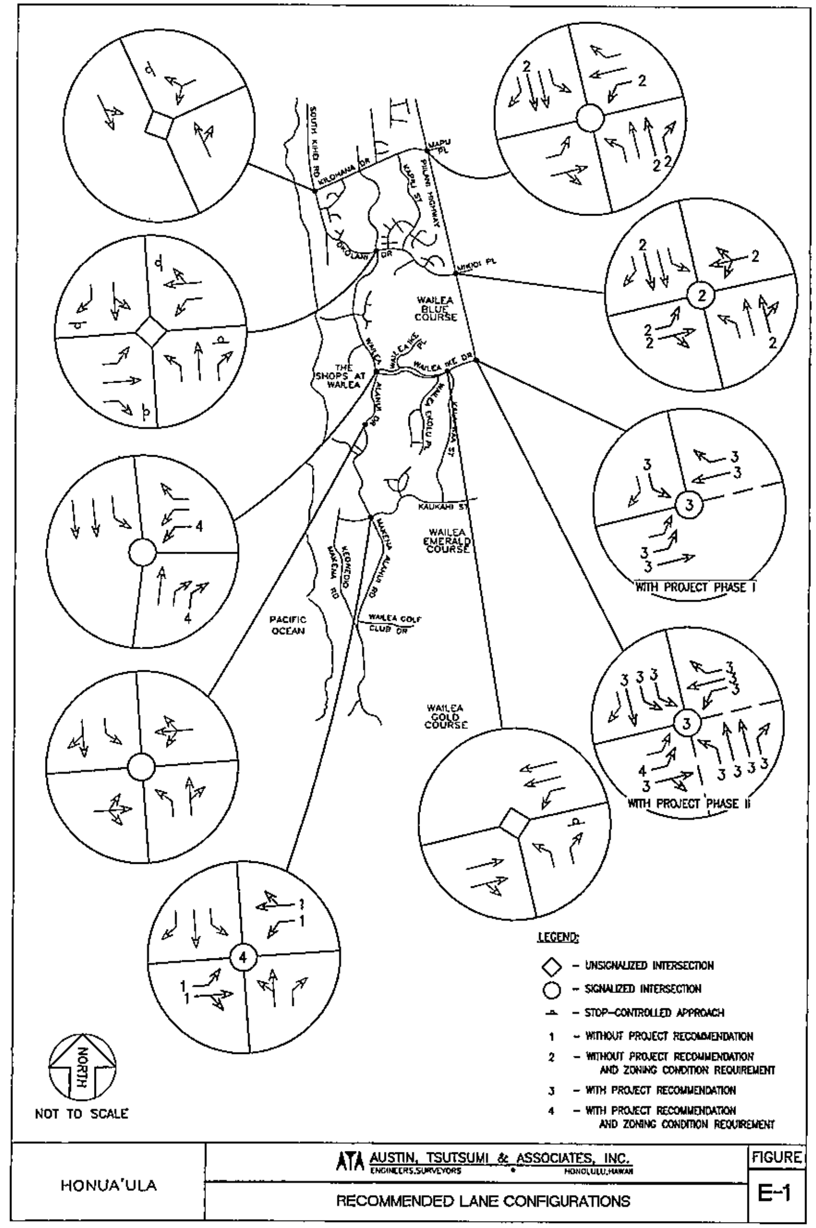
Table D-3: LOS Summary for Year 2022

Intersection	Existing 2008						Base Year 2022 without Project No Mititative Measures Recommended						Future Year 2022 with Project without Mititative Measures						Future Year 2022 with Project with Mititative Measures					
	AM			PM			AM			PM			AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Piilani Highway & Kilohana Drive																								
EB LT	33.8	0.59	C	36.7	0.58	D	33.8	0.72	C	51.8	0.74	D	63	0.73	D	78	0.87	E	63.5	0.73	D	79.4	0.88	E
EB TH/RT	25.8	0.11	C	30.5	0.14	C	21	0.08	C	38.2	0.14	D	37.7	0.08	D	43.2	0.16	D	37.7	0.08	D	43.2	0.16	D
WB LT/TH	26.8	0.26	C	30.8	0.15	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WB LT	-	-	-	-	-	-	21	0.07	C	35.6	0.04	D	37.7	0.07	D	42.3	0.05	D	37.7	0.07	D	42.3	0.05	D
WB TH	-	-	-	-	-	-	21.1	0.1	C	38	0.11	D	37.9	0.1	D	42.8	0.13	D	37.9	0.1	D	42.8	0.13	D
WB RT	25.8	0.1	C	30.2	0.09	C	21.2	0.11	C	35.9	0.1	D	38	0.11	D	42.7	0.1	D	37.9	0.11	D	42.6	0.1	D
NB LT	30.3	0.06	C	38.1	0.06	D	31.1	0.14	C	49.3	0.22	D	49.3	0.05	D	54.1	0.21	D	49.4	0.05	D	54.2	0.21	D
NB TH	-	-	-	-	-	-	10.2	0.47	B	29.1	0.9	C	13	0.54	B	41	0.99	D	13.1	0.54	B	41.2	0.99	D
NB TH/RT	6.1	0.28	A	27.1	0.88	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NB RT	-	-	-	-	-	-	7	0	A	11.4	0.01	B	8	0	A	9.2	0.01	A	8.1	0	A	9.2	0.01	A
SB LT	30.3	0.46	C	43.3	0.71	D	28.8	0.41	C	51.9	0.7	D	49.3	0.38	D	79.8	0.86	E	49.4	0.38	D	79.7	0.88	E
SB TH	9.5	0.69	A	11.2	0.53	B	13.2	0.78	B	12.6	0.61	B	17.7	0.81	B	18.3	0.77	B	17.8	0.81	B	18.3	0.77	B
SB RT	3.8	0.08	A	6.9	0.09	A	6.1	0.11	A	8.4	0.18	A	7.7	0.12	A	7.9	0.16	A	7.7	0.12	A	7.8	0.16	A
Overall	12.4	0.68	B	23.6	0.8	C	14.1	0.77	B	24.7	0.83	C	19.3	0.76	B	32.9	0.95	C	19.4	0.78	B	33.2	0.96	C
2: Piilani Highway & Okolani Drive																								
EB LT	-	-	-	-	-	-	22.4	0.63	C	41.1	0.81	D	38.5	0.76	D	51.2	0.84	D	38.5	0.76	D	51.2	0.84	D
EB LT/TH	23.9	0.18	C	141.7	0.95	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EB TH/RT	-	-	-	-	-	-	18	0.06	B	22.5	0.11	C	22.7	0.06	C	27.4	0.11	C	22.7	0.06	C	27.4	0.11	C
EB RT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WB LT/TH	17.8	0.26	C	27.7	0.26	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WB LT/TH/RT	-	-	-	-	-	-	17	0.24	B	22.7	0.14	C	24.2	0.28	C	27.6	0.14	C	24.2	0.28	C	27.6	0.14	C
WB RT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NB LT	9.1	0	A	8.3	0.01	A	31.9	0.33	C	37.5	0.42	D	41.8	0.34	D	49	0.52	D	41.8	0.34	D	49	0.52	D
NB TH	0	0.13	A	0	0.43	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NB TH/RT	-	-	-	-	-	-	10.4	0.38	B	22.3	0.83	C	11.9	0.5	B	40.4	0.99	D	11.9	0.5	B	40.4	0.99	D
NB RT	0	0.01	A	0	0.02	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SB LT	7.7	0.02	A	9.5	0.09	A	26	0.43	C	37.1	0.56	D	34.8	0.35	C	53.5	0.67	D	34.8	0.35	C	53.5	0.67	D
SB TH	0	0.43	A	0	0.28	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SB TH/RT	-	-	-	-	-	-	21	0.9	C	16.4	0.7	B	20.4	0.9	C	24.8	0.89	C	20.4	0.9	C	24.8	0.69	C
SB RT	0	0.04	A	0	0.02	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Overall	3	0	A	11.9	0	B	18.4	0.73	B	22.2	0.86	C	19.5	0.88	B	34.5	0.97	C	19.5	0.88	B	34.5	0.97	C
3: Piilani Highway & Wailea Ike Drive	To be constructed with Project only						To be constructed with Project only																	
EB LT													22.3	0.68	C	44.3	0.98	D	22.5	0.68	C	44.3	0.98	D
EB TH													-	-	-	-	-	-	-	-	-	-	-	-
EB TH/RT													17.4	0.18	B	11.2	0.16	B	17.4	0.18	B	11.2	0.16	B
WB LT													22.9	0.02	C	46.9	0.05	D	22.9	0.02	C	46.9	0.05	D
WB TH													24.8	0.34	C	48.2	0.82	D	24.8	0.34	C	48.2	0.82	D
WB RT													23.8	0.13	C	43.7	0.44	D	23.8	0.13	C	43.7	0.44	D
NB LT													28.6	0.16	C	47.3	0.15	D	28.6	0.16	C	47.3	0.15	D
NB TH													26.4	0.27	C	46	0.38	D	26.4	0.27	C	46	0.38	D
NB RT													25.2	0	C	43.8	0	D	25.2	0	C	43.8	0	D
SB LT													25.7	0.38	C	50	0.73	D	25.7	0.38	C	50	0.73	D
SB TH													22.7	0.22	C	42.2	0.5	D	22.7	0.22	C	42.2	0.5	D
SB RT													18.1	0.98	B	2.5	0.69	A	18.1	0.98	B	2.5	0.69	A
Overall													20.8	0.98	C	31.9	0.84	C	20.8	0.98	C	31.9	0.84	C
4: Wailea Ike Drive & Kalai Waa Street																								
EB TH/RT	0	0.04	A	0	0.14	A	0	0.14	A	0	0.3	A	0	0.16	A	0	0.33	A	0	0.16	A	0	0.33	A
WB LT	7.8	0.09	A	9.4	0.08	A	10	0.27	A	15.5	0.34	C	10.6	0.3	B	18	0.4	C	10.6	0.3	B	18	0.4	C
WB TH	0	0.21	A	0	0.13	A	0	0.37	A	0	0.25	A	0	0.4	A	0	0.3	A	0	0.4	A	0	0.3	A
NB LT	17.7	0.02	C	23.8	0.05	C	208.1	0.82	F	Err	3.44	F	354.2	1.22	F	Err	5.4	F	354.2	1.22	F	Err	5.4	F
NB RT	9	0.04	A	12	0.21	B	11.3	0.18	B	35.8	0.75	E	11.8	0.2	B	55.1	0.87	F	11.8	0.2	B	55.1	0.87	F

