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August 26, 2011

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Mr. Gary Hooser, Director
Office of Environmental Quality Control
State of Hawaii
235 South Beretania Street, Suite 702
Honolulu, Hawai`i 96813

Aloha Mr. Hooser:

Subject: Draft Environmental Assessment
Ka Makana Ali`i Conceptual Master Plan
East Kapolei, Ewa, Oahu

The attached Draft Environmental Assessment (EA) has been prepared pursuant to Chapter 343, Hawaii Revised Statutes and Chapter 200-2, Hawaii Administrative Rules. We respectfully request publication of this notice in the next issue of the *Environmental Notice* (September 8, 2011). Enclosed are the following items:

- One (1) copy in *pdf* format of the Draft EA and a completed Office of Environmental Quality Control publication form on CD;
- One hard copy of the Draft EA; and
- One copy of the distribution list for you review and verification.

Should you have any questions, please contact Linda Chinn, Land Management Division Administrator, at 808.620.9451.

Me ke aloha,

Albert "Alapaki" Nahale-a, Chairman
Hawaiian Homes Commission

Publication Form
The Environmental Notice
Office of Environmental Quality Control

Instructions: Please submit one hardcopy of the document along with a determination letter from the agency. On a compact disk, put an electronic copy of this publication form and a PDF of the EA or EIS. Mahalo.

Name of Project:	Ka Makana Ali`i Conceptual Master Plan
Applicable Law:	Chapter 343, Hawaii Revised Statutes as amended, and Section 11-200, Hawaii Administrative Rules
Type of Document:	Environmental Assessment
Island:	O`ahu
District:	`Ewa
TMK:	9-1-016:142
Permits Required:	Building permits, grading permits, NPDES permit, and construction noise permits
Name of Applicant:	Department of Hawaiian Home Lands
Address:	P.O. Box 1879
City, State, Zip:	Honolulu, Hawai`i 96805
Contact and Phone:	Ms. Linda Chinn, Administrator Land Management Division, ph. 620-9451
Name of Accepting Authority:	Department of Hawaiian Home Lands
Address:	91-5420 Kapolei Parkway
City, State, Zip:	Kapolei, Hawai`i 96707
Contact and Phone:	Mr. Alapaki Nahale-a, Chairman, ph. 620-9500
Consultant:	Lee Sichter LLC
Address:	45024 Malulani Street #1
City, State, Zip:	Kane`ohe, Hawai`i 96744
Contact and Phone:	Lee Sichter, ph. (808) 382-3836

Project Summary: Summary of the direct, secondary, and cumulative impacts of the proposed action (less than 200 words).

The Ka Makana Ali`i project is a regional mixed use center proposed to be developed by Hawaii DeBartolo LLC on a 67-acre property in East Kapolei, in the district of `Ewa within the City and County of Honolulu. The subject property is owned by the Department of Hawaiian Homelands (DHHL) and is in the process of being leased to Hawaii DeBartolo LLC.

The proposed development will total approximately 1,400,000 square feet of leasable area including a variety of uses such as commercial office space (approximately 217,000 square feet), two or more large retail anchors as well as smaller, boutique stores, a cinema, a gym, two hotels (250 rooms each), numerous restaurants and other eating establishments, and entertainment facilities. These uses are centered on a large urban court/promenade that ties the project together. Pedestrian paths link the uses and provide connectivity to and from the hotel and office space. In addition to the approximately 2,671 parking spaces to be provided at grade, Ka Makana Ali`i will offer approximately 1,826 parking spaces in an underground lot.

The Ka Makana Ali`i project will be constructed in two phases, with the first opening in 2013 and the second phase opening two years later.

Ka Makana Ali‘i
Conceptual Master Plan

Draft Environmental Assessment

Prepared for

Department of Hawaiian Home Lands

Prepared by

Lee Sichter LLC

on behalf of

Hawaii DeBartolo LLC

August 23, 2011

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ACRONYMS AND ABBREVIATIONS

ac-ft	acre-feet
BWS	Board of Water Supply (City and County of Honolulu)
City	City and County of Honolulu
DHHL	Department of Hawaiian Homelands
DLNR	Department of Land and Natural Resources (State)
DPP	Department of Planning and Permitting (City)
Drainage Master Plan	*Drainage Master Plan for East Kapolei I Development*
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESDU	equivalent single-family dwelling units
FEIS	Final environmental impact statement
FEMA	Federal Emergency Management Agency
FIRM	Flood Rate Insurance Map
gpd	gallons per day
Gpm	gallons per minute
HAR	Hawaii Administrative Rules
HCDCH	Housing and Community Development Corporation of Hawaii
HCM	*2007 Highway Capacity Manual*
HECO	Hawaiian Electric Company
HHFDC	Hawaii Housing Finance Development Corporation
HRS	Hawaii Revised Statutes, as amended
KMA	Ka Makana Ali`i project
kV	kilovolt
LLC	Limited Liability Company
LOS	Level of Service
LUC	Land Use Commission (State)
LUO	Land Use Ordinance
MGD	million gallons per day
MSL	mean sea level
MW	megawatt
OR&L	Oahu Railway and Land Company
SHPD	State Historic Preservation Division of DLNR
SIC	Sandwich Isles Communications
subject property	67-acre property
UH	University of Hawai‘i

1 INTRODUCTON

1.1 PROJECT SUMMARY

The Ka Makana Ali`i project is a regional mixed use center proposed to be developed on a 67-acre property (hereinafter, "the subject property") in East Kapolei, in the district of `Ewa within the City and County of Honolulu (Figure 1). The subject property is owned by the Department of Hawaiian Homelands (DHHL), which has committed to lease the property to Hawaii DeBartolo LLC subject to contingencies, including full compliance with Hawaii Revised Statutes Ch. 343. The subject property is identified as Tax Map Key 9-1-016:142. (Figure 2)

The proposed Ka Makana Ali`i Mixed Use Regional Center includes approximately 1,400,000 square feet of leasable area. The project will include a variety of uses such as commercial office space (approximately 217,000 square feet), two or more large retail anchors as well as smaller, boutique stores, a cinema, a gym, two hotels (250 rooms each), numerous restaurants and other eating establishments, and entertainment facilities. All of these uses are centered on a large urban court/promenade that ties the project together. Pedestrian paths lead to and from the various uses and provide connectivity to and from the hotel and office space. In addition to the approximately 2,671 parking spaces to be provided at grade, Ka Makana Ali`i will offer approximately 1,826 parking spaces in an underground lot.

The Ka Makana Ali`i project, also known as a lifestyle center, is designed as an open-air, main street like development with welcoming and high quality architecture that focuses on certain retail neighborhood/districts and blends mixed-uses typical of a traditional main street and pedestrian-friendly centers where consumers can gather in safe public spaces and feel part of a community. The Ka Makana Ali`i center will be a vibrant place where people can work, visit, play, socialize and shop.

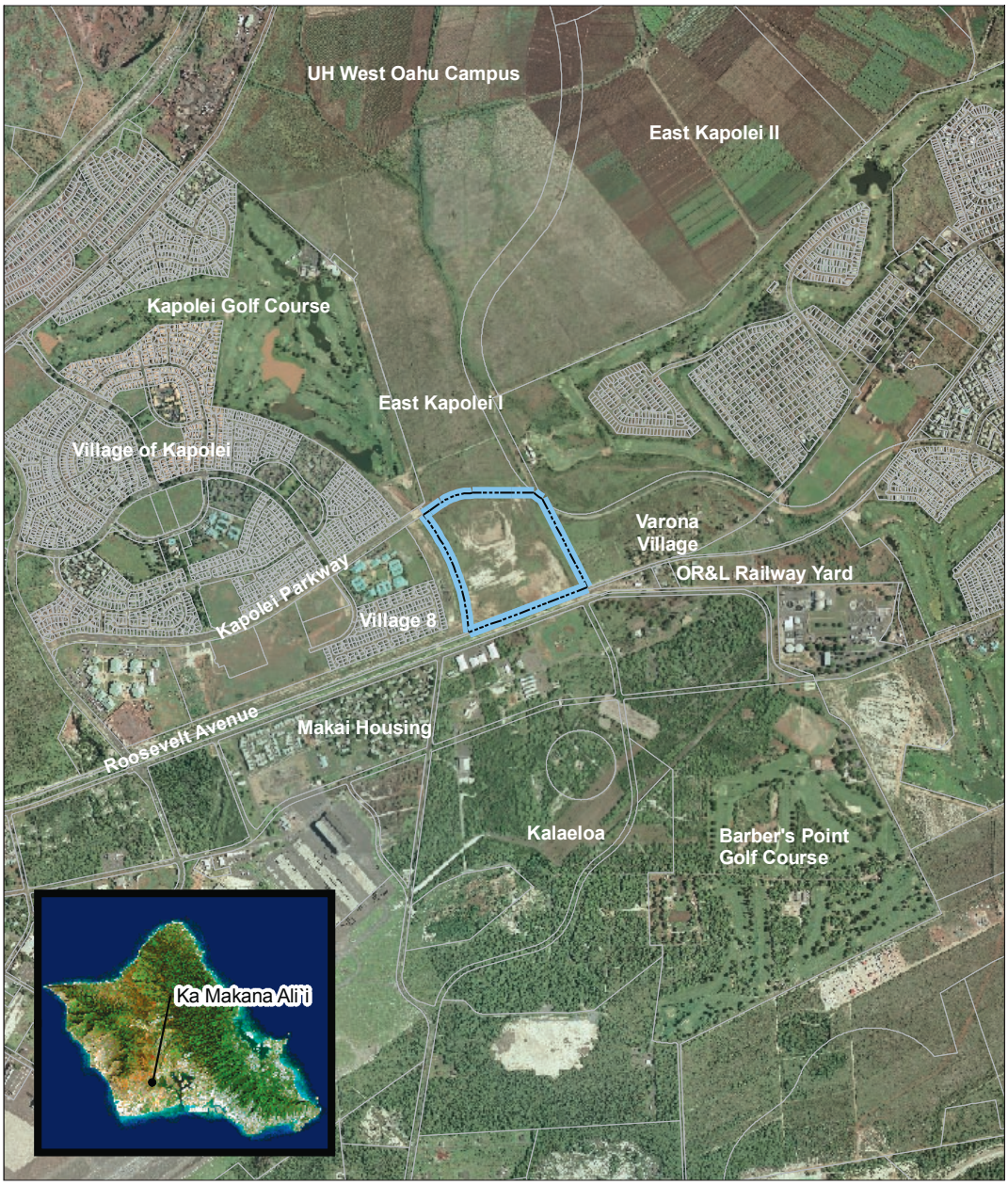
This Environmental Assessment discusses the key elements of the project. At this point in the planning process, the project remains conceptual in nature because the physical character of the proposed development will be ultimately shaped by the outcome of the separate lease agreements between Hawaii DeBartolo LLC and the project's future tenants. Thus, it should be understood that while the DHHL and Hawaii DeBartolo LLC are committed to the development of the project in general conformity to the provisions discussed herein, the site plans presented in the Conceptual Master Plan are subject to revision and modification as lease negotiations are concluded.

1.2 APPLICANT

The proposing agency, referred to in this Environmental Assessment as the 'applicant', is the Department of Hawaiian Home Lands. This Environmental Assessment is being prepared on behalf of DHHL by Hawaii DeBartolo LLC, a subsidiary of DeBartolo Developments.

1.3 ACCEPTING AUTHORITY

The accepting authority is the Department of Hawaiian Home Lands.



Ka Makana Ali'i

FIGURE 1 REGIONAL MAP

N

0' 500' 1000' 2000'

KA MAKANA ALI'I KAPOLEI, OAHU

FIGURE 2 TAX MAP

N

0' 500' 1000' 2000'

Ka Makana Ali'i

KA MAKANA ALI'I KAPOLEI, OAHU

1.4 DESCRIPTION OF THE PROPERTY

The subject property is located at the southern end of the area known as East Kapolei in the `Ewa District of the City and County of Honolulu on the island of O`ahu. It consists of approximately 67.7 acres of vacant land surrounded by existing and proposed urban development. The subject property is relatively flat with a slope of less than two percent. There are no natural variations in the topography.

The subject property is generally characterized as being entirely disturbed by previous development and agricultural activities. (Figure 3) Subsequent to its long-term cultivation in sugar cane, approximately one-third of the property has been excavated for the production of fill material for surrounding developments, resulting a large borrow pit approximately 30 feet deep, extending over an area of approximately 13.8 acres. Another third of the property has been used for the stockpiling of the excavated soil. The existing stockpile, extending over an area of about 5.8 acres, is about 12 feet high in some places. This area also includes the excavated foundation of the formerly proposed regional sports complex stadium (in the rough shape of a baseball diamond). The area excavated for the stadium is about 8 feet deep and covers an area of approximately 4.4 acres. The remaining third of the property was used as a staging area for construction equipment and materials associated with the development of Kapolei Parkway.

1.5 BACKGROUND

In 1999, the subject property was part of a 1,300-acre area known as East Kapolei that was reclassified by the State Land Use Commission (LUC) from a State Agricultural district to a State Urban district (LUC Docket A99-728, approved September 8, 1999). The State Department of Land and Natural Resources (DLNR) owned the East Kapolei property at that time. The Housing and Community Development Corporation of Hawaii (HCDCH) was identified as the proposed developer.

The HCDCH Master Plan for the East Kapolei project included a master-planned community containing 4,300 to 5,800 single-family units; 2,100 to 2,600 multi-family units; four commercial areas; four school parcels; a sports complex; six neighborhood parks; one district park; open space; and recreational land uses.

The subject property was designated as the proposed site of the sports complex, containing a 4,000-seat stadium expandable to 8,000 seats; a grass berm seating area to accommodate an additional 2,000 seats; a multi-purpose building; six practice fields; batting cages; bleachers; pitcher mounds; maintenance sheds and storage; and miscellaneous accessory uses such as lighting, restrooms, and drinking fountains. The sports complex was to be owned and built with public funds and available for public use much like Aloha Stadium.

At the time the East Kapolei property was reclassified to the Urban district in 1999, a 991-acre area east of Makakilo and *mauka* of the H-1 Freeway was being proposed for the development of the University of Hawai‘i’s (UH) West O`ahu campus. The proximity of the East Kapolei project to the proposed West O`ahu campus was discussed in the *East Kapolei Master Plan Final Environmental Impact Statement* (EIS) (July 1998) and in the LUC petition. According to the UH West O`ahu Final EIS (December 2006), subsequent to the reclassification of East Kapolei, “...Hawai‘i’s economy suffered a serious downturn, and there was little or no market demand for new residential development. During this period, it was determined that the

FIGURE 3 - EXISTING CONDITIONS

construction of a new campus *mauka* of the H-1 Freeway would be more expensive than [a *makai* site]." (UH West O`ahu FEIS, page 138).

By 2001, it was determined by the State of Hawai‘i that a 500-acre portion of the East Kapolei project area would be allocated to UH for the West O`ahu campus and that the remaining 800-acre portion of the 1,300 acres would be transferred to DHHL. In 2002, ownership of the East Kapolei property was transferred from DLNR to UH and DHHL respectively.

In 2009, DHHL commenced construction of its East Kapolei project that includes 380 single family homes, a community center, and a new DHHL office building. Discussions also began between DHHL and DeBartolo Development to develop the *makai* portion of the East Kapolei project area. Since then, the DHHL office building has been completed and the Kroc Community Center has been constructed with a grand opening scheduled for August 2011.

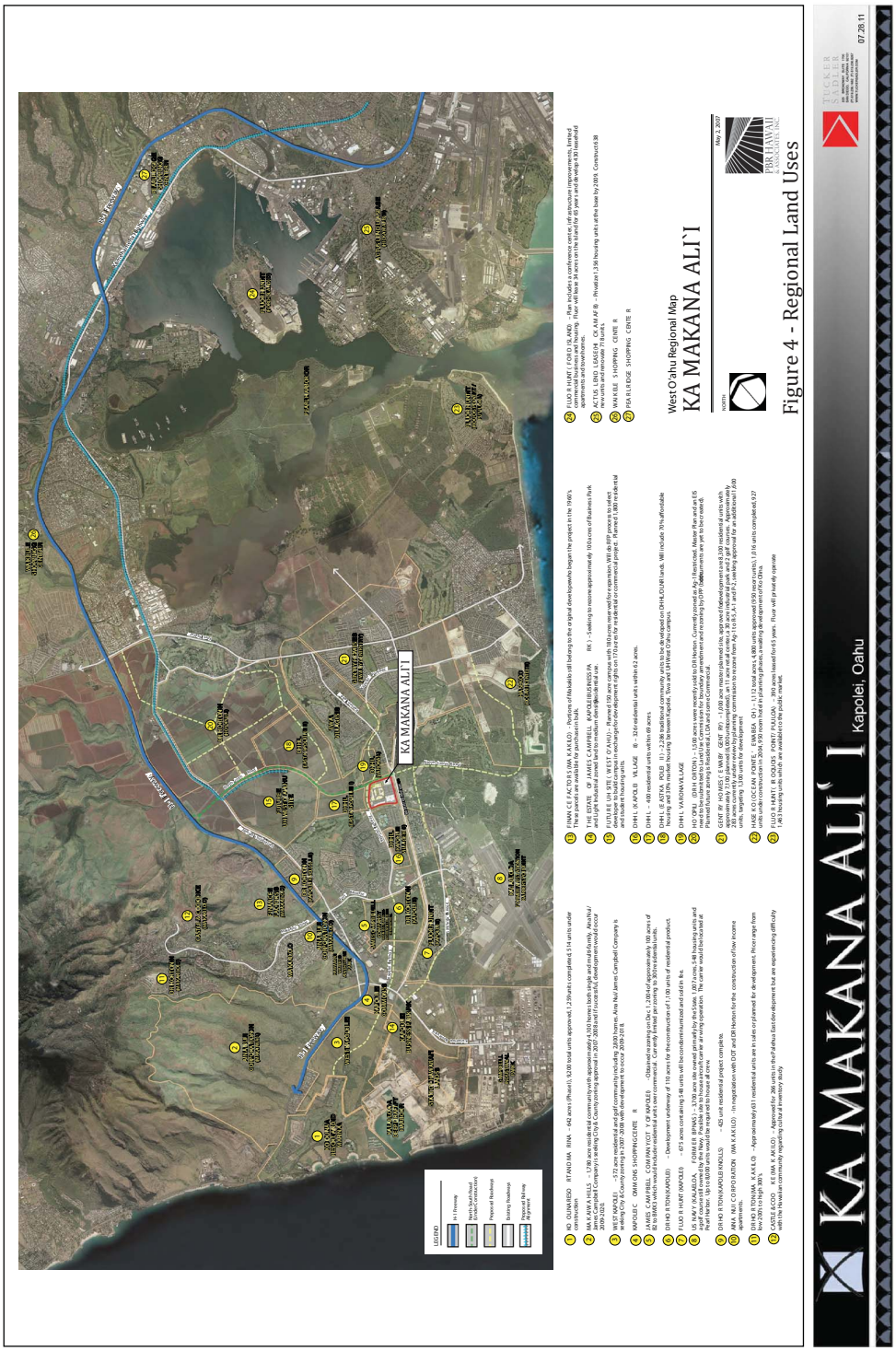
1.6 MAJOR APPROVALS REQUIRED

As discussed above, the subject property was classified Urban District by the State LUC in 1999 and identified at that time as the site of a regional sports complex. The subject property is zoned Ag-1 (Agriculture). However, because the DHHL is exempted from having to comply with City and County of Honolulu land use regulations, no change of zone is needed for the Proposed Action. Therefore, the only land use related approvals that are needed are an approval from the State LUC to change the property's designated use as a regional sports complex to a regional mixed use center, and approvals from the City and County of Honolulu including subdivision, grading, and building permits.

1.7 SURROUNDING LAND USES

The subject property is generally situated between the residential areas known as Kapolei Village 8 (to the west) and Varona Village (to the east). (Figure 4) The subject property is bounded on the north by Kapolei Parkway and on the south by the Oahu Railway and Land Company (OR&L) railway corridor. The western property boundary abuts an unlined drainage channel owned by Housing Finance and Development Corporation (HFDC), the successor to the HCDCH, and generally known as the Kapolei Lower Drainage Channel. The eastern property boundary abuts a 75-foot wide utility easement owned by the Hawaiian Electric Company (HECO) within which 138kv transmission lines supported by 120-foot poles are located. The property on the eastern side of the HECO transmission corridor is owned by the City and County of Honolulu.

From a regional perspective, the subject property is surrounded by East Kapolei to the north, including the proposed UH West Oahu campus, the Villages of Kapolei to the west, Kaleoloa to the south, and Ewa Villages to the east. It lies at the epicenter of land use development in the `Ewa region.


KA MAKANA ALI`I
West O'ahu Regional Map
KA MAKANA ALI`I
Figure 4 - Regional Land Uses
KA MAKANA ALI`I
Kapolei, Oahu
07.28.11

2 DESCRIPTION OF THE PROPOSED ACTION

2.1 PROJECT GOALS AND OBJECTIVES

The Proposed Action is the development and long term operation of the subject property as a regional mixed use center serving the residents of East Kapolei and the greater `Ewa region. The

Proposed Action includes the development of ancillary facilities and infrastructure necessary to support the regional mixed use center.

As the name Ka Makana Ali`i suggests, the proposed project represents an opportunity, a gift, created by DHHL and Hawaii DeBartolo LLC to the Kapolei community that will provide people with new and exciting opportunities to work, to shop, and to celebrate within their community. A guiding theme of DHHL's East Kapolei development is the term "Live, Work and Play."

The goal of the Ka Makana Ali`i project is to help enable DHHL to fulfill its mission to its beneficiaries by generating a lease-revenue income stream. The development of the subject property will generate approximately $141 million of ground rent revenue for DHHL over the initial 25-year period. For the following 40 years, ground rent will be renegotiated based on an independent appraisal process prior to the commencement of the 26th, 36th, 46th and 56th years.

The objectives of the Proposed Action are to help fulfill DHHL's vision for East Kapolei and introduce a substantial employment-producing development into DHHL's East Kapolei project that will improve the community's quality of life by bringing jobs, shopping, and leisure activities into the heart of the `Ewa District. By ground leasing the property to Hawaii DeBartolo LLC, DHHL will ensure the effective development and management of a significant Hawaiian Home Lands Trust asset.

The overall Ka Makana Ali`i development represents a once in a lifetime opportunity to create a vital mixed use district within the existing suburban grid that appeals to the residents of Kapolei, West Oahu and visitors alike. The essence of the project is to create an environment that is authentic and aware of its physical surroundings visual assets, and to provide the community with a secure place to gather, linger and celebrate the true essence of Hawaii and its people. The project is well positioned to offer the surrounding community a vibrant district that first and foremost, serves the community at large while creating an innovative mix of uses for the growing demographics. Ka Makana Ali`i has the vital components necessary to become a landmark that will endure as an asset to the Kapolei community.

2.2 NEED FOR THE PROPOSED PROJECT

The project responds to need from the immediate area and from the larger Leeward O`ahu region for retail, office and hotel facilities. The Ka Makana Ali`i project will serve both as a regional mixed use center and as a neighborhood retail area for its immediate area. The regional population has been growing at high rates in recent years, and is projected to continue to grow by more than 11% every five years through 2035.[1] The East Kapolei area is expected to have more

[1] Allocation by City and County Honolulu Department of Planning and Permitting of County population and employment projected by DBEDT. Projections were made in mid-2009, and take into account the recession felt as of 2008.

than 26,000 residents by 2030. For the combined area of Kapolei Villages, East Kapolei and `Ewa Villages, the population is projected to reach over 54,000 by 2035.

Recent studies for other developments in the area have identified both existing and likely future demand for new retail and office facilities in `Ewa.[2] Key findings from these and general market accounts have included:

- With rapid population growth, `Ewa is emerging as a complex urban area, able to support a range of commercial land uses;
- `Ewa is underserved with regard to retail and office space;
- While plans for new commercial developments have advanced, demand from the `Ewa population is sufficient to justify new retail construction in Kapolei;
- Market studies for other projects have taken into account the presence of a regional mixed use center at the subject property, yet still found additional demand to support projects elsewhere;
- Recent shopping center vacancy rates are low (3.5% island wide, up from a record low of 2.12% at the end of 2006);[3] and
- Islandwide, office vacancy rates have increased to 12%.[4]

Proposed development near Ka Makana Ali`i will provide an immediate (neighborhood) market including residents, students, and workers. The UH West O`ahu property is expected to include 1,484 housing units on University land, and an additional 2,557 units on the private developer's portion of the site. The DHHL anticipates construction of some 2,800 housing units in its East Kapolei lands (in addition to units in Kaupe'a, Village 8 of the Villages of Kapolei.

New housing on the UH West O`ahu and DHHL lands can be expected to generate demand for well over 400,000 square feet of new retail space, some of which will be met on-site.[5]

The preliminary studies for Kalaeloa emphasized residential and industrial development, on the grounds Kapolei retail development would serve regional demand. It was assumed that Kalaeloa could eventually support a neighborhood retail area, but not a larger regional mixed use center. When Kalaeloa's residential population eventually grows, it will add to demand for shopping and services from Ka Makana Ali`i.

The UH West O`ahu will generate demand for temporary lodgings used by visiting lecturers, conference participants and the like. No such lodgings have been included in plans for the

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[2] Colliers Hawaii Consulting, *Makaīwa Hills Commercial Development Market Assessment and Feasibility Study,* in Group 70 International, Inc. *Draft Environmental Impact Statement, Makaīwa Hills,* vol II. Prepared for Makaīwa Hills LLC. (Honolulu, HI: 2007). SMS Research, *Regional Economic Report*, in Belt Collins Hawaii, *Kalaeloa Master Plan.* vol. II. Prepared for Hawaii Community Development Authority (Honolulu, HI, 2006).

[3] Colliers Monroe Friedlander, *Retail Market Report: Oahu Mid-Year 2007.* Posted at http://www.colliers.com/Content/Repositories/Base/Markets/Honolulu/English/Market_Report/PDFs/CMF_MY11_RET_highlight.pdf

[4] Colliers Monroe Friedlander. *Office Market Report: Honolulu Mid-Year 2007.* Posted at http://www.colliers.com/Content/Repositories/Base/Markets/Honolulu/English/Market_Report/PDFs/CMF_MY11_OFC_highlight.pdf

[5] Estimate based on rule of thumb in Makaīwa Hills Commercial Market Study, of 22 square feet per resident.

university.[6] Ka Makana Ali`i provides a site for business travelers, including academics. Similarly, Kapolei is emerging as a business center. While Ko `Olina provides resort lodgings nearby, limited service and value lodgings are available in the region. Ka Makana Ali`i will be attractive to business travelers visiting Kapolei and other `Ewa locations.

2.3 OVERVIEW OF PROPOSED LAND USE

Even though the applicant is exempted from complying with City and County of Honolulu zoning standards, Hawaii DeBartolo LLC has committed to developing the majority of the site in accordance with BMX-3 (Business Mixed Use) zoning standards, with the remaining area of approximately 82,000 square feet developed to BMX-4 zoning standards. Using these standards will ensure that the proposed development is compatible with regional development patterns. The site height limit will be 120 feet.

2.4 DESIGN THEME

The intent of the architectural and landscape design is to create an inviting Hawaiian sense of place where the community can draw together, shop and interact with visitors of Hawaii. The project will be characterized by an innovative, sustainable and unique building design that is originated through the abstraction of historic customs and use of native materials such as coral, wood elements, screens and trellises The building style will reflect the more sleek and simplistic massing and facades of Hawaii's commercial districts with a touch of modern and contemporary architectural detailing. This merger of timeless design with contemporary architecture culminates in the next-generation of mixed-use developments that will enhance and sustain the future of the community. Ka Makana Ali`i, literally meaning the "royal gift", will have distinctive landscaping treatments, signage and way finding elements that incorporate the abstraction of opening the *ho`okupu* throughout the project. The *ho`okupu* is an offering that is given with honor, humility and respect, in Hawaii. The Ti leaves that cover the *ho`okupu* are a symbol of strength and protection and are unwrapped to reveal the special gift within. Ka Makana Ali`i is essentially the gift opened to the community of Kapolei. The overall design honors and builds on proud traditions and the ongoing celebration of life in Hawaii. Creating pedestrian friendly paths, shaded areas, seating, diverse indoor and outdoor dining opportunities and a variety of interactive features will invite the community to experience the project, promoting healthy living and an engaging and active lifestyle.

Hawaiian history and culture will be revealed throughout the development by incorporating facets of its ancestry into the design concepts of the project. The act of opening the *ho`okupu* is expressed in a symbolic structure or element located in the central gathering plaza, becoming the heart of the Ka Makana Ali`i project.. The welcoming element located at the intersection of Kapolei Parkway and Kualaka`i Road will include *hakahaka* style stonewalls referencing the distant mountain peaks and emphasizing their importance to life oh Oahu. The mountain peaks stretching from the northeast across to the southeast point of Diamond Head provide a natural landmark that imposes beauty and historic reference to the site of Ka Makana Ali`i. The project also incorporates attributes of the Ewa Plain, a fertile land between the mid-1800's to the early 1970's, and provides the inspiration for rich color and texture incorporated into the project

[6] PBR Hawaii. *University of Hawaii West Oahu Final Environmental Impact Statement* (2007), page 12. The issue was raised by the Office of Environmental Quality Control, and preliminary discussions with City authorities indicate that a Planned Review Use permit would be needed for lodgings on the UH West O`ahu site.

design. Combining these key ancestral landmark features into the site is paramount to this project's connection to the local people, place, history and culture.