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX E

RECOMMENDED LANE CONFIGURATIONS



APPENDIX F

RESORT RESIDENTIAL TRIP GENERATION RATE DEVELOPMENT

Resort Residential Trip Generation Rate Development

Background

At the request of the State of Hawaii Department of Transportation (HDOT), data were collected to determine if the resort residential trip generation rates documented in the Institute of Transportation Engineers publication entitled, Trip Generation, 7th Edition, were appropriate for the Wailea-Makena area on Maui.

Three major developers within the Wailea-Makena area agreed to participate in this effort and directed their traffic consultants to develop a methodology to collected trip data and use these data to determine alternative resort residential trip generation rates. The three traffic consultants involved were Austin-Tsutsumi and Associates, Parsons Brinckerhoff, and Phillip Rowell Associates.

This write-up summarizes the methodology used to develop alternative resort residential trip generation rates based on observation of existing resort residential development located in Wailea Resort.

Methodology

In developing a methodology to research resort residential trip generation rates for the Wailea-Makena area, it was decided to collect data separately for single-family and for multi-family resort residential development. All developments used for data collection were located in the Wailea Resort area.

Effort was made to determine which multi-family resort residential developments allow units to be rented out as opposed to units that only allow owners and selected guests to occupy the units. Effort was also made through discussions with the Wailea Homeowners Association and Wailea Resort to determine which resort residential developments were primarily absentee owner units that are occupied only a few months out of the year and resident owner units that area occupied all year long.

Based on these criteria, 24-hour traffic data were collected at the accesses to resort residential between July 7, 2006 and July 17, 2006. Using the categories of resort residential identified in the previous paragraph, data were collected at the developments summarized in Table 1.

Table 1
Resort Residential Development Data Collection Sites

Development Name	Residents/ Long-Term Rental	Short-Term Rental	Total Units
Single-Family			
Pualani Estates	92	0	92
Wailea Golf Vistas	48	0	48
Wailea Highlands	23	0	23
Wailea Golf Estates	61	0	61
Wailea Kialoa	102	0	102
Multi-Family			
Palms I	19	139	150
Palms II	120	0	120
Grand Champions	73	128	201
Wailea Elua	73	79	152
Fairway Villas	118	0	118

Note: Fairway Villas data were available because of technical difficulties and the sale of Makena Resort.

All of the multi-family developments were used to calculate trip generation rates for resort multi-family development. This probably makes this rate conservatively high, since it contains both developments that allow short-term rentals and those that do not.

For the single-family developments, only Wailea Golf Estates and Pualani Estates were used to calculate trip generation rates. There were units in Wailea Golf Vistas and Wailea Highlands that were still under construction and it was judged that construction traffic would create an atypical trip generation rate. Wailea Kialoa was not used because it was determined through discussions with Wailea Resort and the Wailea Homeowners Association that Wailea Kialoa contained mostly residents that live in Wailea year round. This is not the typical resort residential situation in which owners usually occupy the unit only part time.

The resulting trip generation rates for resort single-family and resort multi-family are shown in Table 2.

Table 2
Resort Residential Trip Generation Rates

Parcel	AM Peak Hour		PM Peak Hour	
	Rate	Enter/Exit %	Rate	Enter/Exit %
Resort Single-Family Residential	0.46	58/42	0.46	50/50
Resort Multi-Family Residential	0.22	40/60	0.34	49/51

Note: Rates are vehicle trips per hour per dwelling unit.
Single Family rates based on average of Wailea Golf Estates and Pualani Estates.
Multi-Family rates based on average of Wailea Grand Champions, Palms I, Palms II, and Wailea Elua

Table 3 compares the calculated resort residential rates with the ITE published rates. As shown, the calculated resort residential rates for the single-family resort residential are about twice as high as the ITE published rates, and the calculated resort residential rates for the multi-family resort residential are slightly higher for than those published by ITE.

Table 3
Comparison of Calculate and ITE Published Resort Residential Trip Generation Rates

Rate Source	AM Peak Hour		PM Peak Hour	
	Rate	Enter/Exit %	Rate	Enter/Exit %
Calculated Single-Family Residential	0.46	58/42	0.46	50/50
Calculated Multi-Family Residential	0.22	40/60	0.34	49/51
ITE Published Recreational Homes (260)	0.16	67/33	0.26	41/59

Note: Rates are vehicle trips per hour per dwelling unit.

Roadway Agreements

LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

BRENNON T. MORIOKA
DIRECTOR

Deputy Directors
MICHAEL D. FORMBY
FRANCIS PAUL KEENO
JIRO A. SUMADA

IN REPLY REFER TO:

HWY-PS
2.6337

August 23, 2010

RECEIVED
AUG 30 2010
PACIFIC RIM LAND, INC.
MAUI - MAIN

Mr. Charlie Jencks
Honua'ula Partners, LLC
1300 N. Holopono Street, Suite 201
Kihei, Hawaii 96753

Dear Mr. Jencks:

Subject: Piilani Highway Widening, Kilohana Drive to Wailea Ike Drive
Four-Lane Design Typical Section
Honua'ula Development, Maui County Ordinance No. 3554, Item No. 2a
Wailea, Maui

Thank you for your letter dated July 19, 2010 proposing for our consideration three (3) design typical section alternatives which includes for each alternative the constructability considerations, costs and implementation timelines on the subject project to widen Piilani Highway to four lanes of traffic. As described in detail within your letter, it is our understandings the design typical section alternatives are as follows:

1. Design Alternative 1: 76-Ft Wide Road Section with a 4-Ft Wide Median

2. Design Alternative 1A: 80-Ft Wide Road Section with an 8-Ft Wide Median

3. Design Alternative 2: 89-Ft Wide Road Section with a 17-Ft Wide Median

Based on the information and assessment provided, we concur with the use of Design Alternative 1A as the design typical section. We understand the analysis provided identifies Alternative 1A will take the same amount of time to construct as Alternative 1 and costs about 4% more. This Alternative 1A typical section provides an additional four (4) feet of median width, which is double the median width in Alternative 1. This wider median width will allow for a longer clear distance, and consequently safer roadway operations. This increment of investment for a wider median provides for a better benefit-cost than Alternative 1.

Although Alternative 2 provides a desirable median width, we agree that the additional construction cost of an estimated $60 million (three times more) and six more years (four times longer) to complete does not provide for a sound benefit-cost in comparison to Alternative 1A.

The State is appreciative that the typical section considers multi-modes of transportation in relation to the regional land-use, such as 12 foot travel lanes, 4 foot bike lanes, and 6 foot sidewalks. And, for the further consideration of pedestrians, specifically the non-ambulatory, the utility poles should be relocated outside of the sidewalk to minimize obstruction to pedestrian travel. As a possibility, we recommend recessing the utility poles in the retaining wall.

In moving forward with this project please continue to work with our Highways Division since the use of the typical section identified as Alternative 1A will require refinement and coordination as the details of the project plans are being developed.

Additionally, the State supports this project due to the anticipated economic benefits that will be provided to residents of Maui in construction jobs, employment, capital investment, and affordable housing.

If you have any questions, please contact Ken Tatsuguchi, Engineering Program Manager, Highways Division, Planning Branch at (808) 587-1830.

Very truly yours,

BRENNON T. MORIOKA, Ph.D., P.E.
Director or Transportation

Attachment: July 19, 2010 letter

HONUA'ULA

July 19, 2010

Mr. Brennon Morioka, Director
State Department of Transportation
State of Hawaii
869 Punchbowl Street, Room 513
Honolulu, HI 96813

Subject: Design Section Finalization for Piilani Highway Widening Project

Dear Mr. Morioka:

Thank you for your letter of March 24, 2010 (Hwy-PS 2.5022) and your direction relative to the design section for the Piilani Highway widening.

Condition 2a of the Conditions of Zoning by the County of Maui, requires the following:
"That Honua 'ula Partners, LLC, its successors and permitted assigns, shall implement the following traffic improvements:
a. Upgrade Piilani Highway, from Kilohana Drive to Wailea Ike Drive, to four lanes of traffic. The improvements shall be completed prior to the commencement of any construction on the site, with the exception of grading."

The proposed project is anticipated to create over 55 construction jobs over the term of the project. Delays in initiating the widening project will also delay the start of onsite work for the Honua `ula project which will generate $1.2 billion in capital investment, result in 9,537 worker years of employment during the build-out period and contribute 450 affordable housing units. All of this will help to stimulate the economy in Maui County and the state.

As I understand your March 24, 2010 letter, the Alternative 1 January 2010 cross section layout information provided by Austin Tsutsumi & Associates (ATA) is acceptable in concept under State guidelines. Your letter recommended that the median width be increased to 17 feet for the widened portion so as to preserve operational efficiency and aesthetic consistency for the roadway users. You also mentioned in your letter that any deviations from the guidelines are to be addressed to the department for discussion and consideration and be fully documented. To that end I offer the following information and suggested changes for your consideration.

Project Location/Classification
Presently, the entire length of Piilani Highway is functionally classified as an Urban Principal Arterial. The project area is the segment of Piilani Highway south of Kilohana Drive to its current terminus at Wailea Ike Drive. The project area will be referenced as the "Study Section". Exhibit 1 shows the Study Section in relation to the Kihei area.

Study Section Description and Land Control
The existing right of way for the study section varies from 105-feet to 110-feet, with wider right-of-way widths to accommodate grading, intersections and drainage structures. The existing roadway prism consists of fill areas and steep excavated basalt slopes created through construction of the existing road section. The right-of-way is bounded on the mauka and makai side by individually owned single family residential properties and a major utility corridor. There are no significant botanical, wildlife or cultural issues identified within the study section. A preliminary Draft Environmental Assessment has been completed for the study section and proposed project.

The study section was improved by HDOT with the result being a cut condition in basalt for over two thirds of the project section. Steep cut basalt has and continues to erode in sections. Maui Electric has a utility corridor on the makai side of the right of way with wood power poles providing power to a Wailea substation with an overhead 138 KV system.

Given the constrained limits of the right of way and relationship between the improvements and adjacent properties any design section should address the potential for constructability and land issues. Issues such as construction access, placement of improvements and/or the construction process itself including grading and excavation requirements and the needed slope stabilization work necessary for much of the widening are some examples. On the mauka boundary of the study section there are over 40 individual home lots in the Maui Meadows community with rear property lines abutting the right-of-way, which could be potentially impacted by construction issues dependent upon the roadway design section. On the Makai side, there are 13 home sites in Wailea Resort and numerous residential housing units in a residential condominium ownership with property lines abutting the study section which could be potentially impacted by construction issues dependent upon the roadway design section. Parcels controlled by Honua `ula Partners, LLC (HPL) and A&B Wailea will be made available for the improvements needed. However, obtaining additional right-of-ways and/or construction easements from individual property owners will be extremely difficult for a private developer to secure without adding significant project delay and cost.

Design Assumptions
The following design section assumptions have been made:
1. Median Width – Analysis assumes 4 feet, 8 feet and 17 feet striped median widths,
2. Turning Lanes – 11 feet wide turning lanes, 12 feet wide right turn lanes
3. Curb/Gutter and Sidewalks – As requested by HDOT, 6 feet sidewalk and 2 feet curb and gutter on both sides,
4. Travel Lanes – 4 travel lanes at 12 feet each
5. Bicycle Lanes – 4 feet bike lanes provided on both sides
6. Signalization – Revised signal at Kilohana/Mapu, new signal at Okolani/Mikioi and Wailea Ike Drive,
7. Utility Poles – Remain in ROW
8. Drainage – Provided for within ROW

9. Slope Stabilization – Based upon a review of proposed wall locations, current geology and potential graded slope conditions the following summarizes the options for the most efficient and appropriate mechanically stabilized embankment solutions in the study area:

<u>Soil Nail Walls</u>

- Soil nail (mechanically stabilized embankment or MSE) walls may be a good option for the cut walls. The maximum nail length required is a function of the soil conditions, wall height, and amount of sloping area above the wall, surcharge loading, seismic loading and other factors. In general the maximum nail length might be on the order of 0.75 to 1.25 of the total excavated height (slope height plus wall height). The stronger the soil or rock, the shorter the nails can be. This approach to stabilization may be appropriate for higher cuts as well, but there is a limit to its application.

<u>Fill Walls</u>

- For fill walls, a cantilever soldier beam wall would probably be used for retained heights of 10 to 12 ft or less. The concern with soldier beam walls, however, is they have to be drilled into the basalt formation. If rock augers cannot penetrate the basalt at a reasonable rate, the soldier beam wall will be prohibitively expensive. With the limited geotechnical info available at this time, it is not certain whether the soldier beams would have to be drilled into basalt. The drill equipment will have to fit within the work limits which are highly restricted given the current laneage and traffic.

<u>Recommendation</u>

- Mechanically stabilized embankment wall (MSE) would be more economical than a soldier beam wall. It would eliminate both the cost of having to mobilize a large caisson rig and the uncertainties associated with drilling large diameter holes in hard rock. There would probably be some rock excavation involved to achieve a level base for the MSE wall.

<u>Design Alternative 1: 76- Ft. Wide Road Section</u>

Project Scope:

Improvements include widening of roadway to four lanes with provision of a 4 foot wide median for separation of traffic. Signalization work is included within the scope as well as retaining walls or MSE are used to address slopes.

Please refer to Exhibits 2-Typical 76-feet Road Section. The width of the design section is 76-feet wall face to wall face

Estimated Construction Cost: $27,000,000.00

Time Frame to Construct: 18 months after Notice to Proceed

Constructability Considerations:

1. Right of Way
   a. Existing ROW width varies from 105- feet to 110-feet with wider segments to for grading, at intersections and existing drainage structures.
   b. Utility poles will be relocated within the existing right-of-way.
   c. Location of proposed retaining walls is subject to the design width and elements of the typical roadway section and final structural design. It is anticipated that slope/soil stabilization provisions can be constructed with this alternative.
   d. Additional public right-of-way will be required at the Kilohana intersection. Agreement has been reached with the County of Maui.
2. Construction of Walls
   a) Approximately 12 feet to 22 feet from the outside surface of walls to ROW.
   b) Wall footings in close proximity to right-of-way,
   c) MSE anchoring of cut surfaces can be utilized within the limits of the existing right-of-way.
   d) All of the above referenced MSE and wall construction approaches are feasible with this design section,
   e) The property on the makai side is owned by community associations or a single entity (A&B Wailea). Although it was deemed easier to acquire, construction access easements would add 24- months to the construction period.
3. MECO
   a. The existing 138 KV utility lines, located within the makai edge of the right-of-way, will need to be temporarily relocated outside the existing right-of-way during roadway construction until new utility poles are erected which would require access easement from A&B Wailea. This acquisition process will increase the project timeline and cost. Easements for the temporary poles will be within A&B Wailea property and with one section within the landscape easement controlled by a condominium association.
   b. Undergrounding within the planned design section will be at a substantial increase in project cost estimated at $ 4M.