Radiating from the symbolic elements of *ho`okupu* will be corridors of mixed uses framing views of the development and beyond. The spaces created between the architecture sets a stage for public interaction. Cultural events and performances will attract members of the surrounding communities, providing layers of content and establishing a sense of authenticity where the community can gather and celebrate life. These events may include: concerts, cultural/seasonal events, outdoor dances, recreational activities, and public art.

The neighborhood serving uses are easily accessed and organized along the perimeter of Ka Makana Ali`i, providing the much valued retail spaces serving the community's everyday needs. The neighborhood retail seamlessly connects into the commercial mix of uses by the creation of vehicular and pedestrian paths, incorporating the same architectural language by use of similar materials, patterns and color, providing cohesion of the overall project design. Simplistic, yet pleasing visual forms will frame the areas for community gathering.

The office and hotel buildings connect neighborhood uses by anchoring the edges of the project core, respectively. The placement of these two uses provides a backdrop, focusing the energy of the main gathering plaza. The texture of the façades are abstractions derived from the traditional *hakahaka* stone walls used throughout Hawaii, native basketry, authentic Kapa prints, Kou wood and the *ho`okupu*, which is evident in the woven colors and textures of the facades. The building materials and patterns at the base of the buildings relate to the earth, while the glass and woven texture of the vertical elements provide the transparency that allows the building to give way to the natural light. At ground level, specialty restaurants and retail spaces will intrigue both residents and visitors to experience the buildings.

The Ka Makana Ali`i project will serve as the catalyst for the future growth of the area and serving the students, staff and faculty of the planned University of Hawaii's West Oahu Campus. As Ala Moana and Pearl Ridge serve as hubs of retail and amenities for Honolulu and Leeward Oahu, Ka Makana Ali`i will revitalize the area and generate future development of the Ewa Plain and West Oahu communities. Our vision is that of a lively regional center, providing community with retail, office, and entertainment venues that will become the crowning achievement for Kapolei. Ka Makana Ali`i is designed as an open-air development with welcoming architecture that creates neighborhoods of mixed uses, typical of traditional main-street and pedestrian friendly towns, where consumers can gather in safe public spaces as well as be a part of a community.

Ultimately the architectural design provides the framework that creates a renewed sense of place for celebration and gathering in West Oahu, which the community will embrace through pride of ownership.

2.5 LANDSCAPE DESIGN

The landscape design for the site is divided into three main environments. The first aspect relates to the neighborhood serving retail, incorporating indigenous green landscaping green spaces and the use of water features will be minimal but present providing a pleasing and inviting environment to shop, linger and enjoy cultural and seasonal gatherings. The second element is the commercial mix of uses, which the verdant landscape will articulate key areas of

entry, easily accessible for vehicular and foot traffic. The third component is the Main Boulevard and entrance points which will incorporate thriving palms and canopy trees integral to enhancing the quality of life, the community and celebrating the serene Hawaiian landscape. Designating the mix of uses, a different species of native tree will be incorporated in the landscaping delineating the districts. The perimeter landscape will incorporate aspects of all the landscapes into a unified design.

2.6 SMART GROWTH

Ka Makana Ali`i incorporates several key "Smart Growth" components into the community development:

- Public, private sectors collaborate on growth and development issues to achieve mutually beneficial outcomes;
- Land use is comprehensive, integrated and regional;
- The project promotes revitalization to the region;
- Infrastructure is maintained and/or enhanced to serve existing and new residents;
- Neighborhoods are integral components of a healthy regional economy;
- Compact suburban development is integrated into existing commercial areas, new town centers, and/or near existing or planned transportation facilities;
- The project delivers a better, safer and healthier quality of life to the region;
- The project draws the support of diverse interest groups;
- Increases and maintains jobs and housing in balance;
- Protects and increases home values.

2.7 RELATIONSHIP AMONG LAND USES

The proposed project, as shown conceptually on Figure 5, incorporates three main elements: two Anchor tenants situated on the eastern side of the project area; a Village Mixed Use Center situated in the center and northern portion of the project area, which will be anchored by office and hotel buildings; and a Neighborhood Commercial Center that borders the Village Mixed Use Center on the west. The number and layout of the building footprints depicted in Figure 5 may be modified during tenant leasing. The site layout is presented for illustrative purposes only.

Located in the core of the Ka Makana Ali`i Mixed-Use Village, the central design feature represents a Ho‘okupu. Radiating from this point will be corridors of mixed uses framing views of the development and beyond. The spaces created between the Village architecture sets a stage for public interaction. Cultural events and performances will attract members of the surrounding communities, providing layers of content and establishing a sense of authenticity where the community can gather and celebrate life. These events may include concerts, cultural and seasonal events, outdoor dances, recreational activities, and public art.

The Neighborhood Village is easily accessed and organized along the perimeter of the Mixed-Use Village. The former provides retail spaces serving the community's everyday needs. The Neighborhood Village seamlessly connects into the Mixed-Use Village by vehicular and pedestrian paths, incorporating the same architectural language by use of similar materials, patterns and color, providing cohesion of the overall project design

KA MAKANA ALI'I
Kapolei, Oahu
FIGURE 5 - CONCEPTUAL SITE PLAN
ROOSEVELT AVE.
KAPOLEI PARKWAY
KUALAKA'I PKWY.
KEKAHILI STREET
KINOIKI STREET
PROPOSED KUALAKA'I PKWY. EXTENSION
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
R
S
T
U
V
W
X
Y
Z

The office and hotel buildings function as cornerstones of the Mixed-Use Village by providing an ever present population that creates vitality for the development. Figure 6 presents an oblique view of the project's conceptual plan with the office building situated at the center and the hotel building to its left. At ground level, specialty restaurants and retail spaces will invite both residents and visitors to experience the buildings.

Ultimately the architectural design provides the framework that creates a renewed sense of place for celebration and gathering in West O`ahu, which the community will embrace through pride of ownership.

The Ka Makana Ali`i development represents a unique opportunity to utilize a severely distressed and underutilized urban property to create a community gathering place within the suburban grid that appeals to the residents of Kapolei, West O`ahu, and O`ahu's visitors alike. The essence of the project is to create an environment that is authentic and aware of its physical surroundings and visual assets. The project is well positioned to offer the surrounding community a vibrant district that works in concert with existing elements. Ka Makana Ali`i has the vital components necessary to become a landmark that will endure as an asset to the Kapolei community.

2.8 PROJECT CONSTRUCTION AND PHASING

The project is proposed in two phases. (See Figures 7 and 8) With groundbreaking on the project expected in July 2012, the opening of Phase 1 is planned for 2014. Phase 2 would follow in 2015.

Phase 1 consists of approximately 19.72 acres located along the western portion of the project site. It will include a total of 200,681 sf of building area enclosed in 7 different building structures. Phase 1 is projected to take approximately 15 months from start of site work to opening of the Center for business.

The site will be graded to best balance the on-site cut and fill. The proposed building footprints are largely set at a single elevation, with grade variation occurring between units. Building pad elevations are expected to vary to accommodate the change in grade across the property.

The initial site work will involve clearing the Phase 1 property of all surface vegetation and stockpiling the topsoil for future use in landscaping. The three large existing stockpiles contain suitable soils that will be compacted to fill approximately one third of the existing open excavation onsite today (the old stadium footprint and the borrow pit). No additional importation of fill will be required during Phase 1.

The offsite scope of work for Phase 1 consists of the completion of the current three-way signalized intersection on Kapolei Parkway to a full, four-way signalized intersection along with a right-in, right-out connection west of the signalized intersection near the site boundary. In addition, there will be a non-signalized service road in the southwest corner of the project intersecting Roosevelt Avenue. The offsite work should take approximately 6 months to complete.

The buildings will be constructed using several different structural systems from concrete tilt wall and steel to ICF foam filled masonry to wood construction. The buildings will take approximately 9-10 months to complete in their entirety.

FIGURE 6 - OBLIQUE PROPERTY VIEW

KA MAKANA ALI'I
Kapolei, Oahu
FIGURE 7 - PHASE 1
PH-1
06.22.11
ROOSEVELT AVE
PHASE 1
PHASE 2
KAPOLEI PARKWAY
KUALAKA'I PKWY
KEKAHILI STREET
KINOIKI STREET
D
V
W
T
E
J

KA MAKANA ALI`I
Kapolei, Oahu
PH-2
FIGURE 8 - PHASE 2
ROOSEVELT AVE.
KAPOLEI PARKWAY
KUALAKA'I PKWY.
PROPOSED KUALAKA'I PKWY. EXTENSION
KEKAHILI STREET
KINOIKI STREET
PHASE 1
PHASE 2
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
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Y
Z

Phase 2 site work is anticipated to commence prior to the completion and opening of Phase 1. Phase 2 consists of approximately 47.5 acres with a total of 1,145,221sf of building area enclosed in 15 different building structures. The total projected construction duration of Phase 2 is 31 months.

Site work for Phase 2 will consist of completion of the filling of the old stadium foundation and the borrow pit by using approximately 220,000cy of suitable fill in conjunction with the excavation of the subterranean parking structure. The structure will take approximately 10 months to complete and will accommodate over 1,800 parking spaces when finished.

The offsite scope of work for Phase 2 consists of extending Kualaka`i Parkway to the project entrance on the east property line as well as traffic signal readjustments at the Kapolei Parkway intersection. A second access to Roosevelt Avenue will be added at about the center point on the southern side of the subject property.

The buildings will be constructed using several different structural systems from concrete tilt wall and steel to structural frame with metal stud construction. The buildings will take approximately 24 months to complete in their entirety. The Hotel structure may be completed slightly later than the rest of the Center.

2.9 PARKING AND LOADING REQUIREMENTS

Approximately 4,135 parking stalls are proposed for the project, with about 2,580 located at grade and the remaining 1,831 located in a subterranean parking structure. Limited on-street parking will be provided along the project's internal driveway system, with the majority of at-grade stalls being distributed among numerous parking lots. Table 1 provides the off-street parking and loading requirements for the project according to the Honolulu Land Use Ordinance (LUO) Article 6, Table 21.6.1.

Table 1: Off-Street Parking and Loading Requirements

Type of Use	Zoning Requirements	Unit of Measure	Spaces per Unit of Measure	Spaces Required by LUO
Hotel (BMX4)	1 space per 4 units	300	0.2500	75
Commercial Retail/Eating & Drinking	1 space per 400 SF	826,184	0.0025	2,065
Office	1 space per 400 SF	219,400	0.0025	549
Convenience/Grocery Stores	1 space per 300 SF	60,388	0.0033	199
Recreation/Fitness	1 space per 200 SF + 3 per court	48,547	0.0050	246
Theaters/Cinema	1 space per 75 SF of assembly	35,859	0.0133	478
TOTAL REQUIRED				3,612
TOTAL PROPOSED				4,415
LOADING SPACES REQUIRED & PROPOSED				75

2.10 MASTER SIGNAGE CONCEPT

The Ka Makana Ali`i project's master signage concept will maintain the character of the overall architectural concept while providing appropriate and consistent signage. The Ka Makana Ali`i development will implement signage complying with Chapter 21 of the Land Use Ordinance, which defines the appropriate scale, character, and placement of signage. Tenant signage proposals should comply with Chapter 21 of the Land Use Ordinance and will need to be approved by DeBartolo Development Group prior to on-site use.

2.11 MASTER LIGHTING CONCEPT

Ka Makana Ali`i master lighting concept will provide cohesive, sustainable lighting that contributes to the definition of the architecture and of the overall site design. Light levels are to be arranged on site by the use of consistent fixture design, which will be developed for directional and non-directional lighting. The fixtures will be utilized through the project and will provide rhythmic patterns through the manipulation of a single element; from wall sconces to street lighting, as well as midlevel pedestrian lighting. The strategic placement and lighting design will provide the community of Kapolei with a safe and vibrant gathering place in the evening. All lighting design will conform to Chapter 21 of the Land Use Ordinance while providing the highest level of definition to the overall site design.

2.12 GENERAL HOURS OF OPERATION

It is anticipated that the retail/commercial uses will generally operate from 10 AM to 9 PM Monday – Saturday and 10 AM to 6 PM Sundays. Coffee shops will likely open earlier and restaurants may close later. Offices will generally maintain normal business hours (weekdays, 8 AM to 6 PM). The hotels will be open 24 hours, seven days a week. General hours of operation may be extended at retail businesses during holidays in accordance with standard industry practice.

2.13 TRANSPORATION ELEMENTS

The design philosophy of the project's transportation elements is intended to minimize the visual impact of an extensive parking lot that surrounds and isolates the retail experience. This is accomplished through two important elements. The first is to encourage the use of mass transit to the site by incorporating a future connection to the proposed transit station. The second is to reduce the emphasis on motor vehicles as a visual element of this mixed-use development by placing the majority of the parking underground, which creates more green space and public plazas. This project's intent is to emphasize the pedestrian nature of the Village. Ka Makana Ali`i's future light-rail connection will deliver passengers to this mixed-use development, encouraging alternative forms of transportation. In addition to these transportation measures, Ka Makana Ali`i will become a significant new employment area, which will allow Kapolei residents to be employed in the Kapolei region rather than having to commute to downtown Honolulu.

2.14 VEHICULAR AND PEDESTRIAN CIRCULATION

A Traffic Report conducted in December 2008 (see Appendix A) and updated in June 2011 (see Appendix B) examined existing traffic conditions in the area, and identified future conditions after development of the project. The results of the study are summarized in this section.

2.14.1 Existing Roadway Network

Figure 9 summarizes the existing roadway network. Kapolei Parkway is a six-lane, divided major arterial roadway. Ultimately it will provide significant east-west mobility between Kapolei and Ewa. Until 2010, Kapolei Parkway was discontinuous between Kapolei and Ewa. With the opening of Kualaka`i Parkway, Kapolei Parkway is now continuous between Fort Barrette Road and Papipi Road. The posted speed limit on Kapolei Parkway is 30 miles per hour.

Kualaka`i Parkway (formerly North-South Road) is a four-lane, divided major arterial roadway. While currently striped for four lanes, it will ultimately be six lanes. Kualaka`i Parkway connects Kapolei Parkway with H-1 Freeway at a diamond interchange. Its intersection with Farrington Highway is a major signalized intersection. Kualaka`i Parkway forms a signalized, tee-intersection at Kapolei Parkway. The speed limit on Kualaka`i Parkway is 35 miles per hour.

Roosevelt Avenue is a collector roadway providing east-west circulation within Kalaeloa (former Barbers Point Naval Air Station. With Geiger Road, it provides a link between the Ewa Beach area and the City of Kapolei. (Until Kapolei Parkway was completed in 2010, the Roosevelt/Geiger route was the only direct link.) Roosevelt Avenue is a rural, two-lane undivided roadway with exclusive left-turn lanes at some intersections. The posted speed limit on Roosevelt Avenue is 35 miles per hour in the project vicinity. TheBus Route 41 serving Ewa Beach and East Kapolei uses Roosevelt Avenue.

Kamaaha Avenue is a four-lane, divided neighborhood collector roadway that provides access to the Villages of Kapolei development along with Kapolei Middle School. The speed limit on Kamaaha Avenue is 25 miles per hour.

Kinoiki Street is a collector roadway providing access to the East Kapolei I. While currently terminating within East Kapolei I, Kinoiki Street will eventually continue north, connecting with the future east-west collector road. The speed limit on Kinoiki Street is 25 miles per hour.

Renton Road is a four-lane, divided collector roadway providing east-west circulation and access within Ewa. Its western terminus is at a stop-controlled intersection with Roosevelt Avenue. It crosses both Kapolei Parkway and Fort Weaver Road, terminating just beyond Fort Weaver Road. The speed limit on Renton Road is 25 miles per hour.

2.14.2 Traffic Volumes

Manual traffic counts were conducted on Tuesday, March 30, 2010 during the AM and PM peak periods at the following intersections:

- Kapolei Parkway/Kamaaha Avenue
- Kapolei Parkway/Kinoiki Street
- Kapolei Parkway/Kualaka`i Parkway
- Kapolei Parkway/Renton Road

The traffic volumes were then summarized into AM and PM peak hour volumes shown in Figure

5 of the Traffic Study in Appendix A. The AM and PM peak hours were chosen to determine the effect of the regional mixed use center on the periods of maximum congestion on two major `Ewa arterials. The study AM and PM peak hours were 7:00-8:00 AM and 3:30-4:30 PM, respectively.

Appendix A of the Traffic Study contains the traffic count data sheets.

2.14.3 Future Circulation with Proposed Project

The Traffic Evaluation in Appendix B projects that traffic generated by the proposed project can be accommodated by the adjacent roadway network. Some delays that occur along Kapolei Parkway may increase, but the intersections are projected to operate at an acceptable level during the AM and PM commuter peak hours. Recommendations for minimizing traffic delays are provided in Appendix B.

It is concluded that while delays experienced along Kapolei Parkway are expected to increase, the intersections are still projected to operate at an acceptable level during the AM and PM commuter peak hours. The Ka Makana Ali`i Regional Mixed Use Center's traffic can be accommodated by the adjacent roadway network.

2.14.4 2013 Phase 1 Conditions

The 2013 "With Project" scenario represents the future conditions within the project area with Phase 1 of the Ka Makana Ali`i Mixed Use Center development, shown in Figure 9 in Appendix B. As shown, Ka Makana Ali`i would have a main access to Kapolei Parkway and a secondary access to Roosevelt Avenue. An additional right-in/right-out access is also planned on Kapolei Parkway at the northwestern corner of the property that would be used primarily as a service access but would also provide an additional driveway to alleviate pressure on other accesses. The same roadway assumptions were made for this scenario. Kualaka`i Parkway is assumed to form a tee-intersection with Kapolei Parkway.

Project-Related Traffic Volumes

Future traffic generated by the Ka Makana Ali`i regional mixed use center was estimated using the three step method of trip generation, trip distribution, and trip assignment.

Trip Generation: Phase 1 of Ka Makana Ali`i consists of a regional mixed use center land use. Trip generation estimates the number of vehicular trips in and out of the project based on the land use type and density. Trips were estimated using trip generation equations published by the Institute of Transportation Engineers in Trip Generation, Eighth Edition. Table 4 in Appendix B shows the trips generated. Pass-by traffic was assumed to be 20% during the PM while transit share was assumed to be 7%.

Trip Assignment: The project distribution was calculated according to the Oahu Metropolitan Planning Organization model. The project-generated traffic volumes were assigned to the future network based using this trip distribution. The project-generated trips are shown in Figure 8 in Appendix B. The projected 2013 traffic volumes with Phase 1 are shown in Figure 9 in Appendix B.

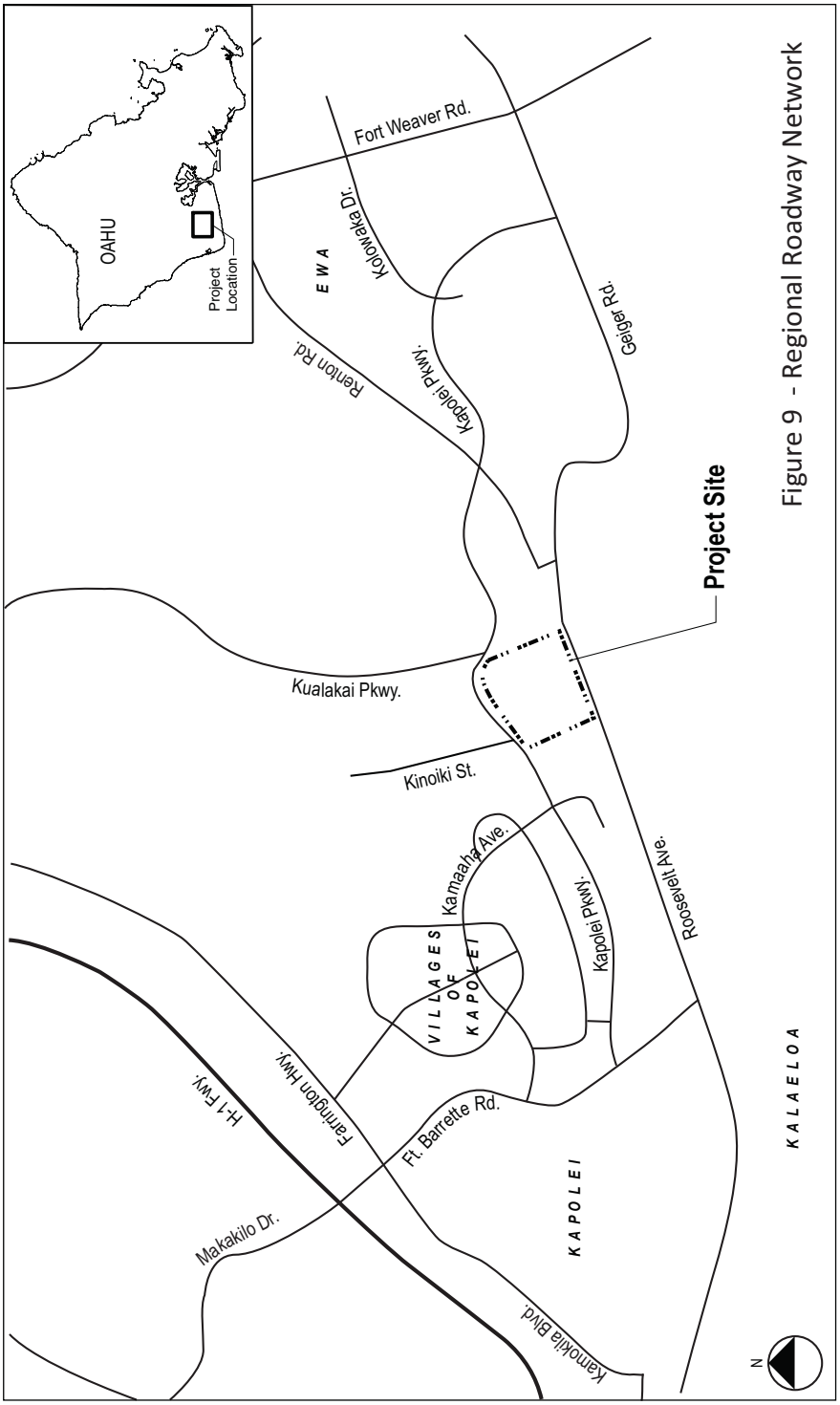

Figure 9 - Regional Roadway Network

KA MAKANA ALI`I Kapolei, Oahu

Projected 2013 Operations With Project

The projected 2013 intersection level of service with Phase 1 of the Ka Makana Ali`i regional mixed use center are shown in Table 4 of the traffic study.

- Kapolei Parkway/Kamaaha Avenue: The intersection of Kapolei Parkway and Kamaaha Avenue is projected to operate at LOS C during the AM peak. All movements operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS C overall as well. All individual movements are projected to operate at LOS C or better
- Kapolei Parkway/Kinoiki Street: The existing intersection of Kapolei Parkway and Kinoiki Street is an unsignalized tee-intersection. Phase 1 of Ka Makana Ali`i is projected to access Kapolei Parkway at Kinoiki Street, forming a signalized cross intersection. The movements in and out of the regional mixed use center are heavy movements. Double left turns into and out of the regional mixed use center are recommended. The intersection is projected to operate at LOS C during both the AM and PM peak hours. During the AM peak hour, all movements are expected to operate at LOS D or better. During the PM peak hour, all movements are projected to operate at LOS C or better.
- Kapolei Parkway/Kualaka`i Parkway: The intersection of Kapolei Parkway and Kualaka`i Parkway is projected to operate at LOS B during both peak hours. All individual movements are projected to operate at LOS C during both the AM and PM peak hours.
- Kapolei Parkway/Renton Road: The intersection of Kapolei Parkway and Renton Road is projected to operate at LOS C during the AM peak hour. Left turn movements are projected to operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS B overall with all movements operating at LOS D.
- Roosevelt Avenue/West Entrance: The west Ka Makana Ali`i access is projected to be stop-controlled with a refuge lane on Roosevelt Avenue. The southbound left turn out is projected to operate at LOS C during the AM peak hour and at LOS E during the PM peak hour.

Transit

The Honolulu High-Capacity Transit Corridor Project (HHCTCP) has started its first phase of construction connecting East Kapolei to Pearl Highlands via Waipahu. The Phase 1 segment is expected to be operational in 2013. The western terminus of the first phase of the transit alignment is located at East Kapolei Station near the Kroc Center. The existing bus services will be rerouted to serve East Kapolei Station and Ka Makana Ali`i.

Summary of 2013 Operations With Phase 1

Overall, the Ka Makana Ali`i regional mixed use center has the greatest impact on the Kapolei Parkway/Kinoiki Street intersection. This is understandable because the intersection would be improved from a tee intersection to a four-legged intersection, one approach of which would be the Center's primary access. The Center also increases the delay at the Kapolei Parkway/North-South Road intersection but the LOS is unchanged. All other study area intersections are projected to operate acceptably.

2.14.5 2015 Phase 2 Conditions

The 2015 "With Project" scenario represents the future conditions within the project area with Phase 2 of the Ka Makana Ali`i development, shown in Figure 12 in Appendix B. As shown, a fourth leg would be constructed at the intersection of Kapolei Parkway and Kualaka`i Parkway that would access the site. This would be Ka Makana Ali`i's new main access, deemphasizing the access at Kinoiki Street. This new leg would terminate at Center's driveway. The access to Roosevelt Avenue from Phase 1 would remain but would be deemphasized in favor of an additional eastern Roosevelt Avenue access constructed during Phase 2.

Additional right-in/right-out service accesses are also planned to be added in Phase 2. One is planned to be located on Kapolei Parkway midway between Kinoiki Street and Kualaka`i Parkway. The other is planned to be located on Kualaka`i Parkway just south of Kapolei Parkway. While the additional accesses are primarily intended to be service accesses, they would also provide an additional driveway to alleviate pressure on other accesses.

Project-Related Traffic Volumes

Future traffic generated by the Ka Makana Ali`i regional mixed use center was estimated as described below.

Trip Generation: Ka Makana Ali`i consists of four uses that can be classified as shopping center, office building, hotel, and cinema. Trip generation estimates the number of vehicular trips in and out of the project based on the land use type and density. Trips were estimated using trip generation equations published by the Institute of Transportation Engineers in Trip Generation, Eighth Edition. Table 7 in Appendix B shows the planned project land use and corresponding trips generated. Pass-by traffic was assumed to be 20% during the PM while transit share was assumed to be 7%.

Trip Assignment: The regional mixed use center distribution was calculated according to the Oahu Metropolitan Planning Organization model. The project-generated traffic volumes were assigned to the future network based using this trip distribution. The project-generated trips are shown in Figure 11 in Appendix B. The projected 2015 traffic volumes with Phase 2 are shown in Figure 12 in Appendix B.

Projected 2015 Operations With Phase 2

The projected 2015 intersection level of service with Phase 2 of the Ka Makana Ali`i regional mixed use center are shown in Table 7 in Appendix B.

- Kapolei Parkway/Kamaaha Avenue: The intersection of Kapolei Parkway and Kamaaha Avenue is projected to operate at LOS D overall during the AM peak. All movements operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS C overall. All individual movements are projected to operate at LOS D or better.
- Kapolei Parkway/Kinoiki Street: With the opening of the new access to Kualaka`i Parkway as part of Phase 2, the Kinoiki Street access will be deemphasized. The intersection is projected to operate at LOS C during both the AM and PM peak hours. During the AM peak hour, all movements are expected to operate at LOS C or better. During the PM peak hour, all movements are projected to operate at LOS C or better with the exception of the eastbound Kapolei Parkway left.

- Kapolei Parkway/Kualaka`i Parkway: The intersection of Kapolei Parkway and Kualaka`i Parkway is projected to operate at LOS C during the AM peak hour. All movements are projected to operate at LOS C or better. During the PM peak hour, the intersection is projected to operate at LOS D overall. The northbound left from the regional mixed use center is projected to operate at LOS E but all other movements are projected to operate at LOS D or better.
- Kapolei Parkway/Renton Road: The intersection of Kapolei Parkway and Renton Road is projected to operate at LOS C during the AM peak hour. All movements are projected to operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS B overall with all movements operating at LOS C or better with the exception of the westbound Kapolei Parkway left which is projected to operate at LOS D.
- Roosevelt Avenue/West Entrance: The west Ka Makana Ali`i access is projected to be stop-controlled with a refuge lane on Roosevelt Avenue. The southbound left turn out is projected to operate at LOS C during the AM peak hour and at LOS D during the PM peak hour.
- Roosevelt Avenue/East Entrance: The east Ka Makana Ali`i access is projected to be signalized tee-intersection with Roosevelt Avenue. The intersection is projected to operate at LOS B for the AM and PM peak hours, with all movements operating at LOS C or better.

Transit

By Year 2015, HHCTCP will further extend the alignment to Aloha Stadium. The transit ridership will increase significantly from 2013. The bus routes serving Ka Makana Ali`i include Route 41 connecting Ewa Beach, UH West O`ahu, and Kapolei City; Route 411 connecting Makakilo, Kapolei City, and East Kapolei; Route 416 connecting Kapolei City and East Kapolei; Route 418 connecting Kapolei City, Kalaeloa, and East Kapolei; Route 421 connecting West Loch, Hoopili, UH West O`ahu, and East Kapolei; Route 422 connecting Hoopili and East Kapolei,

Summary of 2015 Operations With Phase 2

With the extension of Kualaka`i Parkway beyond Kapolei Parkway, the Kinoiki Street intersection is expected to process less project-related traffic. Ka Makana Ali`i would have the greatest impact on the Kapolei Parkway/Kualaka`i Parkway intersection. All other study area intersections are projected to operate acceptably.

Based on the operational analyses of intersections, the following are recommended for implementation in conjunction with the proposed regional mixed use center.

Phase 1 Recommendations

- Signalize the north Ka Makana Ali`i access to Kapolei Parkway at the intersection with Kinoiki Street.
- Configure the intersection of Kapolei Parkway and Kinoiki Street as follows:
    - Eastbound Kapolei Parkway approach as a left turn lane, 3 through lanes, and a right turn lane;
    - Westbound Kapolei Parkway approach as 2 left turn lanes, 3 through lanes, and a right turn lane;
    - Northbound Ka Makana Ali`i driveway approach as 2 left turn lanes, a through

lane, and a right turn lane;
  - Southbound Kinoiki Street approach as a left turn lane, a through lane, and a right turn lane.
- Configure the west entrance intersection along Roosevelt Avenue as stop-controlled at the driveway approach. An eastbound left turn and a westbound right turn lane from Roosevelt Avenue into the regional mixed use center are desirable. A refuge lane for southbound left turns exiting the regional mixed use center is also desirable.
- Provide a right-in/right-out driveway at the western edge of the property along Kapolei Parkway.

Phase 2 Recommendations

- Configure the intersection of Kapolei Parkway and Kualaka`i Parkway as follows:
  - Eastbound Kapolei Parkway approach as 2 left turn lanes, 2 through lanes, and a shared through/right turn lane;
  - Westbound Kapolei Parkway approach as 2 left turn lanes, 3 through lanes, and 2 right turn lanes;
  - Northbound Kualaka`i Parkway approach as a left turn lane, a through lane, and a shared through/right turn lane;
  - Southbound Kualaka`i Parkway approach as 2 left turn lanes, 2 through lanes, and 2 right turn lanes.
- Install a traffic signal at the east entrance intersection along Roosevelt Avenue. An eastbound left turn lane into the regional mixed use center and right turn lane from Roosevelt Avenue into the regional mixed use center are desirable.
- Coordinate with TheBus to provide frequent regional and sub-regional bus services connecting major activity centers in the area such as Kapolei City, Makakilo, Waipahu, UH West O`ahu, and Ewa as well as with the transit stations in Waipahu and Kapolei.
- Provide right-in/right-out driveways on Kualaka`i Parkway south of Kapolei Parkway and on Kapolei Parkway between Kinoiki Street and Kualaka`i Parkway. These driveways will alleviate some of the traffic load at the main accesses.

2.14.6 Roadway Infrastructure Planned or Under Construction by Others

At some point in the future, construction of Kualaka`i Parkway from Kapolei Parkway to Roosevelt Avenue will be undertaken. At this point in time, who will construct it, when it will be constructed, and what its ultimate design will be remain unresolved.

2.14.7 Vehicular Access

Vehicular access to Phase 1 of the proposed project site would be via two main entry points: from Kapolei Parkway at Kinoiki Street, which will have dedicated turn lanes into the site from Kapolei Parkway, and from Roosevelt Avenue (see Figure 5). The Traffic Report prepared for the proposed project indicates that the extension of Kualaka`i Parkway is not necessary for the development of Phase 1.

The eventual construction of the Kualaka`i extension will provide additional vehicular access to the subject property. The Master Plan anticipates the Kualaka`i project entrance to be located about midway along the subject property's eastern property boundary. Any future extension of Kualaka`i Parkway from the eastern property entrance to Roosevelt Avenue will require decision-making by DHHL and the City and County of Honolulu, the two affected property

owners, as well as DOT. DeBartolo Hawaii LLC will contribute its fair share to the eventual extension of the roadway so long as it receives credit for its contribution pursuant to the `Ewa Impact Fee ordinance.

The below-grade parking may be accessed from any of the three main entrances. The design philosophy of the project's transportation elements is intended to minimize the visual impact of an extensive parking lot that surrounds the retail experience.

The internal vehicular circulation system within the subject property is essentially a network of driveways. They will be paved, with curbs, gutters and landscaped medians, and will remain privately owned.

The main driveway width is 60-feet wide, has 4 lanes with a median, is normal crowned, and gently slopes to provide positive drainage to the piped on-site drainage system. The other smaller driveways are 24 to 36-feet wide, with two or three 12-foot lanes. Limited on-street parking will be permitted in some areas. All driveways providing access to the site will be designed to handle the turning movement for large delivery trucks, up to 55-feet in length, and access the loading docks to specific buildings. All driveways and access aisles throughout the parking lot are designed to provide emergency vehicle access in accordance with Honolulu Fire Department requirements. Low vehicular speeds are anticipated; a design speed was not chosen.

2.14.8 Pedestrian Access

Ka Makana Ali`i is designed as an open-air development with welcoming architecture that creates neighborhoods of mixed uses typical of traditional main-street and pedestrian friendly towns. The site design reduces the emphasis on motor vehicles as a visual element of a regional mixed use center by placing almost half of the parking underground, which creates more green space and open space areas. The mixed-use center becomes the main attraction and its green open space character emphasizes the walk-ability of the site. Figure 8 presents the pedestrian circulation plan for the conceptual plan.

2.14.9 Bikeways

As shown on Figure 5, site development will include incorporation of bikeways from the surrounding area to and through the site.

2.14.10 Oahu Railway and Transportation (OR&L) Base Yard and Railway

A 50-foot easement, containing the OR&L railroad tracks, abuts the southern boundary of the subject property. The OR&L easement has been preserved in commemoration of the rich legacy of the O`ahu's historic sugar cane industry. The railroad operated as the principal means of delivering harvested cane from the sugar cane fields to the mills. It served the leeward coast of O`ahu, as well as Central O`ahu and the North Shore. The Hawaiian Railway Society, a private non-profit organization, also occupies and operates a base yard abutting the southeast corner of the subject property. It has restored engines and railway cars that are operated as a visitor attraction, transporting passengers from the base yard to Nanakuli and back.

Implementation of the Proposed Action will require driveways accessing Roosevelt Avenue to cross the OR&L tracks. DeBartolo acknowledges the Society's concerns about potential interference with base yard operations and is committed to working with the Society to find design solutions that are complimentary and supportive continued railway operations. As a point

of fact, the presence of the railway base yard is recognized as an attractive asset to the Proposed Action.

The OR&L easement also contains subterranean fuel pipelines that carry refined oil products from refineries at Campbell Industrial Park to Honolulu International Airport and Honolulu Harbor.

2.14.11 Transit

The design philosophy of the project's transportation elements is intended to minimize the visual impact of an extensive parking lot that surrounds the retail experience. This philosophy is implemented through two important elements. The first is to encourage the use of mass transit to the site by incorporating a future connection to the proposed transit station. The second is to reduce the emphasis on motor vehicles as a visual element of this mixed-use development by placing the majority of the parking underground, which creates more green space and public plazas. The project's intent is to emphasize the pedestrian nature of the Villages. Ka Makana Ali`i's future rail connection will deliver passengers to this mixed-use development, encouraging alternative forms of transportation. In addition to these transportation measures, Ka Makana Ali`i will become a significant new employment area, which will allow Kapolei residents to be employed in the Kapolei region rather than having to commute to downtown Honolulu.

2.15 LANDSCAPING CONCEPT

The landscape design for the site is divided into four main environments. The first aspect relates to the Mixed-Use Village, incorporating indigenous green landscaping and green spaces, providing a pleasing and inviting environment to shop, linger and enjoy cultural and seasonal gatherings. The second element is the Neighborhood Village where the verdant landscape will articulate key areas of entry, easily accessible for vehicular and foot traffic. The third component is the Main Boulevard located between the Mixed-Use Village and the Neighborhood Village, which will be lined with thriving palms welcoming the community and celebrating the Hawaiian landscape. Designating the village uses, a different species of native tree will be incorporated in the landscaping delineating the districts. The fourth and final facet will be the perimeter landscape, which will incorporate aspects of all the landscapes into a unified design.

2.16 ENERGY CONSERVATION

2.16.1 Design

For Ka Makana Ali‘i, the developer envisions an extraordinary place that the people of Kapolei will value, and that represents the future of sustainable environments within West Oahu. The project will allow the community to engage and experience a strong local initiative to Recycle, Reuse and Reduce. Because sustainable design aggressively curtails the use of harmful materials, and makes a highly beneficial difference in the consumption of finite diminishing resources, it also makes a very beneficial difference to communities and their residents.

The design team has utilized advanced best management practices (BMP) for green building to incorporate sustainable principals from conceptual design through the end of construction. These BMP's address aspects of site, water efficiency and reuse, energy consumption,

daylighting, recycling and construction waste management, materials (local, recycled), fixtures, indoor environmental quality, low-emitting materials, and natural resources.

The Ka Makana Ali‘i will seek to minimize its impact on the environment through the appropriate selection of energy efficient systems, and considering sustainable material choices to achieve an environmentally responsible design that strikes a balance between known established practices and emerging sustainable best management practices.

2.16.2 Lighting

The use of daylight harvesting and automatic dimming where natural light is available will reduce the need for artificial lighting. Ka Makana Ali‘i will utilize high efficiency lighting systems, occupancy sensors and dual light levels will be provided to further reduce energy needs for lighting (where applicable). Energy efficient indoor and outdoor LED lighting systems will be provided where applicable.

2.16.3 Air Conditioning

The indoor public and retail spaces will be provided with a displacement ventilation system, utilizing low velocity supply. This system offers significant energy savings by providing greater opportunity for free cooling, and by conditioning only the occupied zone at low level. Prevailing wind, ocean breeze and strategically placed shade trees and awnings will provide passive cooling throughout the project. Underground parking and the use of high performance cool roofing systems will help to reduce the heat island effect.

3 RELATIONSHIP TO PLANS AND POLICIES

3.1 HAWAI‘I STATE PLAN

In 1978, the Department of Business, Economic Development and Tourism (DBEDT) (formerly known as the Department of Planning and Economic Development) completed a Hawai‘i State Plan to: (1) improve the planning process; (2) increase the effectiveness of government and private actions; (3) improve coordination among agencies and levels of government; (4) provide for the wise use of Hawai‘i’s resources; and (5) guide the future development of the State. (State of Hawai‘i, Department of Planning and Economic Development, 1978, Revised 1989, 1991.)

The Legislature adopted the Hawai‘i State Planning Act (Planning Act), as HRS Chapter 226 in 1978. The Planning Act consists of a series of broad goals, objectives, and policies that serve as guidelines for future long-term growth and development. It further (1) provides a basis for determining priorities and allocating limited resources; (2) seeks to improve coordination of Federal, State, and County plans, policies, programs, projects, and regulatory activities; and (3) establishes a system for plan formulation and program coordination to provide for an integration of all major State and County activities.

The Planning Act is divided into three sections: (1) *Overall Theme, Goals, Objectives and Policies*; (2) *Planning Coordination and Implementation*; and (3) *Priority Guidelines:*

Part I of the Planning Act consists of three overall themes: (1) individual and family self-sufficiency; (2) social and economic mobility; and (3) community or social well-being. These

themes are considered "basic functions of society" and goals toward which government must strive (HRS Section 226-3).

Part II of the Planning Act primarily addresses internal government policies to help streamline, coordinate, and implement various plans and processes between governmental agencies. It seeks to eliminate or consolidate burdensome or duplicative governmental requirements imposed on business, where public health, safety, and welfare would not be adversely affected.

Part III of the Planning Act establishes overall priority guidelines to address areas of statewide concern (HRS Section 226-101). The overall direction and focus are on improving the quality of life for Hawai'i's present and future population through the pursuit of desirable courses of action (HRS Section 226-102).

The following Tables 2 and 3 present Parts I and III of the Planning Act and rate the project's conformance and support of the State's goals and objectives. Part II is not presented, as this section primarily pertains to internal government affairs.

Table 2: Hawai'i State Planning Act – Part I

SECTION	CHAPTER 226 - PART I OVERALL THEME, GOALS, OBJECTIVES AND POLICIES	RATING
A = ACTIVELY SUPPORTIVE C= CONFORMS I = GOAL IS INCONSISTENT WITH PROJECT'S OBJECTIVES NA = GOAL IS NOT APPLICABLE		
226-1	Findings and purpose.	
226-2	Definitions.	
226-3	Overall Theme	
226-4	State Goals. In order to guarantee, for present and future generations, those elements of choice and mobility that insure that individuals and groups may approach their desired levels of self-reliance and self-determination, it shall be the goal of the State to achieve:	
(1)	A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawai'i's present and future generations.	A
(2)	A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well being of the people.	A
(3)	Physical, social, and economic well being, for individuals and families in Hawai'i, that nourishes a sense of community responsibility, of caring, and of participation in community life.	C
COMMENTARY: **With an estimated 3,900 total operational jobs, the Ka Makana Ali`i Regional Commercial Center will become a major employment center in the `Ewa region. The broad mix of jobs proposed at the project, ranging from specialty retail to hotel and office, is consistent with the objective of supporting a diverse and growing economy. The proposed architectural design will create a contemporary pedestrian-oriented project.**		
226-5	OBJECTIVE AND POLICIES FOR POPULATION	
(a)	It shall be the objective in planning for the State's population to guide population growth to be consistent with the achievement of physical, economic, and social objectives contained in this chapter;	
(b)	To achieve the population objective, it shall be the policy of this State to:	

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(1)	Manage population growth statewide in a manner that provides increased opportunities for Hawai'i's people to pursue their physical, social, and economic aspirations while recognizing the unique needs of each county.	C
(2)	Encourage an increase in economic activities and employment opportunities on the neighbor islands consistent with community needs and desires.	NA
(3)	Promote increased opportunities for Hawai'i's people to pursue their socio-economic aspirations throughout the islands.	A
(4)	Encourage research activities and public awareness programs to foster an understanding of Hawai'i's limited capacity to accommodate population needs and to address concerns resulting from an increase in Hawai'i's population.	NA
(5)	Encourage federal actions and coordination among major governmental agencies to promote a more balanced distribution of immigrants among the states, provided that such actions do not prevent the reunion of immediate family members.	NA
(6)	Pursue an increase in federal assistance for states with a greater proportion of foreign immigrants relative to their state's population.	NA
(7)	Plan the development and availability of land and water resources in a coordinated manner so as to provide for the desired levels of growth in each geographic area.	NA
COMMENTARY: **Development of the regional commercial center is in direct response to the needs of Kapolei and greater `Ewa community. Over the past 20 years, the `Ewa Plain has seen an extraordinary increase in the number of homes in direct response to the policies of the State and the County. Although Kapolei is intended as the employment center for the rapidly growing residential communities surrounding it, the arrival of new businesses and jobs has lagged behind the residential growth, resulting in significant traffic congestion as `Ewa residents commute outside the district for work, shopping, entertainment, and recreation. Ka Makana Ali`i is intended to have a positive impact upon the community by bringing thousands of new jobs closer to home.**		
226-6	OBJECTIVES AND POLICIES FOR THE ECONOMY-IN GENERAL.	
(a)	Planning for the State's economy in general shall be directed toward achievement of the following objectives:	
(1)	Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawai'i's people.	A
(2)	A steadily growing and diversified economic base that is not overly dependent on a few industries, and includes the development and expansion of industries on the neighbor islands.	C
(b)	To achieve the general economic objectives, it shall be the policy of this State to:	
(1)	Expand Hawai'i's national and international marketing, communication, and organizational ties, to increase the State's capacity to adjust to and capitalize upon economic changes and opportunities occurring outside the State.	NA
(2)	Promote Hawai'i as an attractive market for environmentally and socially sound investment activities that benefit Hawai'i's people.	NA
(3)	Seek broader outlets for new or expanded Hawai'i business investments.	NA

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(4)	Expand existing markets and penetrate new markets for Hawai'i's products and services.	C
(5)	Assure that the basic economic needs of Hawai'i's people are maintained in the event of disruptions in overseas transportation.	A
(6)	Strive to achieve a level of construction activity responsive to, and consistent with, state growth objectives.	C
(7)	Encourage the formation of cooperatives and other favorable marketing arrangements at the local or regional level to assist Hawai'i's small-scale producers, manufacturers, and distributors.	NA
(8)	Encourage labor-intensive activities that are economically satisfying and which offer opportunities for upward mobility.	C
(9)	Foster greater cooperation and coordination between the government and private sectors in developing Hawai'i's employment and economic growth opportunities.	C
(10)	Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems.	A
(11)	Maintain acceptable working conditions and standards for Hawai'i's workers.	C
(13)	Provide equal employment opportunities for all segments of Hawai'i's population through affirmative action and nondiscrimination measures.	C
(14)	Encourage businesses that have favorable financial multiplier effects within Hawai'i's economy.	NA
(15)	Promote and protect intangible resources in Hawai'i, such as scenic beauty and the aloha spirit, which are vital to a healthy economy.	C
(16)	Increase effective communication between the educational community and the private sector to develop relevant curricula and training programs to meet future employment needs in general, and requirements of new, potential growth industries in particular.	NA
(17)	Foster a business climate in Hawai'i - including attitudes, tax and regulatory policies, and financial and technical assistance programs - that is conducive to the expansion of existing enterprises and the creation and attraction of new business and industry.	C
COMMENTARY: **Ka Makana Ali`i will provide a wide diversity of employment opportunities for the `Ewa region.**		
226-7	OBJECTIVES AND POLICIES FOR THE ECONOMY- AGRICULTURE	
(a)	Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives: Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:	
(1)	Viability of Hawai'i's sugar and pineapple industries.	NA
(2)	Growth and development of diversified agriculture throughout the State.	NA
(3)	An agriculture industry that continues to constitute a dynamic and essential component of Hawai'i's strategic, economic, and social well-being.	NA

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(b)	To achieve the agriculture objectives, it shall be the policy of this State to:	
(1)	Establish a clear direction for Hawai‘i's agriculture through stakeholder commitment and advocacy.	NA
(2)	Encourage agriculture by making best use of natural resources.	NA
(3)	Provide the governor and the legislature with information and options needed for prudent decision making for the development of agriculture.	NA
(4)	Establish strong relationships between the agricultural and visitor industries for mutual marketing benefits.	NA
(5)	Foster increased public awareness and understanding of the contributions and benefits of agriculture as a major sector of Hawai‘i's economy.	NA
(6)	Seek the enactment and retention of federal and state legislation that benefits Hawai‘i's agricultural industries.	NA
(7)	Strengthen diversified agriculture by developing an effective promotion, marketing, and distribution system between Hawai‘i's' producers and consumer markets locally, on the continental United States, and internationally.	NA
(8)	Support research and development activities that provide greater efficiency and economic productivity in agriculture.	NA
(9)	Enhance agricultural growth by providing public incentives and encouraging private initiatives.	NA
(10)	Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.	NA
(11)	Increase the attractiveness and opportunities for an agricultural education and livelihood.	NA
(12)	Expand Hawai‘i's agricultural base by promoting growth and development of flowers, tropical fruits and plants, livestock, feed grains, forestry, food crops, aquaculture, and other potential enterprises.	NA
(13)	Promote economically competitive activities that increase Hawai‘i's agricultural self-sufficiency.	NA
(14)	Promote and assist in the establishment of sound financial programs for diversified agriculture.	NA
(15)	Institute and support programs and activities to assist the entry of displaced agricultural workers into alternative agricultural or other employment.	NA
(16)	Facilitate the transition of agricultural lands in economically nonfeasible agricultural production to economically viable agricultural uses.	NA
COMMENTARY: **As the subject property was reclassified to the Urban district in 1999, it is no longer intended for agricultural development.**		
226-8	OBJECTIVE AND POLICIES FOR THE ECONOMY-VISITOR INDUSTRY.	
(a)	Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth for Hawai‘i's economy.	
(b)	To achieve the visitor industry objective, it shall be the policy of this State to:	

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(1)	Support and assist in the promotion of Hawai'i's visitor attractions and facilities.	NA
(2)	Insure that visitor industry activities are in keeping with the social, economic, and physical needs and aspirations of Hawai'i's people.	NA
(3)	Improve the quality of existing visitor destination areas.	C
(4)	Encourage cooperation and coordination between the government and private sectors in developing and maintaining well-designed, adequately serviced visitor industry and related developments which are sensitive to neighboring communities and activities.	C
(5)	Develop the industry in a manner that will continue to provide new job opportunities and steady employment for Hawai'i's people.	NA
(6)	Provide opportunities for Hawai'i's people to obtain job training and education that will allow for upward mobility within the visitor industry.	NA
(7)	Foster a recognition of the contribution of the visitor industry to Hawai'i's economy and the need to perpetuate the aloha spirit.	C
(8)	Foster an understanding by visitors of the aloha spirit and of the unique and sensitive character of Hawai'i's cultures and values.	NA
COMMENTARY: **The proposed project is not oriented exclusively to the visitor industry. It is intended to meet the needs of the surrounding residential community and the future demand generated by the City of Kapolei. However, given its size, the diversity of its shopping opportunities, and its location, it will function as an attraction for the Ko `Olina visitor destination area, and therefore, will have a positive impact upon Ko `Olina.**		
226-9	OBJECTIVE AND POLICIES FOR THE ECONOMY-FEDERAL EXPENDITURES.	
(a)	Planning for the State's economy with regard to federal expenditures shall be directed towards achievement of the objective of a stable federal investment base as an integral component of Hawai'i's economy;	NA
(b)	To achieve the federal expenditures objective, it shall be the policy of this State to:	
(1)	Encourage the sustained flow of federal expenditures in Hawai'i that generates long-term government civilian employment.	NA
(2)	Promote Hawai'i's supportive role in national defense.	NA
(3)	Promote the development of federally supported activities in Hawai'i that respect state-wide economic concerns, are sensitive to community needs, and minimize adverse impacts on Hawai'i's environment.	NA
(4)	Increase opportunities for entry and advancement of Hawai'i's people into federal government service.	NA
(5)	Promote federal use of local commodities, services, and facilities available in Hawai'i.	NA
(6)	Strengthen federal-state-county communication and coordination in all federal activities that affect Hawai'i.	NA

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(7)	Pursue the return of federally controlled lands in Hawai‘i that are not required for either the defense of the nation or for other purposes of national importance, and promote the mutually beneficial exchanges of land between federal agencies, the State, and the counties.	NA
COMMENTARY: **As the proposed project is entirely dependent upon private revenue sources, these objectives and policies are not applicable.**		
226-10	OBJECTIVE AND POLICIES FOR THE ECONOMY-POTENTIAL GROWTH ACTIVITIES.	
(a)	Planning for the State's economy with regard to potential growth activities shall be directed towards achievement of the objective of development and expansion of potential growth activities that serve to increase and diversify Hawai‘i's economic base.	A
(b)	To achieve the potential growth activity objective, it shall be the policy of this State to:	
(1)	Facilitate investment and employment in economic activities that have the potential for growth such as diversified agriculture, aquaculture, apparel and textile manufacturing, film and television production, and energy and marine-related industries.	NA
(2)	Expand Hawai‘i's capacity to attract and service international programs and activities that generate employment for Hawai‘i's people.	NA
(3)	Enhance and promote Hawai‘i's role as a center for international relations, trade, finance, services, technology, education, culture, and the arts.	NA
(4)	Accelerate research and development of new energy- related industries based on wind, solar, ocean, and underground resources and solid waste.	NA
(5)	Promote Hawai‘i's geographic, environmental, social, and technological advantages to attract new economic activities into the State.	C
(6)	Provide public incentives and encourage private initiative to attract new industries that best support Hawai‘i's social, economic, physical, and environmental objectives.	C
(7)	Increase research and the development of ocean-related economic activities such as mining, food production, and scientific research.	NA
(8)	Develop, promote, and support research and educational and training programs that will enhance Hawai‘i's ability to attract and develop economic activities of benefit to Hawai‘i's.	C
(9)	Foster a broader public recognition and understanding of the potential benefits of new, growth-oriented industry in Hawai‘i.	C
(10)	Encourage the development and implementation of joint federal and state initiatives to attract federal programs and projects that will support Hawai‘i's social, economic, physical, and environmental objectives.	NA
(11)	Increase research and development of businesses and services in the telecommunications and information industries.	NA
COMMENTARY: **As a commercial activity, the regional center has a limited role in attracting new growth-related industry. Nevertheless, due to the diverse character of the specialty retail envisioned at the center, it is anticipated that some of the businesses may be offering products generated by new growth industries in Hawai‘i, thereby giving them greater market exposure.**		

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226-10.5	OBJECTIVES AND POLICIES FOR THE ECONOMY-INFORMATION INDUSTRY.	
(a)	Planning for the State's economy with regard to the information industry shall be directed toward the achievement of the objective of positioning Hawai‘i as the leading dealer in information businesses and services in the Pacific Rim;	NA
(b)	To achieve the information industry objective, it shall be the policy of this State to:	
(1)	Encourage the continued development and expansion of the telecommunications infrastructure serving Hawai‘i to accommodate future growth in the information industry;	NA
(2)	Facilitate the development of new business and service ventures in the information industry which will provide employment opportunities for the people of Hawai‘i;	NA
(3)	Encourage greater cooperation between the public and private sectors in developing and maintaining a well-designed information industry;	NA
(4)	Ensure that the development of new businesses and services in the industry are in keeping with the social, economic, and physical needs and aspirations of Hawai‘i's people;	NA
(5)	Provide opportunities for Hawai‘i's people to obtain job training and education that will allow for upward mobility within the information industry;	NA
(6)	Foster a recognition of the contribution of the information industry to Hawai‘i's economy; and	NA
(7)	Assist in the promotion of Hawai‘i as a broker, creator, and processor of information in the Pacific.	NA
COMMENTARY: **These objectives and policies are not applicable to the proposed project.**		
226-11	OBJECTIVES AND POLICIES FOR THE PHYSICAL ENVIRONMENT-LANDBASED, SHORELINE, AND MARINE RESOURCES.	
(a)	Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:	
(1)	Prudent use of Hawai‘i's land-based, shoreline, and marine resources.	C
(2)	Effective protection of Hawai‘i's unique and fragile environmental resources.	C
(b)	To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:	
(1)	Exercise an overall conservation ethic in the use of Hawai‘i's natural resources.	C
(2)	Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.	NA
(3)	Take into account the physical attributes of areas when planning and designing activities and facilities.	C
(4)	Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.	C

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(5)	Consider multiple uses in watershed areas, provided such uses do not detrimentally affect water quality and recharge functions.	NA
(6)	Encourage the protection of rare or endangered plant and animal species and habitats native to Hawai‘i.	NA
(7)	Provide public incentives that encourage private actions to protect significant natural resources from degradation or unnecessary depletion.	NA
(8)	Pursue compatible relationships among activities, facilities, and natural resources.	NA
(9)	Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.	NA
COMMENTARY: **The subject property was reclassified to the Urban district 21 years ago. Although originally planned for a regional sports complex, surrounding land uses around the subject property have changed and evolved to the point where a sports complex on the site would duplicate the facilities planned at the nearby proposed UH West O`ahu campus. The demand for new employment in the `Ewa region suggests that the prudent use of the property would be oriented to the provision of new jobs to support the growing residential population in `Ewa.**		
226-12	OBJECTIVE AND POLICIES FOR THE PHYSICAL ENVIRONMENT-SCENIC, NATURAL BEAUTY, AND HISTORIC RESOURCES.	
(a)	Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawai‘i's scenic assets, natural beauty, and multi-cultural/historical resources.	C
(b)	To achieve the scenic, natural beauty, and historic resources objective, it shall be the policy of this State to:	
(1)	Promote the preservation and restoration of significant natural and historic resources.	NA
(2)	Provide incentives to maintain and enhance historic, cultural, and scenic amenities.	NA
(3)	Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.	C
(4)	Protect those special areas, structures, and elements that are an integral and functional part of Hawai‘i's ethnic and cultural heritage.	NA
(5)	Encourage the design of developments and activities that complement the natural beauty of the islands.	A
COMMENTARY: **No significant archaeological or cultural resources have been identified on the subject property. The excavation of the borrow pit revealed no subsurface resources. The architectural design of the project will not detract from views of the mountains, as there are no existing residential or commercial developments in Kalaeloa *makai* of the project. Due to the flat character of the topography, the ocean and horizon are not visible from the subject property or the neighboring properties.**		
226-13	OBJECTIVES AND POLICIES FOR THE PHYSICAL ENVIRONMENT-LAND, AIR, AND WATER QUALITY.	
(a)	Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives:	