<u>Design Alternative 1A: 80 Ft. Wide Road Section</u>

Project Scope:

Improvements include widening of roadway to four lanes with provision of 8-feet wide median for separation of traffic. Signalization work is included within scope. Retaining walls or MSE used to address slopes.

Please refer to Exhibit- 3-Typical 80-ft. Road Section. The width of the design section from wall face to wall face is 80 feet.

Estimated Construction Cost: $28,000,000

Time Frame to Construct: 18 months after Notice to Proceed

Constructability Considerations:

1. Right of Way
    a. Existing ROW width varies from 105- feet to 110-feet with wider segments for grading, at intersections and existing drainage structures.
    b. Utility poles will be relocated within the existing right-of-way. The utility poles will protrude into the sidewalk reducing the available usable width to around 3 feet.
    c. Location of proposed retaining walls is subject to the design width and elements of the typical roadway section and final structural design. It is anticipated that slope/soil stabilization provisions can be constructed with this alternative.
       Additional public right-of-way will be required at the Kilohana intersection. Agreement has been reached with the County of Maui.
2. Construction of Walls
    a. Approximately 10 feet to 20 feet from the outside surface of walls to ROW
    b. Wall footings in close proximity to ROW,
    c. MSE anchoring of cut surfaces can be utilized within the limits of the existing right-of-way.
    d. All of the above referenced MSE and wall construction approaches are feasible with this design section,
    e. The property on the makai side is owned by community associations or a single entity (A&B Wailea). Although it was deemed easier to acquire, construction access easements would add 24- months to the construction period.
3. MECO
    a. The existing 138 KV utility lines, located within the makai edge of the right-of-way, will need to be temporarily relocated outside the existing right-of-way during roadway construction until new utility poles are erected. Easements for the temporary poles will be within A&B Wailea property and with one section within the landscape easement controlled by a condominium association.
    b. Undergrounding within the planned design section will be at a substantial increase in project cost estimated at $ 4M.

Design Alternative 2: 89-feet Wide Roadway Section

Project Scope:
Improvements include widening of roadway to four lanes with provision of 17' wide median for separation of traffic. Signalization work is included within scope. Retaining walls placed to address slopes.

Please refer to Exhibit 4- Typical 89-Feet Road Section. The width of the design section from wall face to wall face is 89 feet.

Estimated Construction Cost: $86 Million including direct construction cost of $46M and land control cost of approximately $40 M for average minimum value of lots adjacent to ROW. The alternative would increase the project by $59 M over Alternative 1 and $ 58M over alternative 1A.
Potentially 40 homes from Maui Meadows with an approximate value of $1M to obtain the entire property would have a project cost of approximately $40M.

Time Frame for Land Acquisition: 5-Years

Time Frame to Construct: Total 7.5-years (5-years for land control and 2.5-years for Construction.)

Constructability Considerations:

2. Right of Way
    a. Existing ROW width varies from 105- feet to 110-feet with wider segments for grading, at intersections and existing drainage structures
    b. Construction access on the mauka side will require construction easement from individual property owners.
    c. Will require additional ROW for relocation of MECO utility poles or would require the undergrounding of the utility lines.
    d. Placement of retaining walls will require additional right-of way due to the increase height of the retaining walls and close proximity to the existing right-of way.
3. Construction of Walls
    a. Approximately 5.5 feet to 15.5 feet from the outside surface of walls to ROW.
    b. Wall construction options are as follows:
        i. MSE/Soil Nails – The close proximity of the existing right-of-way will result in soil nails to encroach beyond the existing ROWs into or under private property requiring land acquisition,

  ii. Fill Walls – Soldier beam or fill walls may require construction access easement from individual property owners. There is less restriction in the design and construction of fill walls thus may not be a significant issue.
  iii. Use of Steel Pilings Not possible given geology,
  iv. Concrete Rubble Masonry (CRM) – CRM walls are structurally limited to low to moderate wall height (2-feet to 12-feet) and require wide footing due to wall back batter. The high retaining wall heights limit the use to this wall type.
  v. Concrete Walls – Concrete walls can be designed and constructed with higher retaining heights. Wall heights are limited by the width of the wall footings.
  vi. Alternative 2, wide road section, results in higher retaining wall, requiring wider wall footings.

c. Construction access is limited on eastern side given the existing ROW. Properties on the eastern side are individually owned single family dwelling units. It is anticipated that the land acquisition process could take 5-years prior to the start of construction. This lag will significantly impact the economic recovery time for the County of Maui and subsequently the State. It is estimated to increase total cost by $40M.
d. The property on the western side is owned by community associations or a single entity (A&B Wailea). Although it was deemed easier to acquire, construction access easements would add 24- months to the construction period.

4. MECO
   a. The existing 138 KV utility lines, located within the Makai edge of the ROW, will need to be temporarily relocated outside the existing right-of-way during roadway construction until new utility poles are erected. Easements for the temporary poles will be within A&B Wailea property and with one section within the landscape easement controlled by a condominium association.
   b. Undergrounding within the planned design section will be at a substantial increase in project cost estimated at $ 4M.
5. Drainage
   a. Alternative 2 road section will increase storm water runoff requiring additional storage requirements. The increase in storage requirements will need to be accommodated by acquiring additional ROW for open storage detention/Retentions basins
   b. Underground storage system, which would require frequent inspection, monitoring and maintenance time and cost.
   c. Changing the 17-ft median from asphalt pavement to grass swale would not substantially reduce the runoff storage requirements to eliminate the additional open or underground storage

Summary
The limited width of existing right-of-way, high cut sections and retaining wall construction constraints dictate the locations of retaining walls and related grading and slope stabilization work necessary for the walls. Alternative 1A, Typical Roadway section 80-feet wide, face of wall to face of wall is deemed the optimum road section that meet HDOT guidelines and Honua ʻula development schedule. This section as previously discussed provides for four-12-feet travel lanes, 11-feet wide left turn lanes with an 8-foot continuous median. The section also provides 6 feet wide sidewalk, curb, gutter and 4-feet wide bike lanes on both sides of Piilani Highway.

The 17-feet wide median alternative would require a 93-feet, face of retaining wall to face of retaining wall, section and would most likely require additional ROW from individual lot owners. Acquiring the additional ROW would add 5-years to the construction time and $40M to the construction cost.

Based upon the constraints imposed by the existing limited ROW, adjacent properties, the additional time required to obtain additional ROW, the location of existing utilities, topographic constraints and geologic conditions extant within the project area we request that Alternative 1A, 80 Foot Wide Roadway Section with a 8 foot median, be accepted for the proposed widening along with the design assumptions identified above.

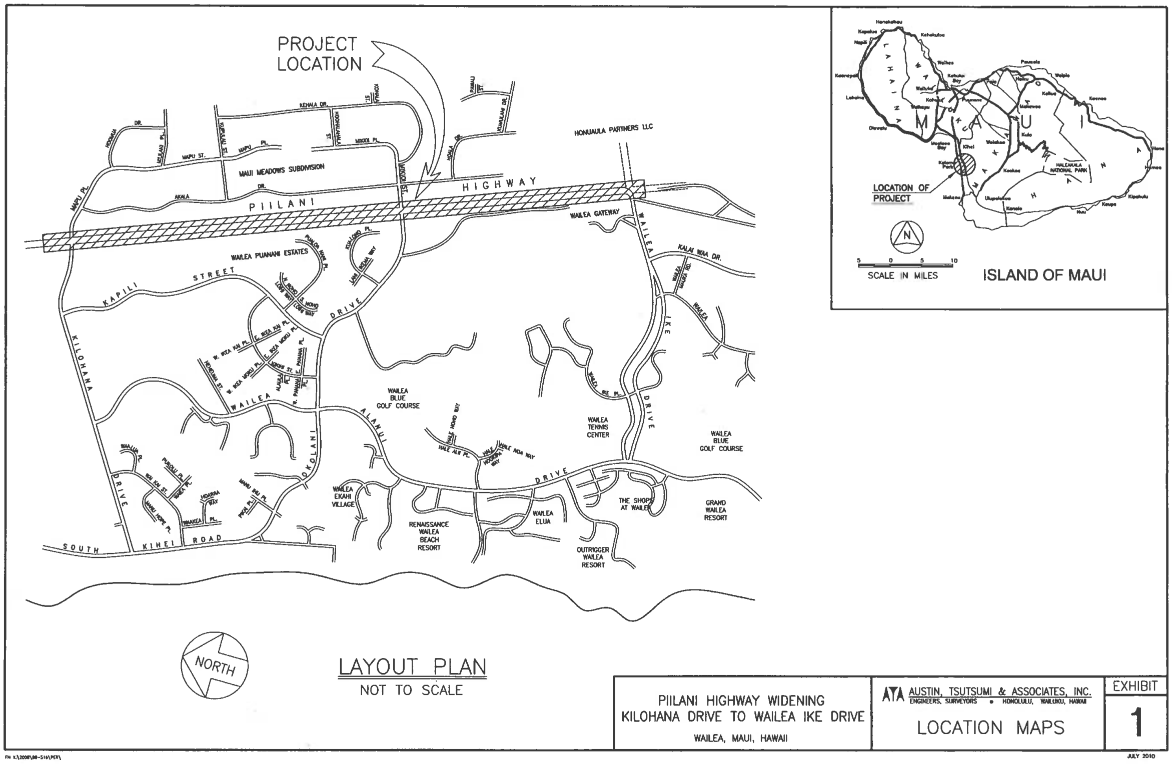
Mr. Morioka, it is our hope that the above proposal can be reviewed quickly within your department. As you are aware, the County of Maui has made it a condition of zoning that the Piilani Highway widening be completed before construction on Honua ʻula can begin.
The project team is ready and able to meet with you and your staff at any time to finalize this discussion and get a final decision on the preferred design section for the widening project.
Should you have any questions or wish to discuss the information contained within this letter please feel free to contact me in my office at 879-5205 or my cell phone at 250-3178 or email at charliej@pacificrimland.com.