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(1)	Maintenance and pursuit of improved quality in Hawai'i's land, air, and water resources.	C
(2)	Greater public awareness and appreciation of Hawai'i's environmental resources.	C
(b)	To achieve the land, air, and water quality objectives, it shall be the policy of this State to:	
(1)	Foster educational activities that promote a better understanding of Hawai'i's limited environmental resources.	C
(2)	Promote the proper management of Hawai'i's land and water resources.	C
(3)	Promote effective measures to achieve desired quality in Hawai'i's surface, ground, and coastal waters.	C
(4)	Encourage actions to maintain or improve aural and air quality levels to enhance the health and well-being of Hawai'i's people.	C
(5)	Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.	NA
(6)	Encourage design and construction practices that enhance the physical qualities of Hawai'i's communities.	C
(7)	Encourage urban developments in close proximity to existing services and facilities.	C
(8)	Foster recognition of the importance and value of the land, air, and water resources to Hawai'i's people, their cultures and visitors.	C
COMMENTARY: **The proposed project will be constructed in compliance with all relevant codes and standards. The project will include a public outreach component in the form of frequently changing exhibits that will help educate the public on a variety of contemporary issues, including the environment.**		
226-14	OBJECTIVE AND POLICIES FOR FACILITY SYSTEMS--IN GENERAL.	
(a)	Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.	C
(b)	To achieve the general facility systems objective, it shall be the policy of this State to:	
(1)	Accommodate the needs of Hawai'i's people through coordination of facility systems and capital improvement priorities in consonance with state and county plans.	C
(2)	Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.	C
(3)	Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.	NA

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(4)	Pursue alternative methods of financing programs and projects and cost-saving techniques in the planning, construction, and maintenance of facility systems.	A
COMMENTARY: **The proposed project will be constructed in careful coordination with the region-serving facility systems, including wastewater treatment, water supply, and storm water drainage.**		
226-15	OBJECTIVE AND POLICIES FOR FACILITY SYSTEMS--IN GENERAL.	
(a)	Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following objectives:	
(1)	Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.	A
(2)	Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas.	A
(b)	To achieve solid and liquid waste objectives, it shall be the policy of this State to:	
(1)	Encourage the adequate development of sewerage facilities that complement planned growth.	A
(2)	Promote re-use and recycling to reduce solid and liquid wastes and employ a conservation ethic.	A
(3)	Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes.	A
COMMENTARY: **The proposed project will be constructed in compliance with all applicable provisions related to the disposal of liquid and solid waste.**		
226-16	OBJECTIVE AND POLICIES FOR FACILITY SYSTEMS-WATER.	
(a)	Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.	A
(b)	To achieve the facility systems water objective, it shall be the policy of this State to:	
(1)	Coordinate development of land use activities with existing and potential water supply.	A
(2)	Support research and development of alternative methods to meet future water requirements well in advance of anticipated needs.	C
(3)	Reclaim and encourage the productive use of runoff water and wastewater discharges.	C
(4)	Assist in improving the quality, efficiency, service, and storage capabilities of water systems for domestic and agricultural use.	NA
(5)	Support water supply services to areas experiencing critical water problems.	NA
(6)	Promote water conservation programs and practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs.	A

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COMMENTARY: **The proposed project will coordinate its water consumption with resource availability. Based on the estimated plumbing fixture units for the Center, the maximum potable supply demand will be on the order of 680 gpm, which is equivalent to approximately 34 single family homes with typical 5/8-inch water meters.**		
226-17	OBJECTIVES AND POLICIES FOR FACILITY SYSTEMS-TRANSPORTATION	
(a)	Planning for the State's facility systems with regard to transportation shall be directed towards the achievement of the following objectives:	
(1)	An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.	A
(2)	A statewide transportation system that is consistent with and will accommodate planned growth objectives throughout the State.	A
(b)	To achieve the transportation objectives, it shall be the policy of this State to:	
(1)	Design, program, and develop a multi-modal system in conformance with desired growth and physical development as stated in this chapter;	A
(2)	Coordinate state, county, federal, and private transportation activities and programs toward the achievement of statewide objectives;	A
(3)	Encourage a reasonable distribution of financial responsibilities for transportation among participating governmental and private parties;	A
(4)	Provide for improved accessibility to shipping, docking, and storage facilities;	C
(5)	Promote a reasonable level and variety of mass transportation services that adequately meet statewide and community needs;	A
(6)	Encourage transportation systems that serve to accommodate present and future development needs of communities;	A
(7)	Encourage a variety of carriers to offer increased opportunities and advantages to interisland movement of people and goods;	NA
(8)	Increase the capacities of airport and harbor systems and support facilities to effectively accommodate transshipment and storage needs;	NA
(9)	Encourage the development of transportation systems and programs which would assist statewide economic growth and diversification;	NA
(10)	Encourage the design and development of transportation systems sensitive to the needs of affected communities and the quality of Hawai'i's natural environment;	A
(11)	Encourage safe and convenient use of low-cost, energy-efficient, non-polluting means of transportation;	A
(12)	Coordinate intergovernmental land use and transportation planning activities to ensure the timely delivery of supporting transportation infrastructure in order to accommodate planned growth objectives; and	NA
(13)	Encourage diversification of transportation modes and infrastructure to promote alternate fuels and energy efficiency.	A

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COMMENTARY: **By the very nature of the development, transportation is integral to the project's success. As a region-serving commercial center, accessibility to the center is a paramount consideration. The proposed project incorporates a multi-modal transportation philosophy that includes private vehicles, pedestrian movement, mass transit, and bikeways. The central Village Square portion of the development focuses upon pedestrian connections between its various buildings, accentuated with numerous pedestrian plazas. The outer ring of the project focuses on accessibility to the private vehicle. To meet the needs of the regional community, Hawaii DeBartolo LLC is designating a site at the center for a future mass transit station that would link to the City's proposed system. The project will also incorporate space along its southern property boundary to link the subject property to the `Ewa regional bikeway system. In addition, DeBartolo has incorporated a railway platform for the OR&L historic railway that adjoins the project's southern boundary and has included a pedestrian link from the platform to the Village Square.**		
226-18	OBJECTIVES AND POLICIES FOR FACILITY SYSTEMS-ENERGY	
(a)	Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all	
(1)	Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;	C
(2)	Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased;	C
(3)	Greater energy security in the face of threats to Hawai'i's energy supplies and systems; and	NA
(4)	Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use.	A
(b)	To achieve the energy objectives, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable energy services to accommodate demand.	NA
(c)	To further achieve the energy objectives, it shall be the policy of this State to:	
(1)	Support research and development as well as promote the use of renewable energy sources;	C
(2)	Ensure that the combination of energy supplies and energy-saving systems is sufficient to support the demands of growth;	C
(3)	Base decisions of least-cost supply-side and demand-side energy resource options on a comparison of their total costs and benefits when a least-cost is determined by a reasonably comprehensive, quantitative, and qualitative accounting of their long-term, direct and indirect economic, environmental, social, cultural, and public health costs and benefits;	C
(4)	Promote all cost-effective conservation of power and fuel supplies through measures including: (A) Development of cost-effective demand-side management programs; (B) Education; and (C) Adoption of energy-efficient practices and technologies;	C
(5)	Ensure to the extent that new supply-side resources are needed, the development or expansion of energy systems utilizes the least-cost energy supply option and maximizes efficient technologies;	C

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(6)	Support research, development, and demonstration of energy efficiency, load management, and other demand-side management programs, practices, and technologies;	C
(7)	Promote alternate fuels and energy efficiency by encouraging diversification of transportation modes and infrastructure;	A
(8)	Support actions that reduce, avoid, or sequester greenhouse gases in utility, transportation, and industrial sector applications; and	A
(9)	Support actions that reduce, avoid, or sequester Hawai'i's greenhouse gas emissions through agriculture and forestry initiatives.	A
COMMENTARY: **The proposed project will incorporate energy efficient technologies into its design and operations. It will explore direct electrical generation opportunities with HECO. The project's inclusion of a bikeway connection and future transit station is supportive of improving fuel efficiency through multi-modal transportation planning.**		
226-18.5	OBJECTIVES AND POLICIES FOR FACILITY SYSTEMS-TELECOMMUNICATIONS.	
(a)	Planning for the State's telecommunications facility systems shall be directed towards the achievement of dependable, efficient, and economical statewide telecommunications systems capable of supporting the needs of the people.	NA
(b)	To achieve the telecommunications objective, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable telecommunications services to accommodate demand.	NA
(c)	To further achieve the telecommunications objective, it shall be the policy of this State to:	
(1)	Facilitate research and development of telecommunications systems and resources;	NA
(2)	Encourage public and private sector efforts to develop means for adequate, ongoing telecommunications planning;	C
(3)	Promote efficient management and use of existing telecommunications systems and services; and	C
(4)	Facilitate the development of education and training of telecommunications personnel.	NA
COMMENTARY: **The project's conformity with the telecommunications objectives and policies is generally limited to the technologies it provides in the proposed hotels.**		
226-19	OBJECTIVES AND POLICIES FOR SOCIO-CULTURAL ADVANCEMENT-HOUSING	
(a)	Planning for the State's socio-cultural advancement with regard to housing shall be directed toward the achievement of the following objectives:	
(1)	Greater opportunities for Hawai'i's people to secure reasonably priced, safe, sanitary, and livable homes, located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals, through collaboration and cooperation between government and nonprofit and for-profit developers to ensure that more affordable housing is made available to very low, low- and moderate-income segments of Hawai'i's population.	NA

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(2)	The orderly development of residential areas sensitive to community needs and other land uses.	NA
(3)	The development and provision of affordable rental housing by the State to meet the housing needs of Hawai'i's people.	NA
(b)	To achieve the housing objectives, it shall be the policy of this State to:	
(1)	Effectively accommodate the housing needs of Hawai'i's people.	NA
(2)	Stimulate and promote feasible approaches that increase housing choices for low-income, moderate-income, and gap-group households.	NA
(3)	Increase homeownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.	NA
(4)	Promote appropriate improvement, rehabilitation, and maintenance of existing housing units and residential areas.	NA
(5)	Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas.	NA
(6)	Facilitate the use of available vacant, developable, and underutilized urban lands for housing.	NA
(7)	Foster a variety of lifestyles traditional to Hawai'i through the design and maintenance of neighborhoods that reflect the culture and values of the community.	NA
(8)	Promote research and development of methods to reduce the cost of housing construction in Hawai'i.	NA
COMMENTARY: **The project does not include a residential component. As an employment center, the project is intended to provide jobs for existing residents of the area and to support the new housing opportunities already planned for the `Ewa region.**		
226-20	OBJECTIVES AND POLICIES FOR SOCIO-CULTURAL ADVANCEMENT-HEALTH.	
(a)	Planning for the State's socio-cultural advancement with regard to health shall be directed towards achievement of the following objectives:	
(1)	Fulfillment of basic individual health needs of the general public.	NA
(2)	Maintenance of sanitary and environmentally healthful conditions in Hawai'i's communities.	C
(b)	To achieve the health objectives, it shall be the policy of this State to:	
(1)	Provide adequate and accessible services and facilities for prevention and treatment of physical and mental health problems, including substance abuse.	NA
(2)	Encourage improved cooperation among public and private sectors in the provision of health care to accommodate the total health needs of individuals throughout the State.	NA
(3)	Encourage public and private efforts to develop and promote statewide and local strategies to reduce health care and related insurance costs.	NA
(4)	Foster an awareness of the need for personal health maintenance and preventive health care through education and other measures.	NA

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(5)	Provide programs, services, and activities that ensure environmentally healthful and sanitary conditions.	C
(6)	Improve the State's capabilities in preventing contamination by pesticides and other potentially hazardous substances through increased coordination, education, monitoring, and enforcement.	NA
COMMENTARY: **Other than ensuring that the proposed project provides a healthful environment for its employees, customers, and guests, the State's objectives and policies are generally not applicable to the project.**		
226-21	OBJECTIVE AND POLICIES FOR SOCIO-CULTURAL ADVANCEMENT-EDUCATION	
(a)	Planning for the State's socio-cultural advancement with regard to education shall be directed towards achievement of the objective of the provision of a variety of educational opportunities to enable individuals to fulfill their needs, responsibilities, and aspirations.	NA
(b)	To achieve the education objective, it shall be the policy of this State to:	
(1)	Support educational programs and activities that enhance personal development, physical fitness, recreation, and cultural pursuits of all groups.	NA
(2)	Ensure the provision of adequate and accessible educational services and facilities that are designed to meet individual and community needs.	NA
(3)	Provide appropriate educational opportunities for groups with special needs.	NA
(4)	Promote educational programs which enhance understanding of Hawai'i's cultural heritage.	NA
(5)	Provide higher educational opportunities that enable Hawai'i's people to adapt to changing employment demands.	NA
(6)	Assist individuals, especially those experiencing critical employment problems or barriers, or undergoing employment transitions, by providing appropriate employment training programs and other related educational opportunities.	NA
(7)	Promote programs and activities that facilitate the acquisition of basic skills, such as reading, writing, computing, listening, speaking, and reasoning.	NA
(8)	Emphasize quality educational programs in Hawai'i's institutions to promote academic excellence.	NA
(9)	Support research programs and activities that enhance the education programs of the State.	NA
COMMENTARY: **The State's objectives and policies related to education are generally not applicable to the proposed project.**		
226-23	OBJECTIVE AND POLICIES FOR SOCIO-CULTURAL ADVANCEMENT-LEISURE.	
(a)	Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.	C
(b)	To achieve the leisure objective, it shall be the policy of this State to:	

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(1)	Foster and preserve Hawai'i's multi-cultural heritage through supportive cultural, artistic, recreational, and humanities-oriented programs and activities.	C
(2)	Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently.	C
(3)	Enhance the enjoyment of recreational experiences through safety and security measures, educational opportunities, and improved facility design and maintenance.	C
(4)	Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring that their inherent values are preserved.	NA
(5)	Ensure opportunities for everyone to use and enjoy Hawai'i's recreational resources.	NA
(6)	Assure the availability of sufficient resources to provide for future cultural, artistic, and recreational needs.	C
(7)	Provide adequate and accessible physical fitness programs to promote physical and mental well-being of Hawai'i's people.	NA
(8)	Increase opportunities for appreciation and participation in the creative arts, including the literary, theatrical, visual, musical, folk, and traditional art forms.	C
(9)	Encourage the development of creative expression in the artistic disciplines to enable all segments of Hawai'i's population to participate in the creative arts.	C
(10)	Assure adequate access to significant natural and cultural resources in public ownership.	NA
COMMENTARY: **As a gathering place, the proposed project will offer extensive opportunities for social, artistic and cultural advancement, primarily through the show casing of community group, artistic and cultural endeavors, in much the same manner as the Center Stage at Ala Moana.**		
226-24	OBJECTIVE AND POLICIES FOR SOCIO-CULTURAL ADVANCEMENT--INDIVIDUAL RIGHTS AND PERSONAL WELL-BEING.	
(a)	Planning for the State's socio-cultural advancement with regard to individual rights and personal well-being shall be directed towards achievement of the objective of increased opportunities and protection of individual rights to enable individuals to fulfill their socio-economic needs and aspirations.	NA
(b)	To achieve the individual rights and personal well- being objective, it shall be the policy of this State to:	
(1)	Provide effective services and activities that protect individuals from criminal acts and unfair practices and that alleviate the consequences of criminal acts in order to foster a safe and secure environment.	NA
(2)	Uphold and protect the national and state constitutional rights of every individual.	NA
(3)	Assure access to, and availability of, legal assistance, consumer protection, and other public services which strive to attain social justice.	NA
(4)	Ensure equal opportunities for individual participation in society.	NA
226-25	OBJECTIVE AND POLICIES FOR SOCIO-CULTURAL ADVANCEMENT-CULTURE.	

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A = ACTIVELY SUPPORTIVE C= CONFORMS I = GOAL IS INCONSISTENT WITH PROJECT'S OBJECTIVES NA = GOAL IS NOT APPLICABLE		
(a)	Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawai‘i's people.	NA
(b)	To achieve the culture objective, it shall be the policy of this State to:	
(1)	Foster increased knowledge and understanding of Hawai‘i's ethnic and cultural heritages and the history of Hawai‘i.	C
(2)	Support activities and conditions that promote cultural values, customs, and arts that enrich the lifestyles of Hawai‘i's people and which are sensitive and responsive to family and community needs.	C
(3)	Encourage increased awareness of the effects of proposed public and private actions on the integrity and quality of cultural and community lifestyles in Hawai‘i.	C
(4)	Encourage the essence of the aloha spirit in people's daily activities to promote harmonious relationships among Hawai‘i's people and visitors.	C
COMMENTARY: **The project will include a permanent exhibit documenting the cultural history of the area.**		
226-26	SECTION 226-26 OBJECTIVES AND POLICIES FOR SOCIO-CULTURAL ADVANCEMENT-PUBLIC SAFETY.	
(a)	Planning for the State's socio-cultural advancement with regard to public safety shall be directed towards the achievement of the following objectives:	
(1)	Assurance of public safety and adequate protection of life and property for all people.	NA
(2)	Optimum organizational readiness and capability in all phases of emergency management to maintain the strength, resources, and social and economic well-being of the community in the event of civil disruptions, wars, natural disasters, and other major disturbances.	NA
(3)	Promotion of a sense of community responsibility for the welfare and safety of Hawai‘i's people.	NA
(b)	To achieve the public safety objectives, it shall be the policy of this State to:	
(1)	Ensure that public safety programs are effective and responsive to community needs.	NA
(2)	Encourage increased community awareness and participation in public safety programs.	NA
(c)	To further achieve public safety objectives related to criminal justice, it shall be the policy of this State to:	NA
(1)	Support criminal justice programs aimed at preventing and curtailing criminal activities.	NA
(2)	Develop a coordinated, systematic approach to criminal justice administration among all criminal justice agencies.	NA
(3)	Provide a range of correctional resources which may include facilities and alternatives to traditional incarceration in order to address the varied security needs of the community and successfully reintegrate offenders into the community.	NA

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(d)	To further achieve public safety objectives related to emergency management, it shall be the policy of this State to:	NA
(1)	Ensure that responsible organizations are in a proper state of readiness to respond to major war-related, natural, or technological disasters and civil disturbances at all times.	NA
(2)	Enhance the coordination between emergency management programs throughout the State.	NA
COMMENTARY: **The State's objectives and policies related to public safety are generally not applicable to the proposed project.**		
226-27	OBJECTIVES AND POLICIES FOR SOCIO-CULTURAL ADVANCEMENT-GOVERNMENT	
(a)	Planning the State's socio-cultural advancement with regard to government shall be directed towards the achievement of the following objectives:	
(1)	Efficient, effective, and responsive government services at all levels in the State.	NA
(2)	Fiscal integrity, responsibility, and efficiency in the state government and county governments.	NA
(b)	To achieve the government objectives, it shall be the policy of this State to:	NA
(1)	Provide for necessary public goods and services not assumed by the private sector.	NA
(2)	Pursue an openness and responsiveness in government that permits the flow of public information, interaction, and response.	NA
(3)	Minimize the size of government to that necessary to be effective.	NA
(4)	Stimulate the responsibility in citizens to productively participate in government for a better Hawai'i.	NA
(5)	Assure that government attitudes, actions, and services are sensitive to community needs and concerns.	NA
(6)	Provide for a balanced fiscal budget.	NA
(7)	Improve the fiscal budgeting and management system of the State.	NA
(8)	Promote the consolidation of state and county governmental functions to increase the effective and efficient delivery of government programs and services and to eliminate duplicative services wherever feasible.	NA
COMMENTARY: **The State's objectives and policies related to government are generally not applicable to the proposed project.**		

Table 3: Hawai`i State Planning Act – Part III

SECTION	CHAPTER 226 - PART III - PRIORITY GUIDELINES	RATING
A = ACTIVELY SUPPORTIVE C= CONFORMS I = GOAL IS INCONSISTENT WITH HECO'S OBJECTIVES NA = GOAL IS NOT APPLICABLE		
226-101	Establishes overall priority guidelines to address areas of statewide concern.	

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226-102	Overall direction. The State shall strive to improve the quality of life for Hawai‘i's present and future population through the pursuit of desirable courses of action in five major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, and quality education.	
226-103	ECONOMIC PRIORITY GUIDELINES.	
(a)	Priority guidelines to stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawai‘i's people and achieve a stable and diversified economy:	
(1)	Seek a variety of means to increase the availability of investment capital for new and expanding enterprises.	NC
(A)	Encourage investments which:	
(i)	Reflect long term commitments to the State;	C
(ii)	Rely on economic linkages within the local economy;	C
(iii)	Diversify the economy;	C
(iv)	Reinvest in the local economy;	C
(v)	Are sensitive to community needs and priorities, and	C
(vi)	Demonstrate a commitment to provide management opportunities to Hawai‘i residents.	C
(2)	Encourage the expansion of technological research to assist industry development and support the development and commercialization of technological advancements.	NA
(3)	Improve the quality, accessibility, and range of services provided by government to business, including data and reference services and assistance in complying with governmental regulations.	NA
(4)	Seek to ensure that state business tax and labor laws and administrative policies are equitable, rational, and predictable.	NA
(5)	Streamline the building and development permit and review process, and eliminate or consolidate other burdensome or duplicative governmental requirements imposed on business, where public health, safety and welfare would not be adversely affected.	NA
(6)	Encourage the formation of cooperatives and other favorable marketing or distribution arrangements at the regional or local level to assist Hawai‘i's small-scale producers, manufacturers, and distributors.	NA
(7)	Continue to seek legislation to protect Hawai‘i from transportation interruptions between Hawai‘i and the continental United States.	NA
(8)	Provide public incentives and encourage private initiative to develop and attract industries which promise long-term growth potentials and which have the following characteristics:	NA
(A)	An industry that can take advantage of Hawai‘i's unique location and available physical and human resources.	NA

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(B)	A clean industry that would have minimal adverse effects on Hawai'i's environment.	NA
(C)	An industry that is willing to hire and train Hawai'i's people to meet the industry's labor needs at all levels of employment.	C
(D)	An industry that would provide reasonable income and steady employment.	C
(9)	Support and encourage, through educational and technical assistance programs and other means, expanded opportunities for employee ownership and participation in Hawai'i business.	NA
(10)	Enhance the quality of Hawai'i's labor force and develop and maintain career opportunities for Hawai'i's people through the following actions:	C
(A)	Expand vocational training in diversified agriculture, aquaculture, information industry, and other areas where growth is desired and feasible.	NA
(B)	Encourage more effective career counseling and guidance in high schools and post-secondary institutions to inform students of present and future career opportunities.	NA
(C)	Allocate educational resources to career areas where high employment is expected and where growth of new industries is desired.	NA
(D)	Promote career opportunities in all industries for Hawai'i's people by encouraging firms doing business in the State to hire residents.	C
(E)	Promote greater public and private sector cooperation in determining industrial training needs and in developing relevant curricula and on-the-job training opportunities.	NA
(F)	Provide retraining programs and other support services to assist entry of displaced workers into alternative employment.	NA
(b)	Priority guidelines to promote the economic health and quality of the visitor industry:	
(1)	Promote visitor satisfaction by fostering an environment which enhances the Aloha Spirit and minimizes inconveniences to Hawai'i's residents and visitors.	C
(2)	Encourage the development and maintenance of well-designed, adequately serviced hotels and resort destination areas which are sensitive to neighboring communities and activities and which provide for adequate shoreline setbacks and beach access.	C
(3)	Support appropriate capital improvements to enhance the quality of existing resort destination areas and provide incentives to encourage investment in upgrading, repair, and maintenance of visitor facilities.	NA
(4)	Encourage visitor industry practices and activities which respect, preserve, and enhance Hawai'i's significant natural, scenic, historic, and cultural resources.	NA
(5)	Develop and maintain career opportunities in the visitor industry for Hawai'i's people, with emphasis on managerial positions.	NA
(6)	Support and coordinate tourism promotion abroad to enhance Hawai'i's share of existing and potential visitor markets.	NA
(7)	Maintain and encourage a more favorable resort investment climate consistent with the objectives of this chapter.	NA

SECTION	CHAPTER 226 - PART III - PRIORITY GUIDELINES	RATING
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(8)	Support law enforcement activities that provide a safer environment for both visitors and residents alike.	C
(9)	Coordinate visitor industry activities and promotions to business visitors through the state network of advanced data communication techniques.	C
(c)	Priority guidelines to promote the continued viability of the sugar and pineapple industries:	
(1)	Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries.	NA
(2)	Continue efforts to maintain federal support to provide stable sugar prices high enough to allow profitable operations in Hawai‘i.	NA
(3)	Support research and development, as appropriate, to improve the quality and production of sugar and pineapple crops.	NA
(d)	Priority guidelines to promote the growth and development of diversified agriculture and aquaculture:	
(1)	Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands.	NA
(2)	Assist in providing adequate, reasonably priced water for agricultural activities.	NA
(3)	Encourage public and private investment to increase water supply and to improve transmission, storage, and irrigation facilities in support of diversified agriculture and aquaculture.	NA
(4)	Assist in the formation and operation of production and marketing associations and cooperatives to reduce production and marketing costs.	NA
(5)	Encourage and assist with the development of a waterborne and airborne freight and cargo system capable of meeting the needs of Hawai‘i's agricultural community.	NA
(6)	Seek favorable freight rates for Hawai‘i's agricultural products from interisland and overseas transportation operators.	NA
(7)	Encourage the development and expansion of agricultural and aquacultural activities which offer long-term economic growth potential and employment opportunities.	NA
(8)	Continue the development of agricultural parks and other programs to assist small independent farmers in securing agricultural lands and loans.	NA
(9)	Require agricultural uses in agricultural subdivisions and closely monitor the uses in these subdivisions.	NA
(10)	Support the continuation of land currently in use for diversified agriculture.	NA
(e)	Priority guidelines for water use and development:	
(1)	Maintain and improve water conservation programs to reduce the overall water consumption rate.	C
(2)	Encourage the improvement of irrigation technology and promote the use of nonpotable water for agricultural and landscaping purposes.	C

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(3)	Increase the support for research and development of economically feasible alternative water sources.	NA
(4)	Explore alternative funding sources and approaches to support future water development programs and water system improvements.	NA
(f)	Priority guidelines for energy use and development:	
(1)	Encourage the development, demonstration, and commercialization of renewable energy sources.	NA
(2)	Initiate, maintain, and improve energy conservation programs aimed at reducing energy waste and increasing public awareness of the need to conserve energy.	A
(3)	Provide incentives to encourage the use of energy conserving technology in residential, industrial, and other buildings.	C
(4)	Encourage the development and use of energy conserving and cost-efficient transportation systems.	C
(g)	Priority guidelines to promote the development of the information industry:	
(1)	Establish an information network that will serve as the catalyst for establishing a viable information industry in Hawai‘i.	NA
(2)	Encourage the development of services such as financial data processing, products and services exchange, foreign language translations, telemarketing, teleconferencing, a twenty-four-hour international stock exchange, international banking, and a Pacific Rim management center.	NA
(3)	Encourage the development of small businesses in the information field such as software development, the development of new information systems and peripherals, data conversion and data entry services, and home or cottage services such as computer programming, secretarial, and accounting services.	NA
(4)	Encourage the development or expansion of educational and training opportunities for residents in the information and telecommunications fields.	NA
(5)	Encourage research activities, including legal research in the information and telecommunications fields.	NA
(6)	Support promotional activities to market Hawai‘i's information industry services.	NA
226-104	POPULATION GROWTH AND LAND RESOURCES PRIORITY GUIDELINES.	
(a)	Priority guidelines to effect desired statewide growth and distribution:	
(1)	Encourage planning and resource management to insure that population growth rates throughout the State are consistent with available and planned resource capacities and reflect the needs and desires of Hawai‘i's people.	C
(2)	Manage a growth rate for Hawai‘i's economy that will parallel future employment needs for Hawai‘i's people.	NA
(3)	Ensure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State.	A

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(4)	Encourage major state and federal investments and services to promote economic development and private investment to the neighbor islands, as appropriate.	NA
(5)	Explore the possibility of making available urban land, low-interest loans, and housing subsidies to encourage the provision of housing to support selective economic and population growth on the neighbor islands.	NA
(6)	Seek federal funds and other funding sources outside the State for research, program development, and training to provide future employment opportunities on the neighbor islands.	NA
(7)	Support the development of high technology parks on the neighbor islands.	NA
(b)	Priority guidelines for regional growth distribution and land resource utilization:	
(1)	Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures, and away from areas where other important benefits are present, such as protection of important agricultural land or preservation of lifestyles.	A
(2)	Make available marginal or nonessential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.	C
(3)	Restrict development when drafting of water would result in exceeding the sustainable yield or in significantly diminishing the recharge capacity of any groundwater area.	C
(4)	Encourage restriction of new urban development in areas where water is insufficient from any source for both agricultural and domestic use.	NA
(5)	In order to preserve green belts, give priority to state capital-improvement funds which encourage location of urban development within existing urban areas except where compelling public interest dictates development of a noncontiguous new urban core.	NA
(6)	Seek participation from the private sector for the cost of building infrastructure and utilities, and maintaining open spaces.	C
(7)	Pursue rehabilitation of appropriate urban areas.	NA
(8)	Support the redevelopment of Kakaako into a viable residential, industrial, and commercial community.	NA
(9)	Direct future urban development away from critical environmental areas or impose mitigating measures so that negative impacts on the environment would be minimized.	C
(10)	Identify critical environmental areas in Hawai'i to include but not be limited to the following: watershed and recharge areas; wildlife habitats (on land and in the ocean); areas with endangered species of plants and wildlife; natural streams and water bodies; scenic and recreational shoreline resources; open space and natural areas; historic and cultural sites; areas particularly sensitive to reduction in water and air quality; and scenic resources.	NA
(11)	Identify all areas where priority should be given to preserving rural character and lifestyle.	NA

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(12)	Utilize Hawai'i's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations.	A
(13)	Protect and enhance Hawai'i's shoreline, open spaces, and scenic resources.	C
226-105	CRIME AND CRIMINAL JUSTICE. PRIORITY GUIDELINES IN THE AREA OF CRIME AND CRIMINAL JUSTICE:	
(1)	Support law enforcement activities and other criminal justice efforts that are directed to provide a safer environment.	C
(2)	Target state and local resources on efforts to reduce the incidence of violent crime and on programs relating to the apprehension and prosecution of repeat offenders.	NA
(3)	Support community and neighborhood program initiatives that enable residents to assist law enforcement agencies in preventing criminal activities.	NA
(4)	Reduce overcrowding or substandard conditions in correctional facilities through a comprehensive approach among all criminal justice agencies which may include sentencing law revisions and use of alternative sanctions other than incarceration for persons who pose no danger to their community.	NA
(5)	Provide a range of appropriate sanctions for juvenile offenders, including community-based programs and other alternative sanctions.	NA
(6)	Increase public and private efforts to assist witnesses and victims of crimes and to minimize the costs of victimization.	NA
226-106	AFFORDABLE HOUSING. PRIORITY GUIDELINES FOR THE PROVISION OF AFFORDABLE HOUSING:	
(1)	Seek to use marginal or nonessential agricultural land and public land to meet housing needs of low-and moderate-income and gap-group households.	NA
(2)	Encourage the use of alternative construction and development methods as a means of reducing production costs.	NA
(3)	Improve information and analysis relative to land availability and suitability for housing.	NA
(4)	Create incentives for development which would increase home ownership and rental opportunities for Hawai'i's low- and moderate-income households, gap-group households, and residents with special needs.	NA
(5)	Encourage continued support for government or private housing programs that provide low interest mortgages to Hawai'i's people for the purchase of initial owner-occupied housing.	NA
(6)	Encourage public and private sector cooperation in the development of rental housing alternatives.	NA
(7)	Encourage improved coordination between various agencies and levels of government to deal with housing policies and regulations.	NA
(8)	Give higher priority to the provision of quality housing that is affordable for Hawai'i's residents and less priority to development of housing intended primarily for individuals outside of Hawai'i.	NA

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226-107	QUALITY EDUCATION. PRIORITY GUIDELINES TO PROMOTE QUALITY EDUCATION:	
(1)	Pursue effective programs which reflect the varied district, school, and student needs to strengthen basic skills achievement;	NA
(2)	Continue emphasis on general education "core" requirements to provide common background to students and essential support to other university programs;	NA
(3)	Initiate efforts to improve the quality of education by improving the capabilities of the education work force;	NA
(4)	Promote increased opportunities for greater autonomy and flexibility of educational institutions in their decision-making responsibilities;	NA
(5)	Increase and improve the use of information technology in education by the availability of telecommunications equipment for:	
(A)	The electronic exchange of information;	NA
(B)	Statewide electronic mail; and	NA
(C)	Access to the Internet.	NA
(6)	Encourage programs that increase the public's awareness and understanding of the impact of information technologies on our lives;	NA
(7)	Pursue the establishment of Hawai'i's public and private universities and colleges as research and training centers of the Pacific;	NA
(8)	Develop resources and programs for early childhood education;	NA
(9)	Explore alternatives for funding and delivery of educational services to improve the overall quality of education; and	NA
(10)	Strengthen and expand educational programs and services for students with special needs.	NA

3.2 STATE FUNCTIONAL PLANS

The Planning Act called for the creation of functional plans to set specific objectives, establish policies, and implement actions for a particular field of activity. These functional plans further identified those organizations responsible in carrying out the actions, the implementing timeframe, and the proposed budgets.

The most current functional plans and the relationship, if any, to DHHL's proposed petition for a boundary amendment are discussed in the following sections. It is important to note that while these plans are considered to be the current "official" State Functional Plans, a deviation from the original goals of the plan may have occurred due to national and world events or other unforeseeable factors.

3.2.1 State Agricultural Functional Plan (1991)

3.2.1.1 Goals of the Plan

The State Agricultural Functional Plan sought to ultimately increase the overall level of agricultural development in Hawai‘i. Its fundamental objectives were to (1) ensure the continued viability of Hawai‘i’s sugar and pineapple industries, and (2) encourage the continued growth and development of diversified agriculture throughout the State. The functional plan for agriculture also set objectives to develop capabilities to convert Hawai‘i-grown crops into potential new value/added products for the local community, visitor industry, and export markets.

3.2.1.2 Conformance with the Goals of the Plan

The State Agricultural Function Plan is not directly relevant to the proposed project because the subject property was reclassified to the State Urban district 21 years ago.

3.2.2 State Conservation Functional Plan (1991)

3.2.2.1 Goals of the Plan

The State Conservation Lands Functional Plan addresses the impacts of population growth and economic development on Hawai‘i’s natural environment and provides a framework for the protection and preservation of pristine lands and shore lands. The objective of the plan is to provide for a management program allowing the judicious use of the State’s natural resources balanced with the need to protect these resources to varying degrees. The State is primarily responsible to provide the management of conservation areas. However, counties play a key role in directing urban and agricultural activities and in retaining open space and cultural sites as lands become urbanized.

3.2.2.2 Conformance with the Goals of the Plan

The State Conservation Function Plan is not directly relevant to the proposed project because the subject property is classified as Urban district.

3.2.3 State Educational Functional Plan (1989)

3.2.3.1 Goals of the Plan

The State Educational Functional Plan reflects the DOE’s strategy to address the goals, policies, and priority guidelines of the Planning Act and the goals of the Board of Education (BOE). The plan outlines actions to be taken by the DOE to improve the public school system and to attend to various societal needs and trends.

3.2.3.2 Conformance with the Goals of the Plan

The State Educational Function Plan is not directly relevant to the proposed project.

3.2.4 State Higher Education Functional Plan (1984)

3.2.4.1 Goals of the Plan

The objectives of the State Higher Education Functional Plan are to provide (1) a number of diverse postsecondary education institutions; (2) quality educational, research, and public services programs; (3) appropriate opportunities for all who can benefit; (4) financing to ensure accessibility; and (5) coordination of educational resources.

3.2.4.2 Conformance with the Goals of the Plan

While the State Higher Educational Function Plan is not directly relevant to the proposed project, the relationship between the subject property and the UH's proposed West O`ahu campus provides a context for the proposed development. The subject property was identified in the 1999 East Kapolei Final EIS as the site of a proposed Sports Complex. However, subsequent to a downturn in the state economy, the original plans for East Kapolei were not implemented and the land was transferred to two entities: UH and DHHL. With the recent approval of UH's proposed West O`ahu campus at East Kapolei, many of the functions that were originally proposed for the subject property will be developed at the West O`ahu campus site. This leaves the subject property available for alternative development.

3.2.5 State Employment Functional Plan (1990)

3.2.5.1 Goals of the Plan

The 1990 State Employment Functional Plan's objectives, policies, and implementing actions address four major issue areas: (1) education and preparation services for employment; (2) job placement; (3) quality of work life; and (4) employment planning information and coordination.

3.2.5.2 Conformance with the Goals of the Plan

At full build out, the proposed development will a principal source of new employment opportunities for the entire `Ewa region. To that end, it is supportive of the Employment Functional Plan.

3.2.6 State Energy Functional Plan (1991)

3.2.6.1 Goals of the Plan

The State Energy Functional Plan sought to (1) support the commercialization of Hawai'i's alternative energy resources, (2) implement a wide range of energy conservation and efficiency technologies; (3) prepare for disruptions in the energy supply; and (4) reduce the State's dependence on imported fossil fuels, such as oil, for 90 percent of its total energy needs as opposed to 42 percent nationally.

The plan called for objectives and courses of action to lessen Hawai'i's dependence on imported fossil fuels. The objectives were to: (1) moderate the growth in energy demand through conservation and energy efficiency; (2) displace oil and fossil fuels through alternate and renewable energy sources; (3) promote energy education and legislation; (4) support and develop an integrated approach to energy development and management; (5) ensure the State's abilities to implement energy emergency actions immediately in the event of fuel supply disruptions, and

ensure essential public services are maintained and provisions are made to alleviate economic and personal hardships that may arise.

3.2.6.2 Conformance with the Goals of the Plan

As discussed in Section 2.16, the project will utilize advanced best management practices (BMP) for green building to incorporate sustainable principals from conceptual design through the end of construction. These BMP's address aspects of site, water efficiency and reuse, energy consumption, day-lighting, recycling and construction waste management, materials (local, recycled), fixtures, indoor environmental quality, low-emitting materials, and natural resources.

The Ka Makana Ali‘i project will seek to minimize its impact on the environment through the appropriate selection of energy efficient systems, and considering sustainable material choices to achieve an environmentally responsible design that strikes a balance between known established practices and emerging sustainable best management practices.

3.2.7 State Health Functional Plan (1989)

3.2.7.1 Goals of the Plan

The 1989 State Health Functional Plan addressed six issue areas: (1) health promotion and disease prevention; (2) communicable disease prevention and control; (3) special populations with impaired access to health care; (4) healthcare services (acute, long-term, primary and emergent) for rural communities; (5) environmental health and protection; and (6) Department of Health (DOH) leadership. The plan also sought to boost the long-term economy by attracting a share of the rapidly developing, affluent, wellness-oriented market. It also sought to develop and implement new environmental protection and health services that would protect, monitor, prevent degradation, and enhance the quality of Hawai‘i's air, land, and water.

3.2.7.2 Conformance to the Goals of the Plan

The State Health Function Plan is not directly relevant to the proposed project.

3.2.8 State Historic Preservation Functional Plan (1991)

3.2.8.1 Goals of the Plan

The State Historic Functional Plan identifies issues, policies, and implementing actions that seek to preserve and protect the unsurpassable beauty, history, and culture of the Hawaiian islands. Hawai‘i's natural scenic beauty, clean environment, and rich multi-cultural heritage (including historic/cultural sites) are reasons why so many people have made Hawai‘i their home, and why so many visit the State.

3.2.8.2 Conformance to the Goals of the Plan

The development of the proposed project will be conducted in compliance with all applicable rules pertaining to historic preservation. To that end, the project is supportive of the Historic Preservation Functional Plan.

3.2.9 State Housing Functional Plan (1989, 1990)

3.2.9.1 Goals of the Plan

The 1990 State Housing Functional Plan identified a need to develop affordable housing throughout the State, and found that the housing needs of lower income households would not be adequately met in future residential developments. Obstacles identified to the development of affordable housing include (1) the lack of infrastructure, particularly on the neighbor islands; (2) the high cost of zoned land, high development costs, and the regulatory system particularly on O`ahu; (3) government policies that have created a shortage of urban land zoned for housing; (4) lack of government funds to develop rental housing; (5) building codes and subdivision standards that constrain innovative, cost-saving technologies; and (6) current labor wages. The Plan recommended increased densities in residential developments where feasible, smaller and basic units, funding for rental developments, and state subsidies.

3.2.9.2 Conformance to the Goals of the Plan

The proposed project does not include a residential component.

3.2.10 State Human Services Functional Plan (1989)

3.2.10.1 Goals of the Plan

The Human Services Functional Plan addressed: (1) elder abuse; (2) child abuse and neglect; and (3) spouse/domestic abuse and violence. The plan details statistics, causes, and prevention measures that can help to combat very pressing societal issues.

3.2.10.2 Conformance to the Goals of the Plan

The State Human Services Function Plan is not directly relevant to the proposed project.

3.2.11 State Recreation Functional Plan (1991)

3.2.11.1 Goals of the Plan

The 1991 State Recreation Functional Plan focused on six issue areas: (1) ocean and shoreline recreation; (2) *mauka*, urban, and other recreation; (3) public access to the shoreline and upland recreation areas; (4) resource conservation and management, (5) management of recreation programs and facilities; and (6) wetlands protection and management.

3.2.11.2 Conformance to the Goals of the Plan

As the proposed project does not constitute an active recreational use, the Recreation Function Plan is not directly relevant to the proposed project. However, to the extent that the project may include tenants that provide recreational amenities, such as bowling alleys or fitness centers, and the extensive pedestrian walkways provided within the development will encourage pedestrian movement (a passive recreational activity), the project is supportive of the State Recreational Functional Plan.

3.2.12 State Tourism Functional Plan (1991)

3.2.12.1 Goals of the Plan

The 1991 State Tourism Functional Plan focused on six issues: (1) the positive and negative impacts of tourism growth on the community; (2) physical development in terms of product quality, product diversity, land use planning, adequate infrastructure, and visitor use of public services; (3) environmental resources and cultural heritage; (4) community, visitor, and industry relations; (5) employment and career development; and (6) effective marketing.

3.2.12.2 Conformance with the Plan

As the proposed project will be a regional commercial center, it will be used by residents and visitors. Its presence in the `Ewa region will provide a valued amenity for the visitor industry, and to that end, it will compliment the Ko `Olina visitor destination area. The proposed hotels may be attractive to visitors but are intended to serve primarily business travelers and the local community's needs.

3.2.13 State Transportation Functional Plan (1991)

3.2.13.1 Goals of the Plan

The 1991 State Transportation Functional Plan sought to (1) construct facility and infrastructure improvements in support of Hawai'i's thriving economy and growing population base; (2) develop a transportation system balanced with an array of new alternatives; (3) implement Transportation Systems Management to maximize the use of existing facilities and systems; (4) foster innovation and use of new technology in transportation; (5) maximize joint efforts with the private sector; (6) pursue land use initiatives which help reduce travel demand; (7) encourage resident quality-of-life improvements through improved mobility opportunities and travel reduction.

3.2.13.2 Conformance with the Plan

Three significant transportation improvements planned for the East Kapolei area will have a direct impact upon the proposed project. The recently completed Kapolei Parkway abuts the northern property boundary of the subject property and provides direct access to the proposed regional commercial center.

At the same time, the State recently completed construction of the Kualaka`i Parkway linking Kapolei Parkway to the H-1 Freeway. That project included a new freeway interchange. DeBartolo proposes to extend Kualaka`i Parkway from Kapolei Parkway south to the project's eastern project entrance. This extension will benefit both the proposed development and the surrounding region because it will enable freeway traffic to directly access the subject property.

3.2.14 State Water Resources Development Functional Plan (1984)

3.2.14.1 Goals of the Plan

The 1984 State Water Resources Development Functional Plan set objectives to: (1) clarify the State water policy and improve management framework; (2) maintain the long-term availability of freshwater supplies while considering environmental values; (3) improve management of

flood plains; (4) assure adequate municipal water supplies for planned urban growth; (5) assure the availability of adequate water for agriculture; (6) encourage and coordinate development of self-supplied industrial water and the production of water-based energy; (7) provide for the protection and enhancement of Hawai‘i’s freshwater and estuarine environment; (8) improve state grant and loan procedures for water programs and projects; and (9) pursue water resources data collection and research to meet changing needs.

3.2.14.2 Conformance with the Plan

The construction of potable water infrastructure need to serve the proposed project will be coordinated with the development of the DHHL East Kapolei project as well as the proposed UH West O`ahu campus.

4 AN ASSESSMENT OF THE CONFORMITY OF THE PROPOSED USE TO OBJECTIVES AND POLICIES OF THE COASTAL ZONE MANAGEMENT PROGRAM, CHAPTER 205A, HRS

Federal Coastal Zone Management (CZM) enforcement authority (Public Law 92-583), as amended, has been delegated to the State and enacted as HRS Chapter 205A. The Hawai‘i CZM Program was promulgated in 1977 in response to the Federal CZM Act of 1972. Other than the review of federal applicants, federal permits, or federal activities, the State CZM review authority has been delegated to the county level through the SMA controls for development along the shoreline.

The CZM area encompasses the entire State including all marine waters seaward to the extent of the State’s police power and management authority, including the 12-mile U.S. territorial sea and all archipelagic waters. The CZM Act is comprised of a number of objectives primarily related to (1) protecting and preserving the coastal zone; (2) improving the quality of coastal scenic and open space resources and ensuring that coastal dependent development such as harbors and ports, and coastal-related development such as visitor industry facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and (3) encouraging research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.

Following is a summary of the project’s conformance with the ten objectives of the coastal zone management program.

1A Provide coastal recreation opportunities accessible to the public.

Not applicable, as the project is approximately 1.7 miles from the coastline.

2A Protect, preserve, and where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

No historic, prehistoric or cultural resources have been identified on the subject property. However, to ensure that potential subsurface resources associated with sinkholes in the coral plain substratum are not disturbed during construction, subsurface archaeological testing will be

conducted prior to construction in all areas where construction may impact the subterranean coral shelf.

3A Protect, preserve, and, where desirable, restore, or improve the quality of coastal scenic and open space resources.

As the proposed project is located about 1.7 miles from the shoreline, it is not applicable to this objective.

4A Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

As discussed under Objective 2A above, the proposed project will not have a significant adverse impact on the coastal ecosystem. According to the drainage master plan for the East Kapolei I development, drainage from the Kaloi and Hunehune gulches is to be directed to a piped drainage system and subsequently to detention basins. Storm runoff from the proposed project will discharge to the Kapolei Lower Channel and Coral Pit with Kalaeloa.

5A Provide public or private facilities and improvements important to the State's economy in suitable locations.

The subject property is classified as Urban land and is situated in the center of Kapolei's residential community. The provision of a regional mixed use center will greatly benefit the surrounding community, both in terms of new employment opportunities and in terms of reducing traffic congestion on the H-1 by helping to reverse traffic flow.

6A Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.

The subject property is situated about 1.7 miles from the coastline, well outside of the identified tsunami inundation zone and the effects of storm waves. There are no streams in the vicinity of the project. The buildings and pavements within the proposed project will create hardstand areas that are not subject to erosion. Landscaped areas will have ground cover and will be maintained to mitigate erosion from storm water runoff. The property is not subject to subsidence. Finally, the proposed uses are not anticipated to generate air or noise pollution.

7 Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

While the coastal element of this objective is not relevant to the project, the public participation aspect is. This environmental assessment helps to ensure that the project's potential impacts are fully disclosed.

8 Stimulate public awareness, education, and participation in coastal management.

As this project is not situated near the coastline, this objective is not applicable.

9 Protect beaches for public use and recreation.

As this project is not situated near the coastline, this objective is not applicable.

10 Promote the protection, use and development of marine and coastal resources to assure their sustainability.

As discussed above, the proposed project will have no significant negative impact upon the coastal resources of `Ewa. Therefore, it is consistent with the intent of this objective.

5 COMPLIANCE WITH CHAPTER 343, HRS

The entire 1,300-acre East Kapolei property, including the subject property was addressed in the East Kapolei Master Plan Final EIS, approved in July 1998, which was triggered by the proposed use of the state-owned land. This current environmental assessment is being prepared in response to a request from the DHHL to update the portion of the original document pertaining to the 67-acre subject property.

6 COMPLIANCE WITH THE `EWA DEVELOPMENT PLAN

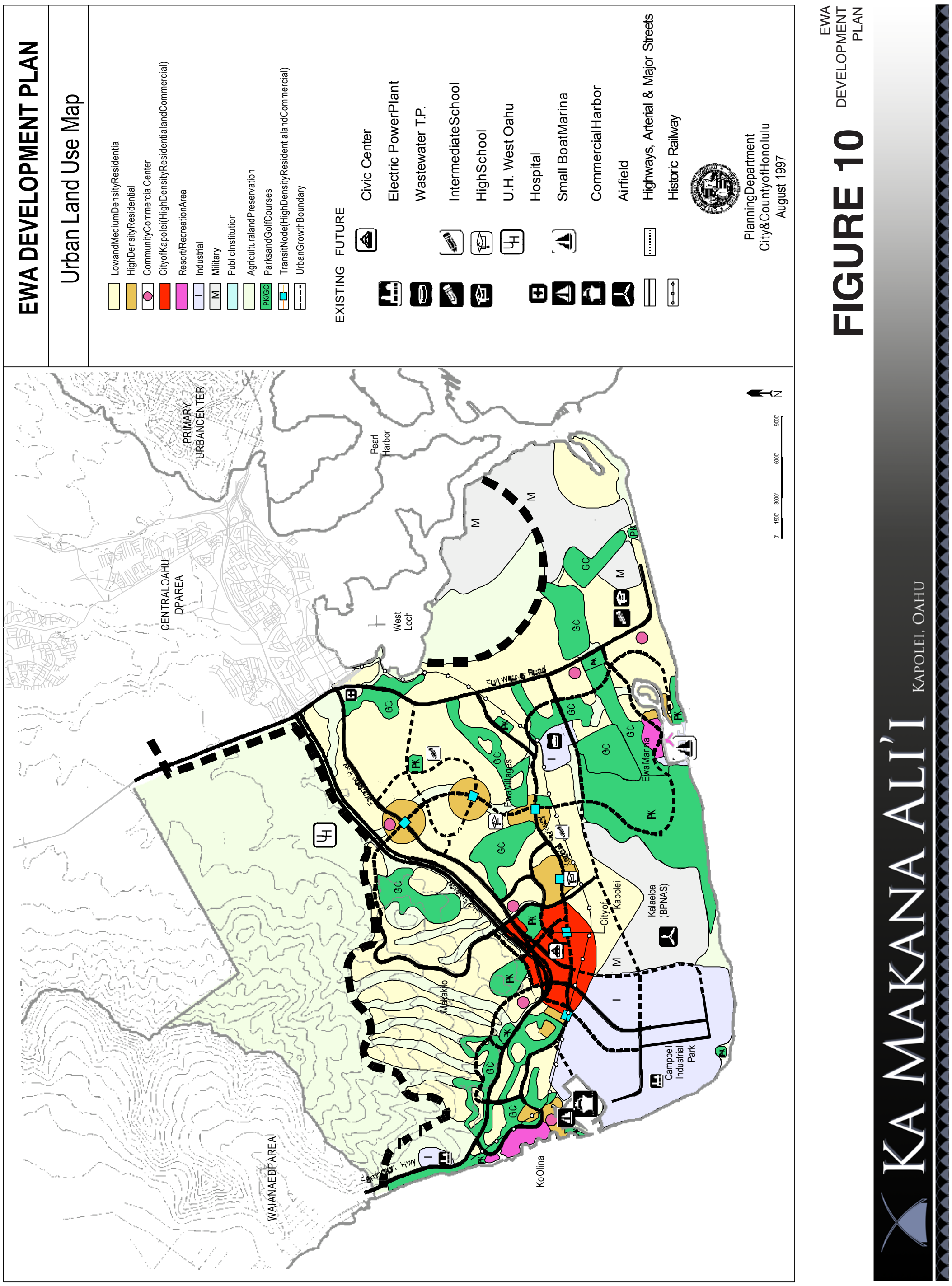
The 1997 `Ewa *Development Plan* designated the property for Low and Moderate Residential Development and assigned the property to the first phase of development in the `Ewa region (1997-2005). (Figure 10)

In 1999, the subject property was part of a 1,300-acre area known as East Kapolei that was reclassified by the State LUC from a State Agricultural district to a State Urban district (LUC Docket A99-728, approved September 8, 1999). At that time, the East Kapolei property was owned by the DLNR. The HCDCH was identified as the proposed project developer.

As discussed above, the East Kapolei area was eventually transferred to the DHHL and to the UH for development.

In October 2008, the DPP released a Public Review Draft in fulfillment of a statutory requirement to periodically revise and update the `Ewa Development Plan. The deadline for comments on the Public Review Draft was March 15, 2009. However, it was subsequently determined by the City that a second Public Review Draft would be prepared in response to comments received. As of mid-June 2011, the second draft document has not been released for public review and comment. Once public review of the soon-to-be released second draft is completed, the DPP will make any revisions that may be necessary and then transmit it to the Honolulu Planning Commission for review and recommendation to the City Council. Once the City Council receives the Planning Commissions comments, it will begin its deliberations. Revisions to the `Ewa Development Plan must ultimately be adopted by ordinance.

The first Public Review Draft identified the general area of the Hawaii DeBartolo LLC project as the site of a Regional Commercial Center, and notes that "…[b]ecause the DHHL has the power under the State Constitution to exempt itself from all State and County land use laws, rules and regulations, the City has no ability to require DHHL to follow the `Ewa Plan vision, policies and guidelines."


EWA DEVELOPMENT PLAN
Urban Land Use Map
Low and Medium Density Residential
High Density Residential
Community Commercial Center
City of Kapolei (High Density Residential and Commercial)
Resort/Recreation Area
Industrial
Military
Public Institution
Agricultural and Preservation
Parks and Golf Courses
Transit Node (High Density Residential and Commercial)
Urban Growth Boundary
EXISTING FUTURE
Civic Center
Electric Power Plant
Wastewater T.P.
Intermediate School
High School
U.H. West Oahu
Hospital
Small Boat Marina
Commercial Harbor
Airfield
Highways, Arterial & Major Streets
Historic Railway
Planning Department
City & County of Honolulu
August 1997
FIGURE 10
EWA DEVELOPMENT PLAN
KA MAKANA ALI'I
KAPOLEI, OAHU
CENTRAL OAHU DP AREA
PRIMARY URBAN CENTER
Pearl Harbor
West Loch
WAIANAE DP AREA
Ko Olina
Campbell Industrial Park
Kalaeloa (BPNAS)
City of Kapolei
Ewa Marina
Makakilo

6.1 COMPLIANCE WITH THE LAND USE ORDINANCE

DeBartolo Hawaii LLC has committed to construct the Ka Makana Ali`i project in substantial compliance with the zoning standards for Business Mixed Use (BMX-3 and BMX-4) as presented in the LUO. Internal roadways will be will be paved, with curbs, gutters and medians, and landscaping will be implemented in general compliance with LUO standards.

6.2 ZONING PARAMETERS

As described in Section 21-3.120 of the LUO, the purpose of the business mixed use district is to recognize that certain areas of the city have historically been mixtures of commercial and residential uses, occurring vertically and horizontally, and to encourage the continuance and strengthening of this pattern. It is the intent to provide residences in very close proximity to employment and retail opportunities, provide innovative and stimulating living environments, and reduce overall neighborhood energy consumption. It should be noted, however, that no residential land uses are proposed as part of the Ka Makana Ali`i development.

As presented in the LUO, the intent of the BMX-3 community mixed use district is to provide opportunities for mixed use development outside of the central business district. The intent of the BMX-4 central business mixed use district is to provide the highest land use intensity for commerce and business.

The Ka Makana Ali`i development proposes the BMX-4 standards for the portion of the Village Mixed Use Center that will accommodate the proposed hotel development (see Figure 5).

6.2.1 Proposed Density

The proposed project is expected to utilize the entire 67-acre property. As shown on Figure 4, Phase 1 will comprise approximately 395,421 square feet; Phase 2 approximately 445,475 sf; and Phase 3 approximately 613,902 square feet. The maximum allowable density (Floor Area Ratio: FAR) is 2.5 for BMX-3 and 4.0 for BMX-4. The anticipated density for the BMX-3 portion of the development is 0.40 (FAR) with a likely maximum density of 2.7 FAR for the BMX-4 area.

6.2.2 Building Area (Lot Coverage)

The majority of the project site will be impervious area. Generally 46 percent of the site will be impervious surfaces consisting of roads, walkways, and rooftops. The remaining areas will be landscaped with canopy trees in parking areas, and larger planting areas around the perimeter and adjacent to buildings.

As presently conceived, approximately 69 percent of the project area will be retained in open space. [Architect to confirm these percentages]

6.2.3 Building Height

The maximum building height for the project area will be 120 feet.

6.2.4 Yard Setbacks

Front yard setbacks for BMX-3 and BMX-4 are 5 feet for uses other than dwellings. There are no side or rear yard setback requirements for uses other than dwellings in BMX-3 and BMX-4.

6.3 VIEW ANALYSIS

6.3.1 Consistency with the `Ewa Development Plan

The `Ewa Development Plan (DP) calls for retention of visual landmarks and significant vistas, including:

- distant vistas of the shoreline from the H-1 Freeway above the `Ewa Plain,
- views of the ocean from Farrington Highway between Kahe Point and the boundary of the Waianae Development Plan Area,
- views of the Wai‘anae Range from H-1 Freeway between Kunia Road and Kaloi Gulch and from Kunia Road,
- views of na pu‘u at Kapolei, Palailai, and Makakilo,
- *mauka* and *makai* views, and
- views of central Honolulu and Diamond Head.