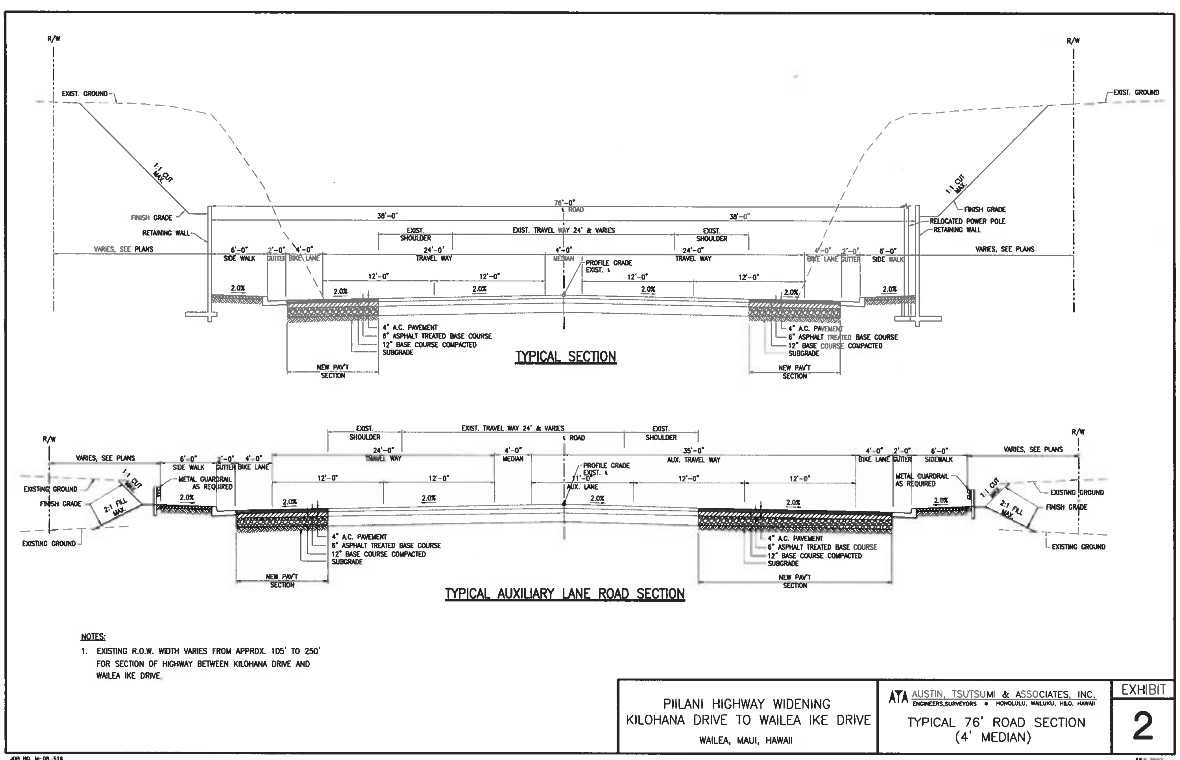
Sincerely,

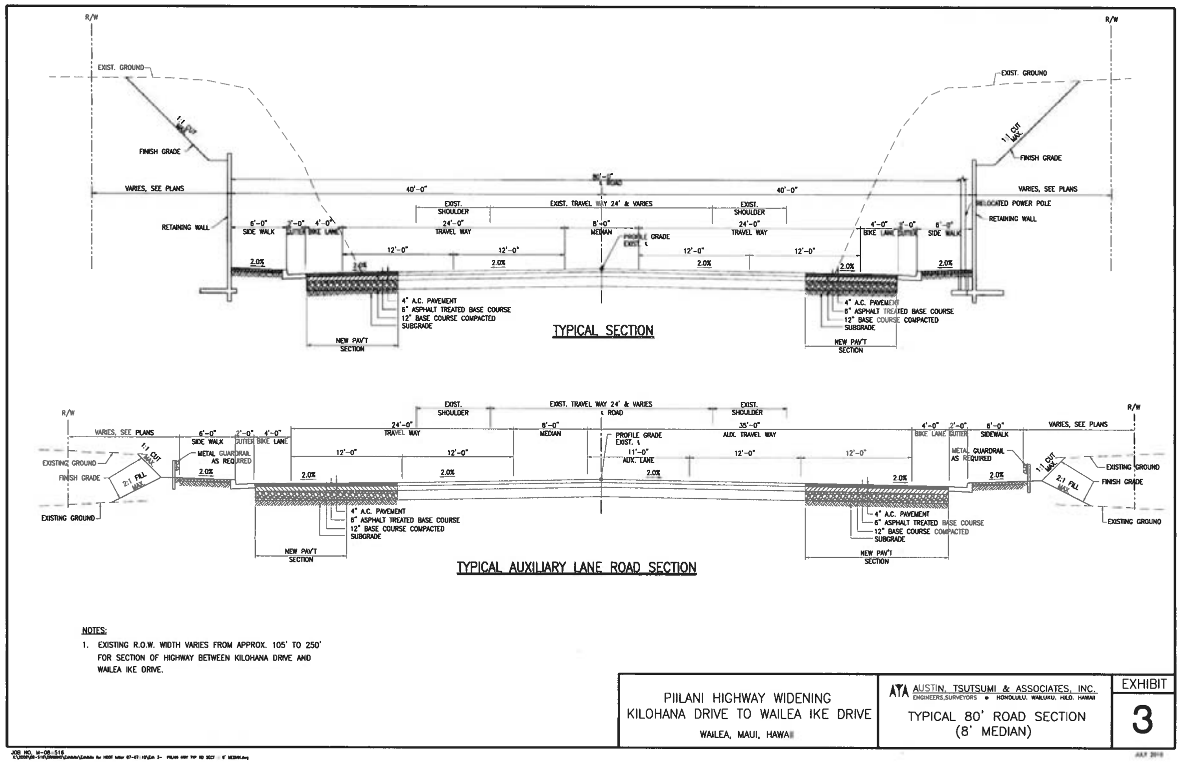
Charles Jencks
Owner Representative
Honua ʻula Partners, LLC

CC: Mr. Keith Niiya, Austin Tsutsumi & Associates

Attachments


PROJECT LOCATION
PIILANI HIGHWAY
MAUI MEADOWS SUBDIVISION
HONUAULA PARTNERS LLC
WAILEA GATEWAY
WAILEA PUANANI ESTATES
KAPILI STREET
KILOHANA DRIVE
WAILEA DRIVE
OKOLANI DRIVE
WAILEA ALANUI DRIVE
WAILEA IKE DRIVE
WAILEA BLUE GOLF COURSE
WAILEA TENNIS CENTER
WAILEA EKAHI VILLAGE
RENAISSANCE WAILEA BEACH RESORT
WAILEA ELUA
THE SHOPS AT WAILEA
OUTRIGGER WAILEA RESORT
GRAND WAILEA RESORT
SOUTH KIHEI ROAD
LOCATION OF PROJECT
SCALE IN MILES
ISLAND OF MAUI
NORTH
LAYOUT PLAN
NOT TO SCALE
PIILANI HIGHWAY WIDENING
KILOHANA DRIVE TO WAILEA IKE DRIVE
WAILEA, MAUI, HAWAII
ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HAWAII
LOCATION MAPS
EXHIBIT
1
JULY 2010


R/W
EXIST. GROUND
1:1 CUT MAX
FINISH GRADE
RETAINING WALL
RELOCATED POWER POLE
76'-0" ROAD
38'-0"
EXIST. SHOULDER
EXIST. TRAVEL WAY 24' & VARIES
VARIES, SEE PLANS
6'-0" SIDE WALK
2'-0" GUTTER
4'-0" BIKE LANE
24'-0" TRAVEL WAY
4'-0" MEDIAN
12'-0"
PROFILE GRADE EXIST. ℄
2.0%
4" A.C. PAVEMENT
6" ASPHALT TREATED BASE COURSE
12" BASE COURSE COMPACTED
SUBGRADE
NEW PAV'T SECTION
TYPICAL SECTION
℄ ROAD
35'-0" AUX. TRAVEL WAY
AUX. LANE
METAL GUARDRAIL AS REQUIRED
EXISTING GROUND
2:1 FILL MAX
TYPICAL AUXILIARY LANE ROAD SECTION
NOTES:
1. EXISTING R.O.W. WIDTH VARIES FROM APPROX. 105' TO 250' FOR SECTION OF HIGHWAY BETWEEN KILOHANA DRIVE AND WAILEA IKE DRIVE.
PIILANI HIGHWAY WIDENING
KILOHANA DRIVE TO WAILEA IKE DRIVE
WAILEA, MAUI, HAWAII
ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HILO, HAWAII
TYPICAL 76' ROAD SECTION (4' MEDIAN)
EXHIBIT
2


TYPICAL SECTION
TYPICAL AUXILIARY LANE ROAD SECTION
R/W
EXIST. GROUND
FINISH GRADE
VARIES, SEE PLANS
RETAINING WALL
SIDE WALK
GUTTER
BIKE LANE
EXIST. SHOULDER
TRAVEL WAY
EXIST. TRAVEL WAY 24' & VARIES
MEDIAN
PROFILE GRADE EXIST. ℄
RELOCATED POWER POLE
4" A.C. PAVEMENT
6" ASPHALT TREATED BASE COURSE
12" BASE COURSE COMPACTED
SUBGRADE
NEW PAV'T SECTION
AUX. TRAVEL WAY
METAL GUARDRAIL AS REQUIRED
EXISTING GROUND
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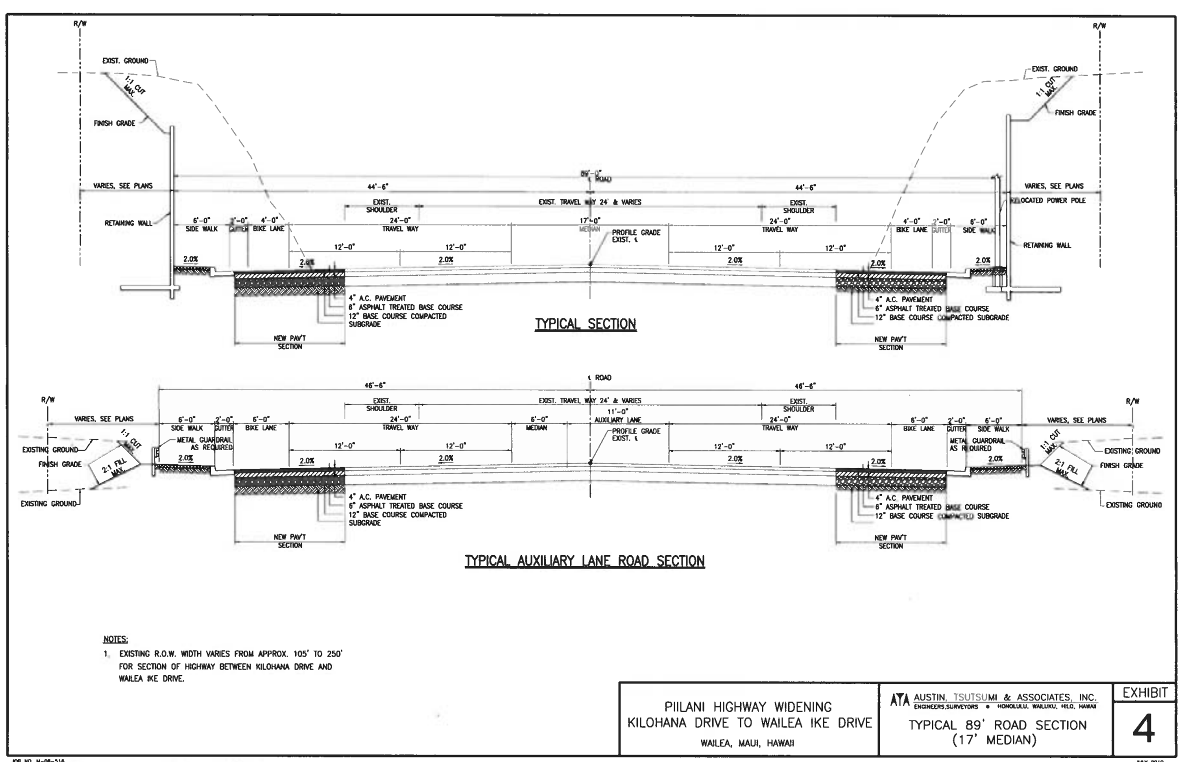
PIILANI HIGHWAY WIDENING
KILOHANA DRIVE TO WAILEA IKE DRIVE
WAILEA, MAUI, HAWAII
ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HILO, HAWAII
TYPICAL 80' ROAD SECTION
(8' MEDIAN)
EXHIBIT
3
JULY 2010


TYPICAL SECTION
TYPICAL AUXILIARY LANE ROAD SECTION
R/W
EXIST. GROUND
FINISH GRADE
VARIES, SEE PLANS
RETAINING WALL
SIDE WALK
GUTTER
BIKE LANE
EXIST. SHOULDER
TRAVEL WAY
EXIST. TRAVEL WAY 24' & VARIES
MEDIAN
AUXILIARY LANE
PROFILE GRADE EXIST. ℄
RELOCATED POWER POLE
4" A.C. PAVEMENT
6" ASPHALT TREATED BASE COURSE
12" BASE COURSE COMPACTED
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PIILANI HIGHWAY WIDENING
KILOHANA DRIVE TO WAILEA IKE DRIVE
WAILEA, MAUI, HAWAII
ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HILO, HAWAII
TYPICAL 89' ROAD SECTION
(17' MEDIAN)
EXHIBIT
4
JULY 2010

LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

BRENNON T. MORIOKA
DIRECTOR

Deputy Directors
MICHAEL D. FORMBY
FRANCIS PAUL KEENO
BRIAN H. SEKIGUCHI
JIRO A. SUMADA

IN REPLY REFER TO:

HWY-PS
2.5022

March 24, 2010

RECEIVED
MAR 26 2010
PACIFIC RIM LAND, INC.
MAUI - MAIN

Mr. Charles Jencks
Owner Representative
Honua'ula Partners, LLC
1300 N. Holopono Street, Suite 201
Kihei, Hawaii 96753

Dear Mr. Jencks:

Subject: Honua'ula/Project District 9 Compliance with Conditions 4, 18k and 19 Relating to Agreements for Infrastructure Improvements
Wailea, Maui, Hawaii

Thank you for seeking consultation regarding compliance with the zoning conditions being imposed upon the Honua'ula development. In response to your letter dated January 22, 2010, we have the following comments:

As established in the Maui County Ordinance No. 3554, the following conditions relate to transportation:

2. That Honua'ula Partners, LLC. its successors and permitted assigns, shall implement the following traffic improvements:

   a. Upgrade Piilani Highway, from Kilohana Drive to Wailea Ike Drive, to four lanes of traffic. The improvements shall be completed prior to the commencement of any construction on the site, with the exception of grading.

   b. Extend Piilani Highway for two lanes of traffic from Wailea Ike Drive to Kaukahi Street. The improvement shall be constructed at or prior to the completion of 50 percent of the project. Said improvement shall be maintained by Honua'ula Partners, LLC, its successors and permitted assigns.

   c. Signalize the Piilani Highway/Okolani Drive/Mikioi Place intersection and provide an exclusive left-turn lane on Okolani Drive prior to occupancy of the first unit in Kihei-Makena Project District 9.

   d. Modify the Piilani Highway/Wailea Ike Drive intersection and provide a free right-turn lane from Piilani Highway to Wailea Ike Drive and a second right-turn lane from Wailea Ike Drive to northbound Piilani Highway prior to occupancy of the first unit in Kihei-Makena Project District 9.

   f. Modify the Piilani Highway/Kilohana Drive/Mapu Place intersection to provide an exclusive left-turn lane, and the southbound Piilani Highway approach to provide an exclusive right-turn lane into Mapu Place prior to occupancy of the first unit in Kihei-Makena Project District 9.