This project is consistent with the relevant sections of the plan, as it retains *mauka* views from the project site.

6.3.2 Regional Views

The hotel and office structures will be visible from areas immediately surrounding the project site, but will not be visible generally from other areas of the `Ewa plain because of the flat topography and the presence of residential subdivisions and vegetation, views will be obstructed by houses and trees. The proposed project will be visible from undeveloped areas within Kalaeloa and from the Makakilo hillside.

6.3.3 Views of Scenic Features within Site

Views of conceptual development within the site from surrounding roadways and adjacent properties are shown on Figures 11, 12, and 13.

Figure 11 depicts views from the southeastern corner of the property looking toward the northwest from the OR&L railway tracks and the adjacent City and County of Honolulu property.

Figure 12 presents a view from the intersection of Kapolei Parkway and Kualaka`i Parkway looking southwest into the project area.

Figure 13 presents a view of the conceptual plan looking southwest across the property. Perspective C depicts the northeast corner of the development looking down its eastern boundary, and Perspective D presents a closer view of the project’s northeastern pedestrian entrance.

7 ASSESSMENT OF THE EXISTING NATURAL ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATION MEASURES

7.1 TOPOGRAPHY

The subject property is relatively flat land with a slope of one to two percent from north to south. It is sparsely vegetated owing to the presence of the borrow pit, foundation area, stockpiles, and the numerous equipment roads that have been graded across the property (see Figure 5).

As depicted in Figure 1, the subject property is generally situated between the Villages of Kapolei and Varona Village. The remainder of the DHHL East Kapolei property lies north of the subject property and Kalaeloa (the formers Barbers Point Naval Air Station) lies to the south. As discussed above, the majority of the subject property has been used for the past two years as a borrow pit, a stockpile area, construction equipment storage, and graded for staging numerous construction vehicle roads. The property also includes an area excavated for the formerly proposed sports complex foundation. The subject property is presently vacant and unused.

Potential Impacts and Mitigation Measures

As discussed in the 1998 FEIS, "Potential environmental impacts will occur primarily during the construction period from noise, soil erosion, increased construction machinery exhaust emissions, and temporary disruption of traffic. After project development and implementation of appropriate mitigation measures, no significant impacts affecting water quality will occur, surface drainage will be significantly improved, the diversity of plant and animal species will increase, and archaeological resources will not be impacted" (1998 East Kapolei FEIS, page 2).

7.2 SCENIC RESOURCES

No scenic resources are located on the subject property. Its distance from the shoreline precludes any views of the shoreline, the horizon, or coastal features along the south shore of O`ahu. The predominant vista associated with the property is a view of the southern portion of the Waianae mountain range, including Pu`u Makakilo.

Potential Impacts and Mitigation Measures

As discussed in the 1998 East Kapolei FEIS, the visual appearance of the subject property will change from vacant scrub vegetation to a built urban environment. In the case of the subject property, approximately half the area has been and continues to be disturbed by grading and stockpiling activities associated with a previously granted grading permit for the excavation of the borrow pit and the stockpiling of excavated material. In addition, a large portion of the remaining property was used for temporary storage of construction materials and construction vehicle access related to the extension of the Kapolei Parkway by the DHHL immediately north

FIGURE 11 - VIEW TO THE NORTHWEST

KA MAKANA ALI'I Kapolei, Oahu

06.22.11

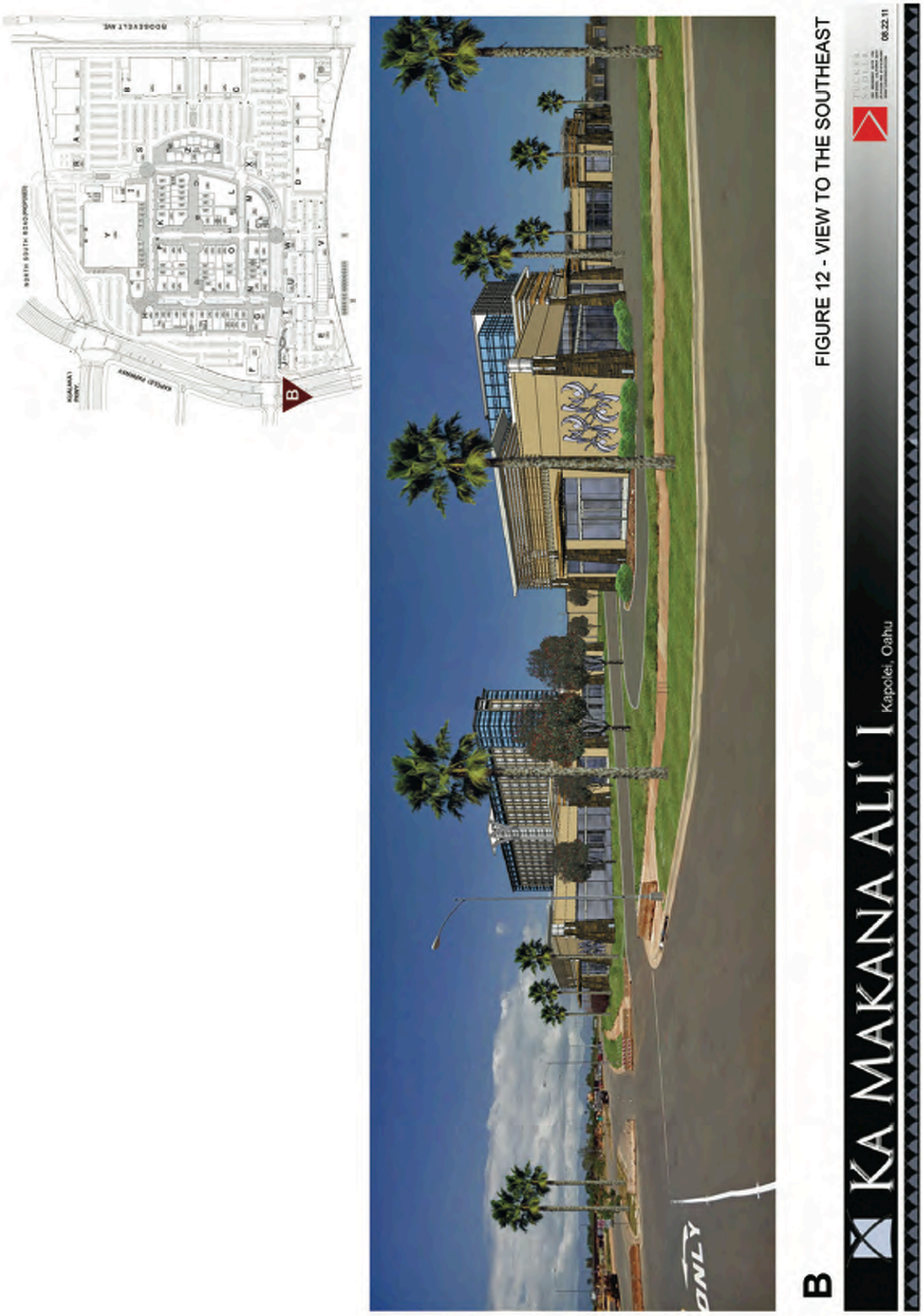


FIGURE 12 - VIEW TO THE SOUTHEAST

C
D
FIGURE 13 - VIEW TO THE SOUTHWEST
KA MAKANA ALI'I
Kapolei, Oahu
08.22.11

of the subject property. Given these existing conditions, the visual appearance of the property will greatly improve with its eventual development.

The proposed development will consist of several structures ranging in height from 25 to 120 feet. The proposed development will be visible from abutting roadways including Kapolei Parkway, Roosevelt Avenue, and the proposed extension of Keoneula Boulevard. It will also be visible from other portions of the East Kapolei development project, Village 8 to the west, and Varona Village to the east. The taller structures on the project site will likely be visible from Farrington Highway, and the entire development will be visible from the eastbound lanes of the H-1 Freeway.

7.3 BOTANICAL RESOURCES

A 1996 botanical survey of the entire East Kapolei property, including the subject property, noted that the property was classified by Ripperton and Hosaka (1942) as one of lowland shrub with a coastal fringe of kiawe trees. A survey conducted by Nagata (1996) found that the vegetation on the property was entirely secondary and determined by its previous history of cultivation (or disturbance) on each individual parcel of land. Eight plant communities were recognized, each community existing as a continuum with one blending into another. Species composition and vegetative cover will differ somewhat during the rainy season.

Within the eight plant communities identified, 99 different plant species were recorded with two indigenous (‘ilima and pa‘uohi‘iaka), two probably indigenous (‘uhaloa and hoary *abutilon*) and one endemic (ko‘oloa‘ula, *Abutilon menziesli*). Except for the ko‘ola‘ula, all the native species on site are common lowland species in Hawai‘i. While a total of 88 individuals of the ko‘olao‘ula were found on the East Kapolei property, none were located on the subject property. The ko‘oloa‘ula is now a federally listed endangered species that was once endemic to Lana‘i, Maui, O`ahu, and Hawai‘i. The individuals were generally found within the central portion of the East Kapolei property roughly under some existing electrical transmission lines. According to the botanist, unknown individual plants likely existed within uncultivated portions of the property during the many years of sugar cultivation. After the property became fallow, seeds from the remaining individuals were able to establish themselves within the previously cultivated area. As part of the East Kapolei project, a Habitat Conservation Plan (HCP) for *Abutilon menziesii* was subsequently prepared and implemented.

A botanical inventory of the subject property was conducted in 2007 and updated in 2011 (see Appendix C). This study concluded that there are two types of vegetation at the project site: ‘Managed Land Vegetation’ and ‘Buffel Guinea Grass Grassland’. Both of these are classified as ‘disturbed vegetation’.

Managed Land Vegetation is associated with the southern portions of the property occupied by the barrow pit, the dirt stockpiles, as well as the various dirt roads that crisscross the property. The native (or possibly native) ma`o (*Abutilon incanum*) was found growing on the stockpiles.

Buffel Guinea Grass Grassland includes a heterogeneous assemblage of plant types united by a dominance of Buffel Grass (*Cenchrus ciliaris*) as the ground cover. On the northern portion of the property, pluchea (*Pluchea carolinensis*) is the dominant shrub. Mixed with it are scattered individuals of koa haole (*Leucaena leucocephala*), kiawe (*prosopis pallida*), and `opiuma (*Pithecellobium dulce*), all three of which are members of the pea family Fabaceae and are

characteristic of dry areas of Hawai`i. In addition to the matrix of Buffel Grass, `ilima (*Sida fallax*), `uhaloa (*Waltheria indica*), creeping indigo (*Indigofera spicata*), vergata mimosa (*Desmanthus pernambucanus*), Austrialian saltbush (*Atriplex semibaccata*), and several other species are present. The `uhaloa and `ilima are indigenous species, the others are all alien species.

The central portion of the subject property occupied by the former stadium excavation is also covered with non-native vegetation.

A total of fifty-eight plant species were recorded at the study site. A list of these species is presented in the appendices included in Appendix C. Only four of the 58 are native; three of them indigenous and one endemic. Indigenous plants are species native to a region or place, but are also found elsewhere. Endemic plants are species restricted to a single region or area, i.e., in the case of Hawai`i, they are found only in Hawai`i. The majority of the 58 species encountered during the survey are naturalized or weedy "alien" plants that were accidently or intentionally introduced to Hawai`i, but which now have become established in the islands and can spread on their own. Two of the indigenous species, `ilima (*Sida fallax*) and `uhaloa (*Waltheria indica*), are widespread species common in disturbed habitats. The other possible indigenous species, ma`o (*Abutilon incanum*) is less common. The endemic species, ko`oloa`ula (*Abutilon mensiesii*), is a federally listed endangered species found in East Kapolei, but not on the subject property.

Potential Impacts and Mitigation Measures

Development of the proposed project will result in the replacement of existing scrub vegetation with a landscaped urban environment including buildings and extensive parking lots. Landscape materials will include lawn areas, ornamental shrubs, and trees. Drought resistant plants will be incorporated into the landscaping palette wherever practicable. The consulting botanist concludes "…there are no botanical reasons why development of the parcel cannot take place…all of the proposed development is on very disturbed land."

7.4 FAUNAL AND AVIFAUNAL RESOURCES

An Avian and Terrestrial Fauna Survey was conducted on the property in June 2011 and is included in this environmental assessment as Appendix D.

There is no federally delineated Critical Habitat present on or adjacent to the property. Thus the development and operation of proposed development will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under State law.

A total of 346 individual birds of 17 species, representing 12 separate families, were recording during station counts on the subject property. All species detected are considered to be alien to the Hawaiian Islands. No other avian species were detected during the survey. No avian species detected during the course of the survey are protected or proposed for protection under either the federal or State of Hawai`i endangered species statues. Avian diversity and densities were in keeping with the highly disturbed nature of the habitat present on site, and the site's location in East Kapolei.

Three terrestrial mammalian species were detected on site during the course of the survey. Tracks, scat and signs of dog (*Canis f. familiaris*), small Indian mongoose (*Herpestes a. auropunctatus*) and cat (*Felis catus*) were encountered at numerous locations within the site. No

mammalian species currently protected or proposed for protection under either the federal or State of Hawai`i endangered species programs were detected during the course of the survey, nor were any expected.

The findings of the survey are consistent with the results of several other faunal surveys conducted in the `Ewa Plains over the past several years. Although not detected during the survey, it is probable that two migratory shorebird species use loafing and foraging resources on this site during the fall and winter months. The two, Pacific Golden-Plover (*Pluvialis fulva*) and Ruddy Turnstone (*Arenaria interpres*) are indigenous migratory shorebird species that nest in the high Arctic during the late spring and summer months, returning to Hawai`i and the Tropical Pacific to spend the fall and winter months each year. They usually leave Hawai`i for their trip back to the Arctic in late April or very early in May. There are no known nesting colonies of any of the resident seabird species on O`ahu on, or in close proximity, of the project site.

Although no rodents were detected during the survey, it is likely that the four established alien *muridae* found on O`ahu, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), European house mouse (*Mus musculus domesticus*), and possibly Polynesian rats (*Rattus exulans hawaiiensis*) use various resources found within the general project area on a seasonal basis. All of these introduced rodents are deleterious to native ecosystems and the native faunal species dependent upon them.

No Hawaiian hoary bats were detected during the course of the survey. Given the paucity of documented records of this species on O`ahu and the complete lack of suitable roosting vegetation on the site, the chance that any use resources on the subject property are extremely low.

Potential Impacts and Mitigation Measures

The principal potential impact that construction and operation of the proposed development poses to protected seabirds is the increased threat that the birds will be downed after becoming disoriented by lights associated with the project during the nesting season. The two main areas of outdoor lighting could pose a threat to these nocturnally flying seabirds are: 1) during construction if it is deemed expedient or necessary to conduct nighttime construction activities; or 2) following build-out, when the potential use of streetlights or other exterior lighting becomes disorienting during the seabird nesting season. These impacts can be mitigated to some extent by shielding construction lighting and by shielding street and exterior lighting

Development of the project will displace fauna and avifauna temporarily. However, this is not considered to constitute a significant adverse impact as no endangered or threatened species have been identified on site. The eventual landscaping of the project site will likely improve the diversity of avifauna on the property because a greater variety of habitat will be created.

7.5 SOIL CLASSIFICATION

The soils on the subject property were generally divided between two soil classifications: Honouliuli series (HxA) and Mamala series (MnC). As presented in Figure 6, the HxA soils constitute the northern half of the site while the MnC soils constituted the southern half. Honouliuli soils are well-drained soils on coastal plains. They are nearly level. Permeability is moderately slow and the erosion hazard is considered to be slight. The Mamala soils are stony silty clay loam with 0-12 percent slopes and their erosion hazard is slight to moderate.

Within the southern portion of the property, the borrow pit is the predominant feature. It was excavated by DHHL so that the subsurface coral material could be utilized as fill material at the neighboring Village 8 residential project. It is presumed that the existing stockpile contains, at least in part, the topsoil that was removed when the borrow pit was excavated.

Potential Impacts and Mitigation Measures

The soil composition of the subject property will be altered by the introduction of fill material through out the property. This is not considered to be a significant impact because the subject property has undergone extensive modification over the course of its known history. The original coral shelf was covered with imported soil in the late 1800s to facilitate the growth of sugar cane. Beginning in 2000, large portions of the property were excavated and were also used for the stockpiling of soil from other development areas in the region.

7.6 AGRICULTURAL LANDS OF IMPORTANCE TO THE STATE OF HAWAI'I (ALISH)

The lands generally occupied by the existing borrow pit and stockpile were formerly identified as Prime Agricultural land. The remainder of the subject property is identified as Other (see Figure 14). The Land Study Bureau classified the subject property as A11i and B16j. The Bureau's five-class productivity rating uses the letters A through E, with A representing the class of highest productivity and E the lowest. As demonstrated in Figure 8, the A lands generally corresponded to the location of the borrow pit and stockpile, with the B lands on the remainder of the site.

Potential Impacts and Mitigation Measures

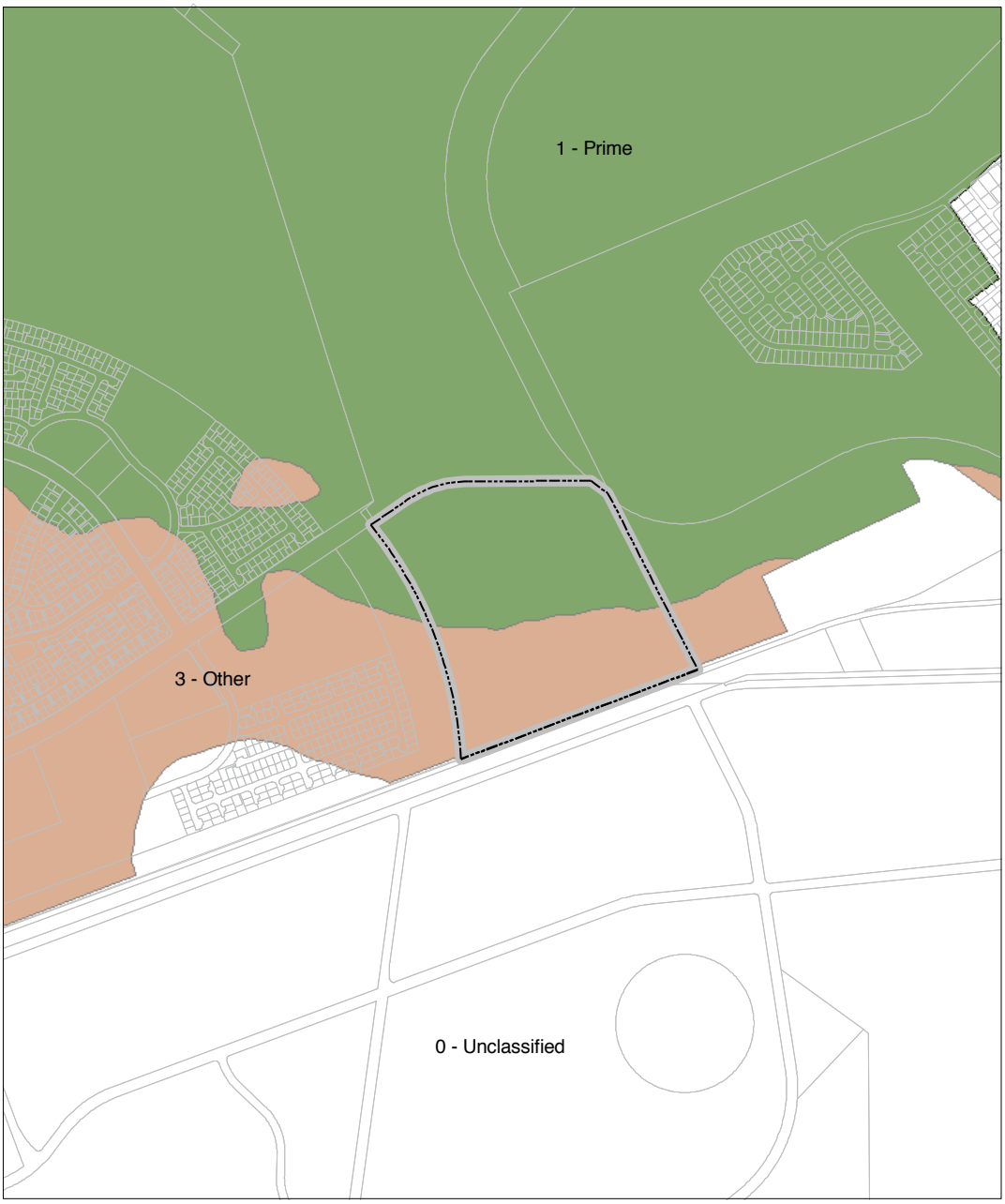
As agricultural activity on the subject property was discontinued approximately 30 years ago and the land has remained fallow since then; the proposed development will have no significant impact upon agricultural activity. Reclassification of the East Kapolei property to the State Urban district in 1998, including the subject property, effectively removed it from the inventory of agricultural lands. The project will have little or no impact on agricultural production.

Nearby lands have been developed for urban uses as housing and schools. At least a mile or more to the northeast, land reaching to Farrington Highway is now being farmed on short-term lease. That acreage has long been slated for urban development. Farm operations are expected to phase out over the coming years as residential development of the DHHL East Kapolei property and lands further east are eventually developed pursuant to the `Ewa Development Plan.

The lifestyle center, community market areas, and restaurants within the project could provide new venues for the sale of local produce. In that respect, the project could encourage island agriculture.

7.7 GROUNDWATER

The `Ewa region of O`ahu overlies the southern O`ahu basal aquifer (SOBA), a designated sole source aquifer. The gently sloping topography of the `Ewa Plain is comprised of terrestrial alluvium which is made up of clay and mud eroded from volcanic rock and is inter-layered with coral lime stone deposited during periods when the area was covered with ocean. The geological feature is commonly referred to as 'caprock' and is estimated to be approximately 1,000 feet



LEGEND

- Ka Makana Ali'i
- 1 Prime
- 2 Unique—none shown
- 3 Other
- 4 Unclassfied

FIGURE 14 ALISH MAP

N

0' 250' 500' 1000'

KA MAKANA ALI'I KAPOLEI, OAHU

thick near the shoreline and extends inland under the subject property. Water in the caprock is too saline to be potable.

Potential Impacts and Mitigation Measures

The construction and operation of the proposed development is not anticipated to result in a significant adverse impact upon the region's groundwater resources. The proposed development will be connected to the City's sanitary wastewater collection and treatment system. Storm water from the project site will drain into the lower channel of the existing East Kapolei drainage channel along the western boundary of the property, in compliance with the East Kapolei I Drainage Master Plan that was accepted by the City and County of Honolulu in 2006.

7.8 CLIMATE

The climate of the Kapolei area is very much affected by its coastal setting and leeward location on the island of O`ahu. Winds are predominantly trade winds from the east-northeast except for occasional periods when *kona* storms may generate strong winds from the south or when the trade winds are weak and diurnal (land-breeze/sea-breeze) circulations may develop. Wind speeds typically vary between about 5 and 15 miles per hour providing relatively good ventilation much of the time.

Temperatures in the leeward O`ahu region are generally very moderate with daily temperatures ranging from about 65 degrees F to 84 degrees F. The extreme minimum temperature recorded at the nearby (former) Ewa Plantation is 47 degrees F, while the extreme maximum temperature is 93 degrees F.

This area of O`ahu is one of the drier locations in the state with rainfall often highly variable from one year to the next. Monthly rainfall has been measured to vary from as little as a trace to as much as 15 inches. Average annual rainfall amounts to about 21 inches with summer months being driest.

Potential Impacts and Mitigation Measures

The Proposed Action is not anticipated to result in significant adverse impacts upon the regional climate. Once the project is completed, there may be some localized increase in temperature resulting from the addition of paved surfaces, rooftops, and sunlight reflected from glass surfaces. However, landscaping and shade trees will help to mitigate some of the potential temperature increases.

7.9 NOISE QUALITY

The existing background ambient noise levels within the project area are from motor vehicle traffic along Kapolei Parkway, Kualaka`i Parkway, Renton Road, and Roosevelt Avenue. Jet, propeller aircraft, and helicopters are some of the other noise events intermittently audible at the project site.

An Acoustic Impact Analysis was conducted in June 2011 for the Proposed Action and is included in this environmental assessment as Appendix E.

The noise descriptor currently used by federal agencies (such as FHA/HUD) to assess environmental noise is the Day-Night Average Sound Level (Ldn or DNL). This descriptor

incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard sound level meter sound levels which occur during the hours of 10pm to 7am are increased by 10 decibels (db) prior to computing the 24-average.

As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas that are removed from high volume roadways. In urbanized areas that are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL and are usually controlled (caused) by motor vehicle traffic noise. Residences that front major roadways are generally exposed to levels of 65 DNL and as high as 75 DNL when the roadway is a high-speed freeway.

For purposes of determining noise acceptability for funding assistance from federal agencies, an exterior noise level of 65 DNL or less is considered acceptable for residences. This standard is applied nationally, including Hawai`i. For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 DNL are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels that exceed 65 DNL.

On the Island of O`ahu, the DOH regulates noise from construction activities, through the issuance of permits for allowing excessive noise during limited time periods. State DOH noise regulations are expressed in maximum allowable property line noise limits rather than DNL. Although they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for commercial properties equate to approximately 60 DNL.

For aircraft noise, the State Department of Transportation, Airports Division, recommends that 60 DNL be used as the common level for determining noise compatibility in respect to noise sensitive uses (such as hotels) near its airports.

At the subject property, the existing 65 DNL traffic noise contour (meaning the maximum distance where noise levels are equal to 65 DNL) is located approximately 136 feet from the centerline of Roosevelt Avenue, 120 feet from the centerline of Kualaka`i Parkway, 58 to 74 feet from the centerline of Kapolei Parkway, and 51 to 75 feet from the centerline of Renton Road.[7]

Potential Impacts and Mitigation Measures

Existing traffic noise levels probably exceed 65 DNL at existing residences that front Kapolei Parkway, Renton Road, and Roosevelt Avenue.

The proposed project will be a contributor to increased traffic noise levels along the major roadways that will serve the project area. The future traffic noise contributions from project traffic should be less than the contributions from non-project related traffic. Traffic noise mitigations measures should not be required for buildings on the project site since the planned buildings have adequate setback distances from the roadways.

Non-project related traffic noise and project-related traffic noise will increase along the major roadways in the future. By 2015, traffic noise levels along Roosevelt Avenue are predicted to increase by 0.9 DNL units without the proposed project and by 1.1 to 1.2 DNL units with the project. Along Kapolei Parkway, traffic noise levels in 2015 are expected to increase by 1.2 to

[7] A new fire station is being constructed across Kapolei Parkway from the project site and the average sound level from sirens is predicted to be in the order of 86dBA in the vicinity of the planned hotels on the project site. Because the hotels are expected to be air conditioned, and can therefore utilize sound attenuation measures, adverse noise impacts should be avoidable.

2.0 DNL by 2015 as a result of non-project related traffic, and by 0.4 to 1.5 DNL by 2015 as the result of project-related traffic. The proposed hotel site within the project area should be outside the 65 DNL traffic noise contour.

The planned hotel included in the project is located outside (beyond) the 60 DNL aircraft noise contour associated with Honolulu International Airport and with Kalaeloa Airport aircraft operations.

Unavoidable but temporary noise impacts may occur during construction of the proposed project, particularly during excavation and site preparation activities. Because construction activities are predicted to be audible within the project site and at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases, but the use of quiet equipment and the use of the State DOH curfew periods are recommended as a standard mitigation.

Closure and air conditioning of residences are effective traffic noise mitigations, particularly at second floor living areas that are difficult to shield with sound attenuating walls. Traffic noise mitigations are typically implemented by individual homeowners and/or developers of noise sensitive properties located along roadways. As there are no existing residences along Kapolei Parkway or Roosevelt Avenue fronting the proposed project, no homes will be directly impacted by project-related noise. Homes along Kapolei Parkway and residential units along Roosevelt Avenue in Kalaeloa further away from the project may be impacted by higher levels of traffic noise by 2015, but these increased noise levels are anticipated to be more related to increases in ambient traffic unrelated to the proposed project.

7.10 AIR QUALITY

The present air quality at the subject property appears to be reasonably good based upon nearby air quality monitoring data collected as part of an Air Quality Impact Study conducted in June 2011 for the Proposed Action and included as Appendix F to this environmental assessment. Air quality data from the nearest monitoring stations operated by the Hawaii State DOH suggests that all national air quality standards are currently being met. It is possible, however, that on occasion the more stringent state standards for carbon monoxide may be exceeded near congested roadway intersections.

Potential Impacts and Mitigation Measures

If the proposed project is given the necessary approvals to proceed, it may be inevitable that some short- and/or long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given

time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, motor vehicles coming to and from the proposed development will result in a long-term increase in air pollution emissions in the project area. However, computer modeling conducted for the Proposed Action indicates that during worst-case conditions, at full build out in 2015, project-related traffic would result in higher carbon monoxide concentrations compared to the without-project scenario at some locations, but would remain well within air quality standards. With the project and with the eventual Kualaka`i Parkway extension to Roosevelt Avenue, worst-case carbon monoxide concentrations were estimated to remain the same or increase only slightly at some locations compared to conditions without the Parkway extension. Implementing mitigation measures for traffic-related air quality impacts are deemed unnecessary by the consulting meteorologist.

Depending on demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Based on estimated demand levels and emission rates involved, any impacts are anticipated to be very likely negligible. Nevertheless, incorporating energy conservation design features within the proposed development could serve to further reduce associated impacts.

7.11 NATURAL HAZARDS

Natural hazards include events such as hurricanes and tropical storms, high winds, tsunami, floods, earthquakes, soil slippage, and volcanic eruptions.

The State of Hawaii has been exposed to the damaging effects of hurricanes twice in the past 30 years; Iwa in 1982 and Iniki in 1992. While Iwa impacted both the eastern coastal areas of Kauai and the western coast of O`ahu, Iniki's impacts were generally confined to Kauai. Continual improvements in forecasting make it possible to predict the likely course of a hurricane or tropical storm up to three days in advance with some, but not complete, certainty. This capability provides area residents with sufficient time to take appropriate actions. But the prediction of hurricanes and tropical storms further into the future is not possible. The project area is no more or less vulnerable to the destructive winds and torrential rains associated with these storms than other areas of O`ahu or the state.

High winds can result from hurricanes, tropical storms, and the juxtaposition of high-pressure and low-pressure areas relative to the Hawaiian Islands. They can occur at virtually any time over the course of the year. The period from June 1st to December 1st is considered to be hurricane season in the Central Pacific. But tropical cyclones can form during the winter months and are called Kona Storms if they located east or southeast of the islands. High winds associated with varying pressure gradients typically occur in the January to March period but are not restricted to those months. The damaging effects of high winds are usually not associated with the winds themselves, but rather, with airborne debris.

The recent devastating tsunami in Japan in early 2011 served as a potent reminder how vulnerable the Hawaiian Islands are to earthquake-induced tsunami around the edge of the Pacific Ocean. Damaging ocean surges can occur for several hours after having travelled

thousands of miles across the ocean. Tsunami waves can inundate coastal regions several hundred yards inland.

Flooding in the subject area is discussed in the next section.

The Hawaiian Islands are susceptible to earthquakes that are typically associated with volcanic activity. The island of O`ahu is situated within Seismic Hazard Zone 2A (on a scale of 1 to 4 with 4 being the most severe). In 2009, electrical power on the island of O`ahu was disrupted for nearly a day as the result of a magnitude 6+ earthquake whose epicenter was located just offshore the Kohala coast of the Big Island.

On a large scale, soil slippage or subsidence in Hawai`i is usually associated with volcanic or seismic activity. On a smaller or localized scale, soil slippage can take the form of mudslides or rock falls typically occurring during or after periods of heavy rain.

Volcanic activity in the Hawaiian Islands is presently confined to the active craters at Kilauea and Mauna Loa on the Big Island of Hawai`i. Hazards associated with volcanic eruptions include lava inundation, exposure to tephra (airborne volcanic debris), and high volumes of gas emissions.

Potential Impacts and Mitigation Measures

As the result of Hurricane Iniki, building codes statewide were revised to include more stringent measures to improve the ability of new structures to withstand hurricane force winds, and provisions for retrofitting existing structures. Construction of the project will be consistent with these codes. The measures will also mitigate the impacts of high winds during non-hurricane events.

The subject property is situated approximately two miles inland from the coastline and is not located within an identified tsunami inundation zone. No direct impacts from tsunami are anticipated.

As is the case with hurricanes, earthquake impacts will be mitigated through compliance with the Uniform Building Code adopted and enforced by the City and County of Honolulu.

The project area is on flat land that is not susceptible to landslides or rock fall. No significant adverse impacts from these natural hazards are anticipated.

As there is no volcanic activity on the Island of O`ahu, the subject property will not be directly impacted by the hazards directly associated with volcanoes. However, the project area may experience the indirect impacts of volcanic emissions (known locally as vog), but these impacts are not anticipated to be significant.

7.12 FLOOD AND DRAINAGE CONDITIONS

As depicted in Figure 15, the majority of the subject property is classified as Flood Zone X by the Federal Emergency Management Agency's Flood Insurance Rate Map (FIRM). A relatively narrow strip of the subject property along its southern boundary is designated as Flood Zone D. Land in Flood Zone X is subject to inundation by the 500-year flood. A designation of Flood Zone D means that the potential for flooding is undetermined.

The East Kapolei area, including the subject property, is impacted by regional storm runoff from a portion of the Kaloi Gulch drainage basin and the Hunehune Gulch drainge basin. The two

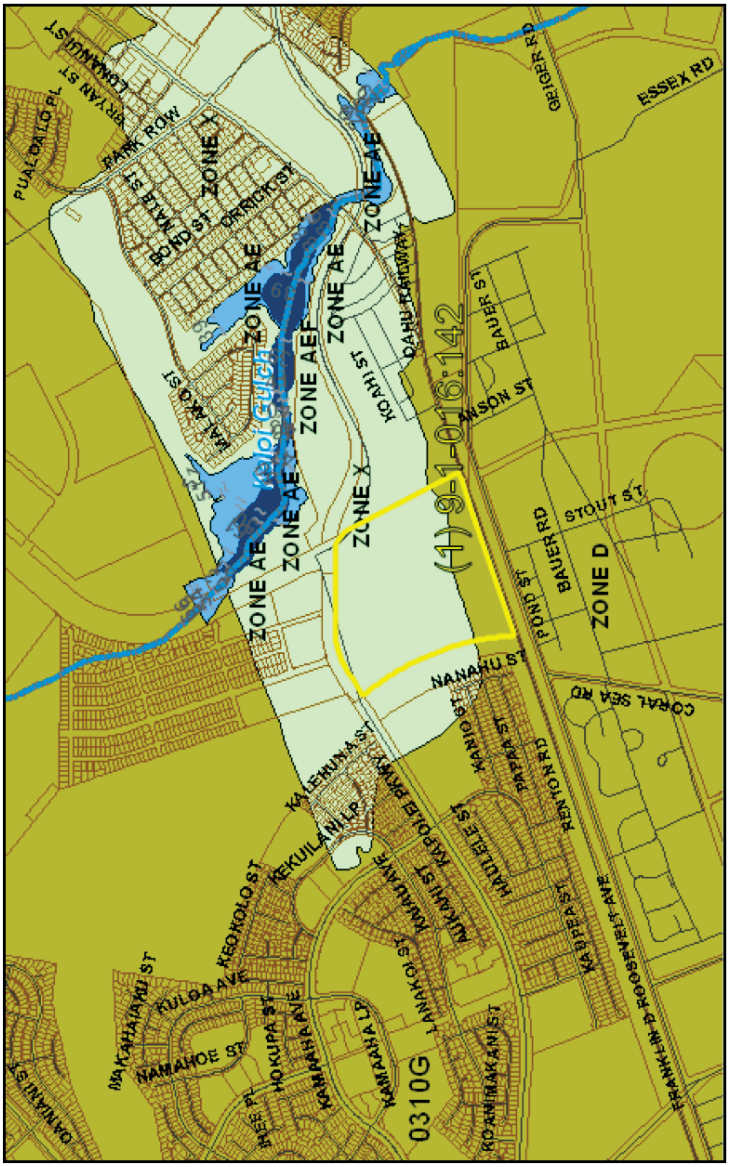


FIGURE 15 FIRM MAP

KA MAKANA ALI'I KAPOLEI, OAHU

gulches converge within the 500-acre UH West O`ahu project site. At times, significant precipitation causes direct runoff that flows overland via the two gulches to the Ewa Villages Golf Course situated northeast of the subject property, and then *makai* to the Coral Creek Golf Course southeast of the subject property.

Storm runoff from the subject property flows that does not flow into and collect in the barrow pit flows into the Lower Kapolei Channel along the western boundary and subsequently into the Coral Pit in Kalaeloa.

Potential Impacts and Mitigation Measures

Runoff generated within the project site typically remains on site in existing pits and depressions, sheet flows to the Kapolei Lower Channel to the southeast, or sheet flows to the adjacent property in the north/northeast. The Kapolei Lower Channel flows northeast to southwest parallel to Roosevelt Avenue and ultimately discharges into a depression on the western side of Fort Barrette Road near its intersection with Roosevelt Avenue, a feature commonly referred to as the "coral pit."

8 ASSESSMENT OF THE EXISTING HUMAN ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATION MEASURES

Ka Makana Ali`i is a regional mixed use center serving Leeward O`ahu, especially the `Ewa Plain. It responds to the needs of a growing community. Located at the heart of `Ewa, it will be convenient to residents of `Ewa Beach, Ewa Villages, and the Gentry subdivisions, as well as to the Kapolei area. It will complement the UH West O`ahu campus and Kroc Center by providing a spine of public uses in the middle of `Ewa, and hence encouraging further development of the `Ewa urban area.

8.1 ARCHAEOLOGICAL RESOURCES

An Archaeological Inventory Survey with backhoe testing was conducted by Pacific Legacy for the proposed project and is presented in Appendix G. Following are the results of the survey.

The 'Ewa Plain of Honouliuli Ahupua'a has a long and complex history, which is apparent from archival research and archaeological investigations carried out in the last 30 years. Archival research has allowed a glimpse of the varied lifeways on the plain. Peripheral areas, especially those bordering Pearl Harbor, offered rich natural resources for fishing and gathering and the perfect matrix for fruitful agriculture in pre-Contact times. Yet, central plain areas presented scant resources needed for survival. Traditional accounts echo this disparity in 'Ewa Plain resources. Local mythology and lore suggest that the entire region is has been the backdrop for legendary tales and the home of many mystical beings as well as *ali'i*. Archaeological investigations have shown that much of the area's cultural resources have been disturbed by sugar plantation activities. However, the most common features in this area are agricultural features and sinkholes containing archaeological and paleontological resources. Due to historic sugar cane and sisal cultivation activities as well as plantation related infrastructure development, features such as these have likely been covered with sediment, encapsulating them and obscuring their locations. The area's more recent past is also significant in understanding the region's economic evolution as well as local cultural dynamics and identities.

The surface survey yielded no archaeological sites. Rather, the project area exhibited signs of continuous disturbances in the form of construction excavations, bulldozing, and dumping. Further, there appeared to be a significant amount of modifications to the land in the form of jumps, tracks, roads, and berms, to help facilitate modern off-roading for off-road vehicles (ORV) and all-terrain bicycles, which are likely non-authorized activities.

While no archaeological sites nor true sinkholes were encountered during this investigation, test excavations revealed that the project area, omitting the borrow pit and other previously excavated areas, is overlain with 0.45 to more than 3.7 meters of sediment relating to modern construction and/or sugar cane cultivation. This is contrary to the previous assumption that the current substrate was all ready graded down to the *karst* bedrock, or within 8 inches of the karst. Further, the study was able to discern areas that appear to have relatively deep layers of modern fill, and conversely, areas where the natural strata are relatively shallow.

A total of 62 test trenches were excavated, revealing varying strata throughout the project area. Trench depths ranged from ca. 20 inches (ca. 0.5 meters) to ca. 12 feet, 2 inches (ca. 3.7 meters), with 54 of the 62 trenches revealing the karst layer. During trench testing, a single trench appeared to reveal a sinkhole in the base of excavation and was hand excavated down only 0.45 meters before reaching the karst layer. This depression was ruled out as being a sinkhole due to its shallow nature. In another test trench, the karst surface was found to be < 0.3 meters deep and appeared to be undisturbed and encapsulated under the topsoil. A test scrape was subsequently performed in the vicinity, which revealed that the top surface of karst was not a flat horizon, but rather, an undulating and irregular surface with many natural depressions. This caused some confusion as to what may or may not be a sinkhole. Two darkly colored depressions in the base of the test scrape that appeared to be sinkholes were hand excavated, but were found to contain only a thin layer of alluvium (< 0.2 meters). Thus, no sinkholes were encountered during the testing phase.

Neither sinkholes nor cultural materials were encountered during the subsurface testing. Nonetheless, the current stratigraphy of the project area has been comprehensively recorded to provide a better understand the land's varying topography and past land use as well as providing information on which to generate an accurate monitoring plan.

Potential Impacts and Mitigation Measures

Given the lack of finding any archaeological resources or even finding evidence of sinkholes within the project area, the consulting archaeologists concludes that no further archaeological work is necessary within this area. However, in the event that limestone bedrock (*karst*) is encountered during construction activities, the Applicant acknowledges that work in this area should halt and a qualified archaeologist should be summoned to the site to monitor excavations in the limestone areas. If any filled and buried sinkholes are encountered during these construction excavations, they should be archaeologically investigated to determine if they contain potentially significant archaeological deposits, including human burials. If at any time during construction potentially significant archaeological remains are encountered, work in the immediate vicinity should halt and the State Historic Preservation Division should be contacted.

8.2 CULTURAL RESOURCES

A Cultural Impact Assessment (CIA) was conducted for the proposed project by Pacific Legacy and is presented in Appendix H. Following is a summary of its findings.

To carry out the Ka Makana Ali`i CIA, archival research was conducted followed by community consultations to identify cultural practices, cultural resources, and beliefs associated with the area. Cultural practices are typically customs relating to subsistence, commerce, residency, agriculture, recreation, religion, spirituality, and collection of cultural resources, which may be carried out by Hawaiian practitioners or practitioners from other ethnic groups. Further, cultural resources, such as natural features, archaeological sites, and collectable materials associated with these types of customs, as well as traditional cultural properties and historic sites are also subject to this CIA.

Archival research has revealed that, in general, the ‘Ewa Plain in which the proposed mixed-use complex is to be built on has a long and interesting history. From the archaeological record, traditional stories and myths, and Historic documents attributed to the vast area, it is evident that these lands have been the stage to many significant acts in the long drama of O‘ahu’s pre- and post Contact history. However, no previous archaeological research has been conducted on the project area. Oral traditions and Historical references to the specific area do not exist prior to its use as cane field, when it is shown on a 1939 ‘Ewa Plantation Map as Field No. 46 (see Figure 9 in Appendix H). It is possible, that a major feature of pre-Contact and early Contact Honouliuli, the Kualaka‘i Trail, cut across or passed near to the project area according to the Malden (1825) map featuring the south coast of O‘ahu (see Figure 6 in Appendix H). This prominent trail once connected Honouliuli Village to the coastal settlements of Oneula and Kualaka‘i, and would have been crucial to life on the ‘Ewa Plain and its coast. It is likely that the probability of encountering subsurface archaeological deposits increases with proximity to where ancient trail was located.

Furthermore, the project area borders the historic OR&L Railroad to the north. This historic railway, in operations from 1889 to 1947, was placed in the National Register of Historic Places in 1975. The railway no longer serves as the backbone of O‘ahu’s economy, nor instrumental in U.S. military operations on O‘ahu, nor the main mode of transportation for O’ahu’s citizens to seek services, work, shop, and play far from home. Nevertheless, today it is a vital and tangible means to experience the period in which Hawai‘i transitioned from an autonomous island nation to an island brimming with an eclectic group of immigrants and entrepreneurs; to an island under U.S. territorial rule and subsequently a major economic and U.S. military hub for the entire Pacific region. Thus, the OR&L railway is itself a cultural resource for those who identify themselves with or have connections to bygone plantation and military cultures as well as those who seek to experience such an important period in the region’s history.

No archaeological features were positively identified within the project area during this assessment or in the Archaeological Inventory Survey and Backhoe Testing prepared in concordance with this CIA. Evidence of cultural activities occurring in the project area prior to sugarcane cultivation (before ca. 1939) are now either obliterated by past agricultural and/or construction activities or encapsulated under plantation era soils.

Ethnographical evidence supports the possibility that cultural practices occurred on the property prior to the large-scale cultivation of sugar cane. Sinkholes in the general area were utilized as

natural planters for *kalo* (taro, dry-land variety), temporary shelters, storage features, and sources of water. However, no sinkholes were found onsite during the archaeological inventory survey. According to one interviewee, some portions of the project area were used by Hawaiians for a variety of activities. For example, the lands may have been planted in *'ulu* (breadfruit), *liliko'i* (passion fruit), *niu* (coconut), and two types of *mai'a* (banana). Additionally, birds were trapped for feathers in or near to the project area, including the *ae'o* (*Himantopus mexicanus knudseni*), *i'iwi* (*Vestiaria coccinea*),*'apapane* (*Himatione sanguine*), and the *mamo* (*Drepanis pacifica*). The interviewee also recalls the existence of at least one *ahu* (shrine) in the general area, which was dedicated to agriculture. This *ahu 'aina* was made of stacked waterworn basalt boulders and cobbles, likely collected from a nearby stream bed, that stood up to five feet tall and possibly as wide as it was tall with a circular plan view. On these *ahu*, devotees, including the interviewee, would leave offerings to show appreciation for these natural resources and respect for the divine. However, the *ahu 'aina* was destroyed many years ago, sometime during the initial preparation of the land for sugarcane cultivation.

It has not been demonstrated that any cultural practices have been ongoing from the pre-Contact era or Historic era to the present. As the majority of the project area has been heavily disturbed by agricultural and construction activities prior to this CIA, contemporary cultural practices taking place in the project area were limited to the gathering of *'uha loa* (*Waltheria indica*) for traditional Hawaiian medicine and *'alae* (red clay) for coloring salt, medicine, dye, and spiritual purification. A total of three cultural practitioners were documented as gatherers of these cultural resources: an interviewee and his two *lā'au lapa'au* students. Although these resources exist in localities outside of this project area, the location is desired for its easy access, abundance of the resources, and the lack of pesticide sprays in its interior. The proposed development will undoubtedly impact these activities.

Additionally, three of the four interviewees state that the general area of central 'Ewa Plains is the land of the "Wandering Spirits" and "Night Marchers." One interviewee claims that these restless spirits become a problem for many recent developments in the area and has performed many "clearings" to rid public buildings, businesses, and residences of unwanted spirits.

Potential Impacts and Mitigation Measures

In total, two Native Hawaiian cultural resources have been identified as being potentially impacted by the proposed project: *'uha loa* (*Waltheria indica*) for traditional Hawaiian medicine and *'alae* (red clay) for coloring salt, medicine, dye, and spiritual purification. An interviewee and his two *lā'au lapa'au* students were the only cultural practitioners to be currently collecting these resources from the area. Obviously, the subject development and cultural resources, such as *'uha loa* and *'alae*, will not likely be able to occupy the same space at the same time. Fortunately, these resources are not endangered and can be found in other, albeit less convenient, locations. *'Uha loa* is readily available commercially and therefore can easily be incorporated into landscaping at the project.

Another concern raised by cultural informants is about the scarcity of fresh water in the general area. This is a growing concern for the entire *ahupua'a* of Honouliuli with the rapidly escalation of new homes and businesses. One interviewee suggests that the new development use native, drought-tolerant plants in its landscaping to ensure that local agriculture and aquaculture projects aimed at increasing our independence from outside commodities will be successful. The

Applicant concurs. At this point in time, the landscaping plan is anticipated to include a mix of drought tolerant plants and exotic.

Furthermore, there is the concern about unsettled spirits that remain in the area causing unwanted paranormal activities to plague the new development or, conversely, surrounding localities being haunted by the displaced spirits. Some informants fear that archaeological sites and burials, also cultural resources, possibly contained in sinkholes and concealed by plantation era soils may be damaged or lost during ground disturbing activities related to the project's construction. It is a common belief that the disturbance of archaeological sites and burials can also upset spirits or cause bad fortune to befall those who have caused the disturbance. To address this, cultural informants recommend that efforts should be made to bless the groundbreaking at Ka Makana Ali`i formally as well as at the grand opening of the mixed-use complex. As discussed in the section above, after extensive surface and sub-surface surveys, no sinkholes, archaeological sites, or burials have been located on the property. Therefore, the likelihood of disturbing sinkholes during construction is greatly reduced.

In regards to concerns about potential archaeological sites and burials, an archaeological monitoring plan will be prepared prior to the commencement of construction. Further, if archaeological sites are encountered during the construction of Ka Makana Ali`i, interpretive cultural displays at the project will incorporate artifacts (to the extent possible), archival photos, artistic renderings, and traditional accounts to educate its patrons of 'Ewa Plain's colorful past.

Other cultural informants, specifically those currently living in nearby Varona Village, fear that the new development may be further cause to displace them from their plantation era homes. Those informants associated with the Hawaiian Railway Society have similar fears of proposed roadways conflicting with existing tracks and switching yard - ultimately displacing them from their current location. Communications with these groups will help dispel misconceptions and begin a healthy discourse regarding the proposed project.

8.3 COMMUNITY CONCERNS AND SOCIAL IMPACTS

A socio-economic impact analysis of the proposed project was prepared by Belt Collins Hawaii, Ltd. and is presented in Appendix I. As part of the socio-economic analysis, community residents were interviewed to identify both their general concerns and their specific concerns related to the proposed project. (The interview protocol is presented in Appendix I.)

8.3.1 General Community Concerns

In interviews, local stakeholders discuss traffic congestion immediately as a regional problem. The slow process of designing and building Kualaka'i Parkway (long known as the North-South Road) over two decades has fueled a widely-held sense that the area's needs are not a priority for State and County agencies. Next, the poor condition of older roadways has led to fatalities (of pedestrians as well as automobile passengers).

Many 'Ewa residents have expressed strong support for the new rail transit system. However, some residents of eastern 'Ewa have argued that the new system should be re-aligned to serve their communities as well as the west.

Local community stakeholders have long pressed for development of new schools and have greeted innovative schools warmly. However, by the time new schools are built, they typically

serve a large population and soon include portable structures as well as permanent facilities. Kapolei schools are on a multi-track calendar, to allow them to serve a large student population.

Continued operation of the Waimānalo Gulch Sanitary Landfill for the City and County of Honolulu has long been contested by stakeholders from Kapolei and from the Wai‘anae Coast. The landfill and trucks carrying refuse to it are identified as sourced of trash and dust affecting residential areas and the ocean. Both Mayor Hannemann and Mayor Carlisle have supported planning for an alternative site and measures to decrease waste going to the landfill, while expanding the existing landfill.

Crime and vandalism have been problems in Kalaeloa and at the western edge of ‘Ewa Beach. These areas were not well patrolled for many years. Homeless campers occupied areas in Kalaeloa near the ocean. These have been evicted, but much of the district is undeveloped land covered by brush. Transitional housing for homeless veterans and families has been developed in old Navy facilities in the urbanized part of the district. These are supported by service agencies and a shuttle service.

After the closure of Naval Air Station Barbers Point, area residents have sought to keep several facilities open for community use. These include a child care center and bowling alley in the Downtown area, along with sports fields near the northern edge of the Kalaeloa District. Pride Field, across Franklin D. Roosevelt Avenue from the project site, is heavily used for baseball and softball.

8.3.2 Project Specific Concerns

Both interviewees and community groups listening to presentations about Ka Makana Ali`i expressed concern that it would create or add to traffic congestion. Questions were raised concerning construction traffic during rush hour periods and about eventual growth in traffic as Ka Makana Ali`i becomes a retail and entertainment destination. Pedestrian safety was of concern, given the size and location of the project.

Some interviewees saw the project as leading to further development of the Kalaeloa District. While they welcomed investment, they had questions about a future extension of Kualaka‘i Parkway. This future road would cross tracks used by the Hawaiian Railway Society and could affect traffic on Franklin D. Roosevelt Avenue and other roads within Kalaeloa.

When the project was introduced to the two regional Neighborhood Boards, questions were raised concerning the following:

- The project’s location on DHHL property: some view the use of DHHL land for commercial uses when Hawaiians in the beneficiary pool do not have leases as inappropriate. (However, DHHL leases lands for commercial and industrial use to fund the homestead program.)[8]
- Whether the project would fund or support a road link between Kapolei Parkway and Roosevelt Avenue. (The State Legislature has allocated funds to build an extension of Kualaka‘i Parkway to Roosevelt Avenue. The Ka Makana Ali`i project does not make that link necessary.)

[8] The responses provided here mostly paraphrases of ones recorded in Neighborhood Board minutes. No response was recorded to the comment about the use of DHHL lands; the comment shown here is based on the Department’s stated policies.)

- Whether water and sewer lines were in place to support the project. (They were.)
- Whether the project would increase water use. (Past plans for the site already allowed for the use of water equivalent to that needed to support approximately 34 households.)
- Whether the project would involve "green" buildings. (Plans include sustainable design for some of the buildings.)
- How the project would affect the Hawaiian Railway Society. (The State Department of Transportation and the developer will be working with the society to resolve problems.)
- Whether the project would respond to the spectrum of residents' needs. (The response indicated that medical care and childcare could be part of the project, as well as retail stores, if justified by demand.)

Interviewees largely viewed the project as benefitting the region. They saw a commercial center as offering new shopping opportunities. They expected that the project operators would be able to co-operate with nearby institutions.

8.3.3 General Social Impacts

Construction will involve temporary impacts: dirt, fugitive dust, noise and traffic congestion due to large loads. These have been irritants for 'Ewa residents in the past. All of these can be limited by using best practices, and are subject to State and County rules that limit impacts on neighbors. Before construction begins, the developer will work out plans to mitigate impacts on the community. For example, open areas will be watered to limit dust on a regular basis, and the general contractor will probably be expected to offer a telephone contact, to hear about and respond to neighbors' problems quickly.

When the first phase opens, the project will offer stores and services that are convenient for the immediate neighborhood. It will provide residents of East Kapolei and areas along Kapolei Parkway an alternative to trips to more congested shopping centers. It should also benefit residents of housing areas in Kalaeloa.

As Phase Two is developed, the center will provide more stores and services. It will combine offices with retail and entertainment areas, and hence become an important employment center. It will serve the larger region, not just its immediate neighborhood.

The community institutions on Kualaka'i Parkway will work together to bring residents to the central corridor, increasing the appeal of each of these facilities. The University of Hawai'i West O'ahu, the Kroc Center and Ka Makana Ali`i are likely to increase demand for each other, simply by making it more convenient to visit any one of these. (In other words, these will have a cumulative impact, increasing and reinforcing demand for each facility.) Again, the project could increase travel along the rail transit line to the terminus next to the Kroc Center, if a shuttle or bus service links the terminus with the regional commercial center.

In interviews, some stakeholders looked forward to partnerships between the project and surrounding institutions. Collaboration on community activities should be mutually beneficial, and seems likely to occur.

UHWO, the Kroc Center and the project will all contribute, over time, to change island and regional residents' views of 'Ewa as a whole. First, these all serve the region, not just a subarea.

Second, they work to make ‘Ewa, not just the City of Kapolei, the “second city” of O‘ahu. Until recently, non-residential development in the region was concentrated in the west; residents of subdivisions along Fort Weaver Road had little reason to view Kapolei as serving them. Road connections between the two sides of the DP area were few and in poor repair, so access was also difficult. Nowadays, improved connections and new attractions make Kualaka‘i Parkway into a central corridor for the entire region. With its commercial and entertainment venues, Ka Makana Ali`i can serve as a “gathering place” for people from all parts of ‘Ewa.

The project’s impacts on its neighbors to the south will emerge over time. First, any entry from Roosevelt Avenue to Ka Makana Ali`i will cross the Hawaiian Railway Society tracks. Crossing gates or the like will be needed when trains run along the route.

Next, extension of Kualaka‘i Parkway to Roosevelt Avenue – a link for which the Hawaii State Legislature has already set aside funds – will cross tracks used for switching rail cars in the Railway Society yard; these are used more often than the tracks leading west. Ka Makana Ali`i’s developers have not proposed this connection, as it would not be needed to develop the center or to mitigate its impacts on regional traffic. Nonetheless, the project can collaborate with the State and the Railway Society to find ways to mitigate the future roadway’s impacts. It may be possible to re-organize the Railway Society’s yard space to minimize the interaction between the yard and a potential roadway extension.

Location of a regional commercial center next to the Kalaeloa Community Development District will increase the appeal of that area for residents, both of existing and eventual neighborhoods. Again, that impact is cumulative and would depend on new roadway connections, both between Kalaeloa and the rest of the region and within Kalaeloa.

The project will generate a continuing cash flow for DHHL to support its work on behalf of Native Hawaiians. This is an important objective for the Department, which has relied in recent years on payments from the State for past land takings – payments which will cease in a few years. Development of commercial space on DHHL lands in Kapolei and elsewhere offers a long-term financial basis for the Department, and hence for Native Hawaiian communitiesThe Ka Makana Ali`i project will include entertainment and recreation facilities, such as a cineplex and health club. It may include play areas for children, but will probably not have facilities for outdoor sports. As the project is not anticipated to generate a significant impact in terms of resident population growth, it is not anticipated that the project will have a measurable impact upon existing recreational facilities or result in a significant demand for new recreation facilities

8.3.4 Schools

The ‘Ewa Development Plan Area includes eleven public elementary schools, three middle schools, and two high schools, as shown in Table 4. The school population has grown quickly. The Department of Education (DOE) has opened new schools in recent years, and has organized schedule and programs so that schools such as Kapolei Middle School can operate with high enrollments.