4. That Honua'ula Partners, LLC, its successors and permitted assigns, shall be responsible for all required infrastructural improvements for the project, including water source and system improvements for potable and nonpotable use and fire protection, drainage improvements, traffic-related improvements, wastewater system improvements and utility upgrades, as determined by the appropriate governmental agencies and public utility companies. Except as otherwise provided by more specific conditions of zoning, said improvements shall be constructed and implemented concurrently with the development of each phase of Kihei-Makena Project District 9, and shall be completed prior to issuance of any certificate of occupancy or final subdivision approval, unless improvements are bonded by Honua'ula Partners, LLC, its successors and permitted assigns. Honua'ula Partners, LLC shall execute appropriate agreements with governmental agencies regarding participation in improvements of infrastructure and public facilities as determine by the agencies.

18. That Honua'ula Partners, LLC, its successors and permitted assigns, shall address in their Project District Phase II application the following:

   k. Roadway improvements to the satisfaction of the State Department of Transportation and the County Department of Public Works and proposed agreements are incorporated in the application and site plan and finalized as part of Project District Phase II approval.

19. That Honua'ula Partners, LLC, its successors and permitted assigns, shall execute appropriate agreements with the State of Hawaii and County of Maui agencies regarding participation in improvements of infrastructure and public facilities where such improvements are reasonably related to Honua'ula Partners, LLC's project.

28. That, prior to the commencement of any construction activity, Honua'ula Partners, LLC, its successors and permitted assigns, shall develop and submit a Transportation Management Plan ("TMP"), to be reviewed and approved by the State Department of Transportation, the County Department of Public Works, and the County Department of Transportation. The purpose of the TMP shall be to reduce traffic generated by construction activity related to the Kaonoulu Light Industrial Subdivision and

> Kihei-Makena Project District 9, including traffic generate by the improvements to Piilani Highway between Kilohana Drive and Wailea Ike Drive. The TMP shall provide for programs such as park and ride, during peak hour traffic. Upon approval, project contractors shall implement the TMP during construction activities. Honua'ula Partners, LLC, its successors and permitted assigns, shall submit an annual report to the State Department of Transportation, the County Department of Public Works, the County Department of Transportation, and the Maui County Council to document the success of the TMP in meeting its benchmarks of reducing traffic during project construction.

The improvements to be performed by Honua'ula Partners LLC as stated within Condition No. 2 are consistent to the improvements identified in the Traffic Impact Analysis Report (TIAR) dated October 29, 2009. These improvements are understood to be considered the "fair share" for traffic related improvements of the affected area. The improvement of widening Piilani Highway from two to four lanes from Kilohana Drive to Wailea Ike Drive will be in accordance to the federal and state guidelines for an urban principal arterial following the attached cross-section. The cross-section design layout Alternative 1 dated January 2010, which was submitted by your consultant for the Piilani Highway widening project is acceptable in concept under state guidelines. It is our recommendation that the median be adjusted to a total of 17 feet including the left turn auxiliary lane and the bike lane should be adjusted to 6 feet. We also recommend that the median width of 17 feet be maintained as much as possible throughout the project area to preserve operational efficiency and aesthetic consistency for the roadway users. Deviations in the width of the median and layout of the lanes may cause operational inefficiencies due to potential roadway users' adjustments to changes in the traffic pattern. Any such deviations should be requested to the department for discussion and consideration and justifications for such a request should be fully documented. Final construction plans based on the aforementioned guidelines will need to be submitted for review and approval to our department. Also, for this widening effort for the intersections on Piilani Highway at Kilohana Drive/ Mapu Place, Okolani Drive/ Mikioi Place, and Wailea Ike Drive as identified in the ordinance and to be performed by Honua'ula Partners LLC are the minimum traffic improvements to be performed. The actual traffic improvements at these intersections, such as the signalization, turning lanes, lane widths and lengths, and pedestrian and bicycle accommodations will be reviewed and accepted by our department. The extension of Piilani Highway for two lanes of traffic from Wailea Ike Drive to Kaukahi Street will be designed as an urban minor arterial with no access unto Piilani Highway. The actual intersection design will be submitted to our department for review and acceptance.

In regards to Condition No. 28 involving the development of a TMP for the subject project, we are satisfied with your final comments for the TMP proposal and a formal approval should be forthcoming. The approval of the TMP is based on the understanding that the specific details of the construction and traffic control plan will need to be coordinated and approved by our department.

As the accepting agency of the HRS 343 Environmental Assessment (EA) for the Piilani Highway Widening from Kilohana Drive to Wailea Ike Drive no construction work may begin until the EA is accepted by the State.

The State Department of Transportation acknowledges the continued coordination efforts by Honua'ula Partners, LLC in maintaining due diligence and in meeting the milestones necessary in complying with the zoning conditions set-forth in the aforementioned County ordinance and look forward to continuing the efforts for Honua'ula Partners, LLC to achieve full compliance.

If there are any questions, please contact Ken Tatsuguchi, Head Planning Engineer, Highways Division, at (808) 587-1830.

Very truly yours,

BRENNON T. MORIOKA, Ph.D., P.E.
Director of Transportation

Attachment

HONUA'ULA

January 22, 2010

Mr. Brennon Morioka, Director
State Department of Transportation
State of Hawaii
869 Punchbowl Street, Room 513
Honolulu, HI 96813

Subject: Honua `ula/Project District 9 Compliance with Conditions 4, 18k and 19 Relating to Agreements for Infrastructure Improvements

Dear Mr. Morioka:

As you may know, the Honua `ula project team is in the final stages of completing a project Environmental Impact Statement and Project District Phase II application for Honua `ula. Included within those documents are the typical sections and areas of technical importance needed to not only provide the information decision makers need to make good decisions but also responses that clearly respond to the conditions of approval placed upon the project. To that end this letter addresses the conditions referenced above and detailed as follows:

Condition 4:
That Honua'ula Partners, LLC, its successors and permitted assigns, shall be responsible for all required infrastructural improvements for the project, including water source and system improvements for potable and non-potable use and fire protection, drainage improvements, traffic-related improvements, wastewater system improvements and utility upgrades, as determined by the appropriate governmental agencies and public utility companies. Except as otherwise provided by more specific conditions of zoning, said improvements shall be constructed and implemented concurrently with the development of each phase of Kihei-Makena Project District 9, and shall be completed prior to issuance of any certificate of occupancy or final subdivision approval, unless improvements are bonded by Honua'ula Partners, LLC, its successors and permitted assigns. Honua'ula Partners, LLC shall execute appropriate agreements with governmental agencies regarding participation in improvements of infrastructure and public facilities as determined by the agencies.

Condition 19:
That Honua'ula Partners, LLC, its successors and permitted assigns, shall execute appropriate agreements with the State of Hawaii and County of Maui agencies regarding participation in improvements of infrastructure and public facilities where such improvements are reasonably related to Honua'ula Partners, LLC 's project.

As noted in the above conditions and highlighted by the underlined text, for the project to remain in compliance with the conditions it is necessary for the relevant public agencies to concur by agreement that the project is indeed participating in improvements to infrastructure as required by those agencies.

The following conditions of approval relate to your specific agency and the following response addresses the project's current status in responding the specific condition:

Condition 2:
That Honua'ula Partners, LLC, its successors and permitted assigns, shall implement the following traffic improvements:

a. Upgrade Piilani Highway, from Kilohana Drive to Wailea Ike Drive, to four lanes of traffic. The improvements shall be completed prior to the commencement of any construction on the site, with the exception of grading.

c. Signalize the Piilani Highway/Okolani Drive/Mikioi Place intersection and provide an exclusive left-turn lane on Okolani Drive prior to occupancy of the first unit in Kihei-Makena Project District 9.

d. Modify the Piilani Highway/Wailea Ike Drive intersection into a signalized intersection and provide a free right-turn lane from Piilani Highway to Wailea Ike Drive and a second right-turn lane from Wailea Ike Drive to northbound Piiiani Highway prior to occupancy of the first unit in Kihei-Makena Project District 9.

f. Modify the Piilani Highway/Kilohana Drivel/Mapu Place intersection to provide an exclusive left-turn lane, and the southbound Piilani Highway approach to provide an exclusive right-turn lane into Mapu Place prior to occupancy of the first unit in Kihei-Makena Project District 9.

Response:
With regard to the above condition, the project team has already completed a draft Environmental Assessment (EA) along with design build construction plans for the subject improvements. The initial in house draft EA, design build plans and a formal re-designation request were transmitted to your agency for review and comment. The project team is now re-grouping on the project EA and design work given changes driven by your agency's decision to not allow the re-designation of the highway.

Given the above condition and the project team's response to your requirements it is clear there have been and continue to be positive efforts put forth by the project in responding to your requirements.

As to direct compliance with the conditions requiring agreements between the project ownership and the various agencies, it is proposed that in lieu of agreements between the parties your office simply respond to this letter acknowledging compliance to date with the conditions referenced and that the two parties will continue to work together to achieve full compliance with the terms of the conditions.

Mr. Morioka, I would truly appreciate a quick response from you with regard to the referenced letter as the EIS and Phase II applications are near their finalization with submittal to the County of Maui anticipated for early February. Should you have any questions regarding this letter or the subject conditions please feel free to contact me in my office at 879-5205, on my cell phone at 250-3178 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Owner Representative
Honua `ula Partners, LLC

CHARMAINE TAVARES
Mayor

MILTON M. ARAKAWA, A.I.C.P.
Director

MICHAEL M. MIYAMOTO
Deputy Director

Telephone: (808) 270-7845
Fax: (808) 270-7955

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET, ROOM NO. 434
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Development Services Administration

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

February 24, 2010

RECEIVED
FEB 26 2010
PACIFIC RIM LAND, INC.
MAUI - MAIN

Mr. Charles Jencks
Owner Representative
HONUA`ULA PARTNERS, LLC
P. O. Box 220
Kihei, Maui, Hawaii 96753

Dear Mr. Jencks:

SUBJECT: HONUA`ULA/PROJECT DISTRICT 9 COMPLIANCE WITH CONDITION NOS. 4, 18k, AND 19 RELATING TO AGREEMENTS FOR INFRASTRUCTURE IMPROVEMENTS

This is to clarify our response in our February 17, 2010 letter regarding compliance with the above-referenced conditions. We confirm that Honua`ula Partners, LLC is in compliance with and has initiated implementation of Condition Nos. 2e, g and h as defined in the conditions of zoning for the Honua`ula project.

Please call Michael Miyamoto at 270-7845 if you have any questions regarding this letter.

Sincerely,

MILTON M. ARAKAWA, A.I.C.P.
Director of Public Works

MMA:MMM:ls
xc: Highways Division
Engineering Division
Development Services Administration
Department of Planning
s:\mike\cjencks_honuaula_clarify 2.17.10 ltr re compliance

CHARMAINE TAVARES
Mayor

MILTON M. ARAKAWA, A.I.C.P.
Director

MICHAEL M. MIYAMOTO
Deputy Director

Telephone: (808) 270-7845
Fax: (808) 270-7955

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET, ROOM NO. 434
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Development Services Administration

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

February 17, 2010

RECEIVED
FEB 22 2010
PACIFIC RIM LAND, INC.
MAUI - MAIN

Mr. Charles Jencks
Owner Representative
HONUA`ULA PARTNERS, LLC
P. O. Box 220
Kihei, Maui, Hawaii 96753

Dear Mr. Jencks:

SUBJECT: HONUA`ULA/PROJECT DISTRICT 9 COMPLIANCE WITH CONDITIONS 4, 18k, and 19 RELATING TO AGREEMENTS FOR INFRASTRUCTURE IMPROVEMENTS

We reviewed your letter dated January 28, 2010, and have no comments at this time.

Please call Michael Miyamoto at 270-7845 if you have any questions regarding this letter.

Sincerely,

MILTON M. ARAKAWA, A.I.C.P.
Director of Public Works

MMA:MMM:ls
xc: Highways Division
Engineering Division
S:\LUCA\CZM\honuaula_proj_dist-9_compliance_agreements_to_infrastruc_imp_ls.wpd

HONUA'ULA

January 28, 2010

Mr. Milton Arakawa, Director
Department of Public Works
200 South High Street
Wailuku, HI 96793

Subject: Honua `ula/Project District 9 Compliance with Conditions 4, 18k and 19 Relating to Agreements for Infrastructure Improvements (Attached)

Dear Mr. Arakawa:

As you may know, the Honua `ula project team is in the final stages of completing a project Environmental Impact Statement and Project District Phase II application for Honua `ula. Included within those documents are the typical sections and areas of technical importance needed to not only provide the information decision makers need to make good decisions but also responses that clearly respond to the conditions of approval placed upon the project. To that end this letter addresses the conditions referenced above and detailed as follows:

Condition 4:
That Honua'ula Partners, LLC, its successors and permitted assigns, shall be responsible for all required infrastructural improvements for the project, including water source and system improvements for potable and non-potable use and fire protection, drainage improvements, traffic-related improvements, wastewater system improvements and utility upgrades, as determined by the appropriate governmental agencies and public utility companies. Except as otherwise provided by more specific conditions of zoning, said improvements shall be constructed and implemented concurrently with the development of each phase of Kihei-Makena Project District 9, and shall be completed prior to issuance of any certificate of occupancy or final subdivision approval, unless improvements are bonded by Honua'ula Partners, LLC, its successors and permitted assigns. Honua'ula Partners, LLC shall execute appropriate agreements with governmental agencies regarding participation in improvements of infrastructure and public facilities as determined by the agencies.

Condition 19:
That Honua'ula Partners, LLC, its successors and permitted assigns, shall execute appropriate agreements with the State of Hawaii and County of Maui agencies regarding participation in improvements of infrastructure and public facilities where such improvements are reasonably related to Honua'ula Partners, LLC 's project.

1300 N. Holopono Street, Suite 201 • P.O. Box 220 • Kihei, Hawai'i 96753 • p: 808-879-5205 • f: 808-879-2557

As noted in the above conditions and highlighted by the underlined text, for the project to remain in compliance with the conditions it is necessary for the relevant public agencies to concur by agreement that the project is indeed participating in improvements to infrastructure as required by those agencies.

The following conditions of approval relate to your specific agency and the following response addresses the project's current status in responding to the specific conditions:

Condition 2:
That Honua'ula Partners, LLC, its successors and permitted assigns, shall implement the following traffic improvements:

e. Modify the Wailea Alanui/Wailea Ike Drive intersection to add a signalized double right-turn movement from northbound to eastbound turning traffic and provide two left-mm lanes for southbound traffic from Wailea Ike Drive prior to occupancy of the first unit in Kihei-Makena Project District 9.

g. Signalize the Wailea Ike Drive/Kalai Waa Street intersection in coordination with Wailea Resort and Makena Resort when warranted.

h. Signalize the Wailea Alanui/Kaukahi Drive/Kaukahi Street intersection in coordination with Wailea Resort and Makena Resort when warranted.

Response:
With regard to the above condition, the project team has already completed a draft Environmental Assessment (EA), Special Management Area Permit application, submitted subdivision applications for the needed right of way and civil construction plans for the Wailea Alanui/Wailea Ike Drive intersection improvements (Condition 2 e). The Final Environmental Assessment for the project has been published in the Office of Environmental Quality Bulletin and a tentative schedule for the SMA permit hearing has been set for March 23, 2010.

With regard to Conditions 2 g and h, the project team has engaged the firm of Austin Tsutsumi and Associates to provide preliminary design studies for inclusion in the project Environmental Impact Statement. These improvements are not warranted at present.

Given the above condition and the project team's response to your requirements it is clear there have been and continue to be positive efforts put forth by the project in responding to your requirements. As to direct compliance with the conditions requiring agreements between the project ownership and the various agencies, it is proposed that in lieu of agreements between the parties your office simply respond to this letter acknowledging compliance to date with the conditions referenced and that the two parties will continue to work together to achieve full compliance with the terms of the conditions.

Mr. Arakawa, I would truly appreciate a quick response from you with regard to the referenced letter as the EIS and Phase II applications are near their finalization with submittal to the County of Maui anticipated for early February. Should you have any questions regarding this letter or the subject conditions please feel free to contact me in my office at 879-5205, on my cell phone at 250-3178 or via email at charliej@pacificrimland.com.

Sincerely,

Charles Jencks
Owner Representative
Honua`ula Partners, LLC