The National Guard operates the Youth ChalleNGe program for at-risk youth, helping them earn high school diplomas in a structured program, at a site in the Kalaeloa redevelopment area. Nearly 200 cadets graduate each year.

Private schools in the area include Island Pacific Academy in Kapolei, Friendship Christian and Lanakila Baptist in Ewa Villages, and Messiah Lutheran and Our Lady of Perpetual Help in ‘Ewa Beach.

Table 4: Public School Enrollment, `Ewa Development Plan Area

School	2010-2011 Enrollment
Barbers Point Elementary	401
Ewa Beach Elementary	507
Ewa Elementary	1,003
Holomua Elementary	1,382
Iroquois Point Elementary	718
Kaimiloa Elementary	610
Kapolei Elementary	1,043
Keoneula Elementary	847
Makakilo Elementary	502
Mauka Lani Elementary	563
Pohakea Elementary	565
Ewa Makai Middle	587
Ilima Intermediate	777
Kapolei Middle	1,424
Campbell High	2,639
Kapolei High	2,107

SOURCE: Hawai‘i State Department of Education, enrollment data posted at http://doe.k12.hi.us/reports/enrollment.htm

Additional schools are proposed for sites in the UH West O‘ahu lands, the Ho‘opili project, the DHHL East Kapolei Phase I project, and the East Kapolei Phase II project, including a new elementary school adjacent to the proposed community center. When residential development occurs in the Kalaeloa Community Development District, additional schools would be needed in that area.

University of Hawai‘i West O‘ahu enrolls some 1,306 students at its Pearl City campus (as of mid-2011). The university will move to its new site in fall 2012. The campus is designed for eventual enrollment of 7,600 students.

Potential Impacts and Mitigation Measures

As a commercial project, Ka Makana Ali`i will not generate a school population. It will serve a growing regional population, and will provide jobs for adults and young people from the region.

8.3.5 Parks and Recreation

The `Ewa *Development Plan* area includes beach parks, neighborhood parks, community parks, and space for regional park development. The developed park acreage totals approximately 211.6 acres.[9] Nearby, in Central O`ahu, the City and County of Honolulu has created regional parks (Central O`ahu Regional Park) and a soccer facility serving the entire island (Waipio Peninsula Soccer Park). See Figure 10 for the location of parks in relationship to the proposed development.

New recreational facilities are planned for the Kroc Center, just inland from the project site, the UH West O`ahu campus, and when permitted, the Ho`opili project to the northeast:

The Kroc Center is being developed by the Salvation Army. It will have approximately 100,000 square feet under roof, including a theater and gymnasium. A pool and fields for outdoor activities will also be developed. It will be located within the DHHL portion of the East Kapolei lands, *mauka* of the project. It will be a major community recreational facility, on a scale found nowhere else in Hawai‘i.

Plans for the UH West O`ahu propery show playfields and a gymnasium.

The Ho`opili project, if eventually developed, could have both passive and active park space. Project plans suggest that extensive bike trails will be incorporated into the project design.

The Kalaeloa Community Development Area includes beach parks, a golf course, and stables. Hundreds of acres have been identified as appropriate for redevelopment as open space, to include a cultural preserve.

Potential Impacts and Mitigation Measures

The Ka Makana Ali`i project will not add to recreational demand in the region.

Development of the subject property as a regional commercial center will have no significant impact upon recreational resources in the region. The property was originally proposed as a regional sports complex in the 1998 East Kapolei FEIS. However, the subsequent relocation of the proposed UH West O`ahu campus to the northern end of the East Kapolei property has undermined the feasibility of developing a sports complex on the subject property. Many of the facilities originally proposed for the subject property are now proposed to be included on the UH West O`ahu campus.

8.3.6 Medical Facilities

‘Ewa is served by a single hospital, Hawaii Medical Center – West, founded as St. Francis Medical Center West. It has 102 beds. It is located on Fort Weaver Road. The Kaiser and Queens health systems have clinics in Kapolei.

The Emergency Medical Services Division, City and County of Honolulu Emergency Services Department, has 19 ambulance units and two rapid response paramedic units located on O‘ahu. The project site is in the region serviced by the Makakilo ambulance unit. Honolulu Fire Department units also commonly respond to emergency calls.

[9] Department of Land and Natural Resources, *Statewide Comprehensive Outdoor Recreation Plan.* Honolulu, HI, 2003.

With continuing residential development in the region, demand for medical services can be expected to increase.

Proposed senior residential areas (Franciscan Vistas in ‘Ewa Villages; Leihano in Kapolei) may make nursing care available to residents and some neighbors.

The proposed Ho‘opili development would include a commercial area near the Hawaii Medical Center – West hospital. Medical offices could be located there if demand warrants.

Potential Impacts and Mitigation Measures

The project may include medical offices or clinics. While it will increase the visitor population in ‘Ewa slightly, and visitors will rely upon local medical services and facilities during their stay, it is not expected that the project will have a significant impact on demand for medical services.

8.3.7 Police Protection

The Honolulu Police Department (HPD) has a district headquarters in the City of Kapolei. For O‘ahu as a whole, the department has 2.3 officers for every 1,000 residents.[10] District 8 of the City and County of Honolulu Police Department covers most of the ‘*Ewa Development Plan* area and all of the Wai‘anae Coast. (Part of ‘Ewa near Waipahu is included in District 3).

The Kalaeloa Redevelopment District is patrolled in part by private security services. The Honolulu Police Department responds to calls from that area. (The Navy withdrew its security patrols after the closure of Barbers Point Naval Air Station in 1996. Vandalism and theft of property from unprotected buildings occurred. By 2004, as many as 100 people were living in cars and tents near Nimitz Beach until HPD and representatives of other City agencies conducted a sweep of the area.)

A West O‘ahu Security Coalition has recently formed. It brings together private security firms and local businesses as partners with HPD to increase public safety (personal communication, Major Raymond Ancheta, HPD, July 2011).

With population growth in the region, demand for public safety services is likely to rise over time. However, road improvements have reduced traffic congestion in parts of the region. Kualaka‘i Parkway provides a new central corridor, connected to new H-1 interchange and major East-West roadways (Farrington Highway and Kapolei Parkway). Traffic congestion, and hence traffic control duties for HPD, is now more likely on Fort Barrette Road and at the west end of Kapolei.

Potential Impacts and Mitigation Measures

As a regional mixed use center, Ka Makana Ali`i will have on-site security patrols to assure customers’ safety. Also, by developing a site near the Kalaeloa Redevelopment Area the project will improve accessibility and hence security for the region.

The project’s location adjacent to two major new roads will not likely create major traffic control problems for HPD. The traffic study of the project indicates that it will not cause a significant reduction in level of service on the surrounding roadways.

During construction, cement trucks will be able to reach the site from Makakilo Quarry via Kualaka‘i Parkway. As a result, project construction is likely to pose little problem for traffic

[10] HPD statistics for 2009, posted at http://www.honolulupd.org/download/HPD2009annualreportstats.pdf.

control, even during peak traffic periods. Currently the project site has no immediately adjacent neighbors, and it can be reached by Roosevelt Avenue in Kalaeloa as well as by Kapolei Parkway and Kualaka‘i Parkway.

8.3.8 Fire Protection

Battalion 4 of the Honolulu Fire Department (HFD) covers Waipahu, `Ewa, and the Wai‘anae Coast. HFD has stations in Makakilo (No. 35) and on the west side of Kapolei (No. 40). A new station is under construction by the Kapolei Parkway/Kualaka‘i Parkway intersection. It is planned to house both an engine and ladder company, and to have space for emergency supplies and for training facilities.[11]

Brush fires have been a serious concern in Leeward O`ahu, notably along the Wai‘anae Coast. In 2007, O`ahu's largest recorded brush fire burned for nearly a week above Waialua on the North Shore. Parts of the Kalaeloa Redevelopment Area have burned due both to dry conditions and to arson.

Potential Impacts and Mitigation Measures

The project will be built to current fire control standards, with access to structures via roadways large enough to meet Fire Department standards.

With development of the property and improved access for fire control vehicles to the Kalaeloa Redevelopment Area, the risk of brush fires in the region will decrease.

8.3.9 Extent Any Public Agency Would Be Impacted

Development of the subject property will result in increased demand for police, fire, and emergency related services. As no residential units are proposed, the project will not result in a direct impact upon the region's population, and will therefore not have a primary impact upon public agencies such as schools or hospitals. The proposed hotel units will result in a potential secondary impact upon the need for additional hospital services for any guests that may require them during their stay.

8.4 ECONOMIC RESOURCES

The socio-economic impact analysis' key findings pertaining to the economy and fiscal resources are summarized below.

8.4.1 Historic Economic Setting

The proposed project is located at the center of the ‘Ewa plain, the southwest part of the island of O‘ahu. The ‘Ewa region has been slated for urban development for decades. The City and County of Honolulu identifies ‘Ewa as a Development Plan area, like the Primary Urban Center, but unlike the five regional "Sustainable Communities Plan" areas that make up the rest of the island.[12] While several commercial areas are located in the region, the largest ones serving ‘Ewa – Pearlridge and Ala Moana – are to the east.

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[11] J. Goolsby, "New Fire Station Slated for Kapolei." *Midweek.* July 28, 2010.

[12] The ‘Ewa Development Plan (DP) area (City and County of Honolulu) includes two Neighborhood Board Areas: ‘Ewa (Number 24) and Makakilo/Kapolei/Honokai Hale (No. 34). The ‘Ewa Development Plan area and the ‘Ewa judicial district (State of Hawaii) are distinct. The latter includes much of Central O‘ahu. It will not be discussed in this report. All references to ‘Ewa as a region in the remainder of this report are to the DP area.

Urbanization of the region has long been planned. Development along the western side of the region began with the funding of the H-1 Interstate Highway in the 1960s. Next, Makakilo and the James Campbell Industrial Park were established. The State of Hawaii created Barbers Point Kalaeloa Harbor as a commercial harbor supplementing Honolulu harbor. As "the secondary urban growth area" on O'ahu, Kapolei was designated as a city in the 1977 General Plan, and was to include the full range of urban land uses. The Villages of Kapolei were master planned by the State housing development agency, and then built by private developers. The Estate of James Campbell and its successor companies began development of the Kapolei city center in the early 1990s, and have leased or sold large parts of the area to the west for commercial projects. Ko 'Olina is being developed as a resort area.

In the 1990s, most new development in 'Ewa was residential. Suburban growth spread down the major north-south roadways: Fort Weaver Road in the east, Fort Barrette Road in the west. New commercial development began with the Kapolei Shopping Center, which opened in 1992. Additional commercial areas have been built nearby. Commercial development along Fort Weaver Road has been slow, although residential development has continued steadily for nearly twenty years. Even during the current recession, new housing development has continued. Most of O'ahu's new housing development is located in 'Ewa.[13]

Many of the large residential projects in 'Ewa still have large increments to be built. At the northeast and northwest corners of the region, the Ho'opili and Makaīwa Hills developments have been proposed not yet granted development approvals. Similarly, residential and commercial uses on UHWO land have been proposed in concept, but have not yet been designed or permitted. Redevelopment of the Kalaeloa District, immediately south of the project site, could eventually involve some 6,500 additional residential units. As of 2009, approximately 21,750 housing units have been built, out of a potential total of nearly 60,000 units.

The 'Ewa DP area has been planned to be self-sufficient, with a mix of homes and commercial, industrial and civic facilities. It includes visitor units at Ko 'Olina and, in time, Ocean Pointe. Unique land uses, serving the whole island, include a general aviation airport and a water park. Many 'Ewa DP area residents commute to work in Honolulu and at Pearl Harbor. With regional growth (and continuing congestion of the H-1 Interstate Highway making long-distance commuting difficult), the number and variety of jobs in the `Ewa DP area are expected to increase.

8.4.2 Population, Housing and Employment

Between 1990 and 2010, the region's population increased by 135%. This growth is clear in Table 5, when historic DP area counts and recent ZCTA totals are compared.[14] The population is young when compared to the islandwide population and few people live in group quarters or non-family households (as shown in Table 6). Households in 'Ewa are larger, in general, than the statewide average. Homeownership is more prevalent than elsewhere in Hawai'i. Rental units are found throughout the region as well. Notably, when the Navy withdrew from the area in the

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[13] Data for 2009 and 2010 compiled for City and County of Honolulu *Development Plan Annual Report.* Personal communication, Michael Watkins, planner, DPP (July 2011).

[14] DP area demographics and projections are developed by the Department of Planning and Permitting, City and County of Honolulu. The 2010 counts are not yet posted. Because the DP areas do not overlap neatly with census tracts in the Waipahu area, the ZCTA figures seem the most useful current Census counts for the region.

mid-1990s, rental housing in both Kalaeloa and Iroquois Point – now the "Waterfront at Pu'uloa" area – became available for rent by civilians. Even though 'Ewa is seen as a new development area, where subdivisions have replaced cane fields, the density of settlement is already much higher than the statewide average.

Table 5: Recent Population Growth in `Ewa

	'Ewa DP Area	Both ZCTAs	'Ewa Beach ZCTA 96706	Kapolei ZCTA 96707
Population				
1990	42,931			
2000	68,718	68,928	43,874	25,054
2010		101,547	62,730	38,817
Housing Units				
1990	11,722			
2000	20,804	20,838	12,961	7,877
2010		30,780	18,319	12,461

NOTES: The Development Plan (DP) Area geography is used by the City and County of Honolulu, but not the State of Hawaii. It is close to the combined Zip Code Tabulation Areas (ZCTAs) shown above. ZCTAs are Census areas, based on the Postal Service's zip code geography, but the Census is not obligated to correspond fully to that geography, or to reflect changes in zip code areas. While Barbers Point has a separate zip code, it is included in the 96707 ZCTA.

In the next few years, new institutions along Kualaka'i Parkway will provide a center for the DP area, serving both east and west:

- The Honolulu High Capacity Rail line will run from a station beside the Kroc Center to Honolulu. It is planned to be fully operational by 2019. Trains may run from its western terminus to locations such as Pearl Harbor and the Honolulu Airport before the tracks extend to Ala Moana in Honolulu. (Eventually, the line could be extended to Kalaeloa and the City of Kapolei, and to Waikiki and the University of Hawai'i at Mānoa.)
- The University of Hawai'i West O'ahu is slated to move all operations to its Kapolei campus as of the fall 2012 semester. The new campus will serve up to 7,600 students in time.
- The Kroc Center will provide recreational, meeting and worship facilities. At 200,000 square feet, it will be the largest recreational center in Hawai'i. It is to open in 2011. It is located next to the terminus of the rail line.
- A community center for Department of Hawaiian Homelands (DHHL) residents and a separate commercial facility are planned by the Kapolei Community Development Corporation. The commercial facility will be located across Kapolei Parkway from the Ka Makana Ali`i project.

With rapid population growth in 'Ewa, traffic congestion has been a serious problem. The construction of Kualaka'i Parkway, improvements to the H-1 highway interchange at Makakilo

and opening of a new interchange at Kualaka'i Parkway, along with widening of Fort Weaver Road have addressed the problem. Planned improvements to Fort Barrette Road and the Kapolei

Interchange Complex will be needed to reduce congestion in the western side of the area. Rush hour traffic to and from Honolulu via H-1 remains slow and is expected to become slower.[15]

Table 6: Demographic and Household Characteristics, 2010

	State of Hawaii	Combined ZCTAs	'Ewa Beach ZCTA 96706	Kapolei ZCTA 96707
Population				
Total Population	1,360,301	101,547	62,730	38,817
Share under 18	22.3%	28.8%	28.8%	28.9%
Share 18 to 64	63.4%	63.0%	62.5%	63.7%
Share 65 and over	14.3%	8.2%	8.7%	7.4%
Median Age	38.6	NA	32.9	32.8
Share in				
Family Households	82.8%	91.8%	92.7%	90.3%
Non-family Households	14.1%	7.2%	6.9%	7.7%
Group Quarters	3.2%	1.0%	0.3%	2.0%
Housing				
Housing Units	519,508	30,780	18,319	12,461
Vacant Share	12.4%	7.1%	5.4%	9.7%
Occupied Units	455,338	28,584	17,331	11,253
Owner-Occupied Share	57.7%	67.8%	67.9%	67.7%
Share of Households				
Family Households	68.9%	82.3%	82.3%	82.2%
Non-family Households	31.1%	17.7%	17.7%	17.8%
Average Household Size	2.89	3.52	3.61	3.38
Owner-Occupied	3.02	3.64	3.75	3.48
Rental Units	2.72	3.25	3.3	3.18
Density of Settlement				
Persons per square mile	212	NA	3,661	895

SOURCE: U.S. Census data available on American FactFinder (www.census .gov) or through DBEDT (http://hawaii.gov/dbedt/info/census/Census_2010/SF1/DEC_10_SF1_GCT_ZIPCODE.xls).

When Naval Air Station Barbers Point closed in 1996, a direct route between 'Ewa Beach and Kapolei (along Geiger Road, Franklin D. Roosevelt Avenue, and Fort Barrette Road) was opened. More recently, segments of Kapolei Parkway have been completed, making that drive possible along roads built to current standards.

[15] Oahu Metropolitan Planning Organization. *Oahu Regional Transportation Plan 2035.* Honolulu, HI, 2011. As noted in the plan, both the new rail system and job growth in 'Ewa will tend to limit, but not reverse, increased traffic congestion along the highway.

In Kalaeloa, near-term initiatives include a headquarters for the Federal Bureau of Investigation, now under construction, and three different solar projects, capable of producing some 15 Megawatts of energy. Other recreational, commercial and residential areas have been planned, but are not now being developed, largely due to the high cost of infrastructure that would meet current standards. Further development within the district will depend on improvements in its roadways and utilities.

Much new housing for residents of O‘ahu will be built in ‘Ewa, so the DP Area population is expected to grow much faster than that of the City and County as a whole. Job growth is also projected for the region. (see Table 7)

Table 7: Population and Employment Projections, 2010 to 2035

	2010	2015	2020	2025	2030	2035
POPULATION						
Development Plan Subareas:						
Ewa Villages	5,650	6,227	6,403	6,550	6,677	6,834
Ewa Gentry/West Loch	26,458	27,315	27,411	27,440	27,447	27,490
Ewa Beach/Iroquois Pt	17,972	17,860	17,670	17,464	17,260	17,072
Ocean Pointe	6,652	7,981	8,783	9,235	9,657	10,117
Kalaeloa/Campbell Ind Park	1,381	1,690	3,147	5,057	7,484	10,534
Ko Olina/West Kapolei	3,942	4,766	6,750	7,697	8,344	9,040
City of Kapolei	756	3,339	4,804	6,418	7,469	8,577
Villages of Kapolei	14,012	14,422	14,462	14,466	14,465	14,471
East Kapolei	809	4,382	11,803	18,605	26,421	32,886
Makakilo/Makaiwa Hills/Kunia	16,872	19,252	21,868	24,789	26,108	27,535
‘Ewa Development Plan Area	94,504	107,234	123,101	137,721	151,332	164,556
O‘ahu Total	**911,841**	**941,847**	**969,467**	**994,632**	**1,017,576**	**1,038,317**
Ewa share of Island Total	10%	11%	13%	14%	15%	16%
JOBS						
Development Plan Subareas:						
Ewa Villages	1,485	1,480	1,459	1,485	1,557	1,639
Ewa Gentry/West Loch	3,591	4,007	4,020	4,235	4,501	4,758
Ewa Beach/Iroquois Pt	3,302	3,429	3,432	3,484	3,620	3,759
Ocean Pointe	1,233	2,517	2,600	2,799	3,006	3,139
Kalaeloa/Campbell Ind Park	7,951	10,714	13,430	17,124	20,303	23,296
Ko Olina/West Kapolei	2,623	4,000	4,618	4,810	5,081	5,287
City of Kapolei	13,591	16,730	18,899	20,774	22,116	23,112
Villages of Kapolei	3,138	2,843	2,731	2,794	3,024	3,301
East Kapolei	6,855	13,857	17,801	21,764	25,658	29,558
Makakilo/Makaiwa Hills/Kunia	2,407	3,087	3,984	4,825	5,225	5,585
‘Ewa Development Plan Area	46,176	62,664	72,974	84,094	94,091	103,434
O‘ahu Total	**561,684**	**597,183**	**621,115**	**643,963**	**666,194**	**688,380**
Ewa share of Island Total	8%	10%	12%	13%	14%	15%

SOURCE: Allocation by City and County of Honolulu Department of Planning and Permitting of County population and employment projected by DBEDT. Projections were made in mid-2009, and take into account the recession felt as of 2008. Sub-areas are shown in Figure 2-3 in Appendix I.

While little population growth is projected for ‘Ewa Beach/Iroquois Point and the Villages of Kapolei, all other sub-areas will see significant growth in both residents and jobs. A small visitor population has been projected for Ocean Pointe, and a larger one for Ko ‘Olina.

Commercial development is part of the largest projects slated for ‘Ewa. Ho‘opili includes a planned commercial area next to Waipahu that may include medical offices, and a second commercial area on Kualaka‘i Parkway. The University of Hawai‘i at West O‘ahu site includes lands for commercial and residential development. These will be expected to support further expansion of the University. A new shopping center has long been planned for Fort Weaver Road. A new Safeway store is to be built soon. Near Kapolei Shopping Center, a WalMart store is now under construction. At the western end of the DP area, Kapolei Commons is still being developed and additional commercial areas are planned for Makaīwa Hills.

Potential Impacts and Mitigation Measures

Following is a summary of the key findings presented in the socio-economic impact study (Appendix I).

8.4.3 Population Impacts

The project will provide jobs that may appeal to local residents. Office space in the project will help island firms to locate or expand activities in ‘Ewa. No direct resident population impact is anticipated, since few or no employees will need to move from outside O‘ahu to fill positions at Ka Makana Ali`i.

When firms establish offices or stores in a new commercial area, many current employees must commute from other neighborhoods. Over time, the project’s workforce will likely be drawn increasingly from ‘Ewa, since jobs will be convenient for local residents. Also, the regional center will be an amenity for residents, offering a wide range of goods and services.

Consequently, while the project is likely to have little or no impact on resident population, it may contribute to housing demand in the ‘Ewa region, and may make the region more attractive to some residents of other parts of the island.

The hotel component of the project introduces a new facility for non-residents. It will serve travelers on business or visiting family and friends in the region, and will be designed as less upscale than the major hotels in Waikiki and Ko ‘Olina. One market served by these hotels will be sports teams attending tournaments or similar events at the Waipi‘o Peninsula Soccer Park or Central O‘ahu Regional Park. Major tournaments bring teams from other islands in Hawai‘i and from the U.S. Mainland. It is reasonable to expect that hotels near the major sports venues will benefit visiting teams and their supporters, especially ones from the Neighbor Islands.

Presumably, many of the hotel guests would come to the area in any event, staying in resort hotels or with family and friends. The hotels at Ka Makana Ali`i will make it easier for some travelers to come to ‘Ewa and for others to extend their stays. With some 500 rooms, the hotels can be expected to house, on average, some 700 persons.[16] If approximately 20 percent of these are attracted to stay because of the new facilities, the impact would be an increase of the visitor

[16] This assumes average occupancy of 70% of available rooms, and two persons per room.

population by 140 persons.[17] This is small, both in comparison with the number of tourists on O'ahu (80,324 in 2009)[18] and with the resident population of 'Ewa (over 100,000 by 2010), and therefore does not amount to a significant impact

8.4.4 Economic Impacts

Table 8 shows calculations of construction jobs and wages derived from estimated construction cost. Construction work on a project is not permanent, so these job impacts are counted in person-years, i.e., full-time jobs for a year.

Construction of Phase 1 would generate about 190 direct person-years of work; construction of Phase 2 would involve approximately 1,470 person-years. The total employment impact of Phase 1 construction is approximately 550 person-years, while the total impact of Phase 2 construction is nearly 4,280 person-years of work.

Direct construction jobs include on-site work and work in contractors' yards and offices. The actual number of workers at a job site varies from day to day, depending on the type of work to be done. (If a construction project involves 60 person-years of direct work over 18 months, the average number of direct jobs would be 40 per year. However, many workers could be present in some phases, and few at others.) Indirect jobs are located at suppliers' places of business, while induced jobs are found throughout the island, wherever workers spend their wages.

Table 8: Construction-Related Employment and Wages

	Phase 1	Phase 2	Combined
Construction Cost (Million $s)	$40.0	$310.0	$350.0
Construction-Related Jobs (Person-Years)			
Direct	189	1,468	1,657
Indirect and Induced	363	2,812	3,175
Total	552	4,280	4,832
Construction-Related Wages (Million $s)			
Direct	$13.0	$100.6	$113.5
Indirect and Induced	$16.3	$126.1	$142.3
Total	$29.2	$226.6	$255.9

NOTES: Construction costs estimates supplied by Hawaii DeBartolo LLC.
Direct construction jobs estimated from ratio of excise tax base for construction to annual job count for 2009. Direct construction jobs include on-site jobs and ones at yards and headquarters needed to support firms' work on construction. Indirect jobs are jobs in firms supplying materials and services to direct construction firms; induced jobs are jobs supported by spending of the workforce in direct and indirect jobs. The ratio of indirect and induced jobs to direct jobs is estimated from the State's Input-Output model,

[17] The 20 percent figure is a high estimate of the likely new visitor impact. It is intended to include both new visits and potentially longer visitor stays.

[18] Hawaii Tourism Authority, *2009 Annual Visitor Research Report*. Honolulu, HI. 2010.

as recently updated to take into account 2007 Economic Census data. All construction employment estimates are in "person-years," i.e., full-time jobs for a year. The actual number of workers on a construction site will vary depending on the phase of work.

Wages are estimated from the average wages in construction (for direct jobs) and all covered employment (for indirect and induced jobs) in the City and County of Honolulu in 2009. Average wages have been increased to mid-2011 dollars in line with increases in the Consumer Price Index for Honolulu.

SOURCES: DBEDT, *State of Hawaii Data Book, 2009; Hawaii State 2007 Input-Output Model; Quarterly Statistical and Economic Report, Second Quarter 2011*; Hawaii State Department of Labor and Industrial Relations, *Employment and Payrolls in Hawaii, 2009.*

Once Ka Makana Ali`i opens, it will offer permanent jobs in retail, eating and drinking establishments, and hotels. Office space will house a range of businesses. Project management, maintenance and security work will be needed as well. Table 9 provides an estimate of the number of these permanent jobs on-site, once each phase of the project is completed, along with the indirect and induced jobs associated with them. More than 3,900 direct jobs will eventually be located at Ka Makana Ali`i.

Direct operations jobs continue year after year, and so do the indirect and induced jobs associated with them. The calculations show employment with build-out and occupancy of each phase of the project. These levels will be reached over several years' time.

Table 9: Operations-Related Employment

COMPONENT OF PROJECT	DIRECT JOBS (1) Phase 1	Phase 2	Both Phases	INDIRECT AND INDUCED JOBS (2)	TOTAL
Retail	400	1,340	1,740	886	2,626
Eating and Drinking	200	640	840	361	1,201
Entertainment		50	50	28	78
Offices		870	870	901	1,771
Hotel		380	380	372	752
Project Administration, Maintenance	10	25	35	29	64
Total	610	3,305	3,915	2,578	6,493

NOTES:

(1) Employment estimated on the basis of estimated gross square footage for various uses.

Retail	varies:	from 2 to 3.5 per 1,000 sq. ft
Eating and Drinking	3.15	per 1,000 sq. ft
Entertainment	1.3	per 1,000 sq. ft
Offices	4	per 1,000 sq. ft
Hotel	0.75	per hotel room

(2) Indirect and induced jobs estimated from Hawaii State Input Output tables based on a model developed and refined by DBEDT, incorporating 2007 Economic Census data. For this analysis, office jobs were assigned to the "other professional services" industrial category.
SOURCES: DBEDT, *Hawaii State Data Book, 2009*; *Hawaii State Input-Output Model, 2007*.

Operations-related wages can be estimated from average salaries in different industries. (See Table 10.) The amounts shown are for annual wages once each phase of the project is built out. Wages will likely increase in each phase as it is developed and spaces within the commercial center are filled.

Table 10: Operations-Related Wages

	Industry	Annual Wages Associated with Project (Million $s)		
		Phase 1	*Phase 2*	*Both Phases*
Direct Jobs				
Retail	Retail	$11.5	$38.7	$50.2
Eating and Drinking	Eating/Drinking	$4.8	$15.3	$20.1
Entertainment	Arts and Entertainment		$1.3	$1.3
Offices	Average of Covered Employment		$39.0	$39.0
Hotel	Accommodation	$0.0	$9.1	$9.1
Project Administration, Maintenance	Administrative, Support Services	$0.3	$0.8	$1.1
Direct Jobs Total		$16.6	$104.1	$120.7
Indirect and Induced Jobs	Average of Covered Employment			$115.6

NOTES: Wages estimated from 2009 averages, adjusted to 2011 in line with the Consumer Price Index.
SOURCE: Department of Labor and Industrial Relations, *Employment and Payrolls in Hawaii, 2009*; DBEDT, *Quarterly Statistical and Economic Report, Second Quarter, 2011.*

The project will provide jobs that may appeal to local residents. Office space in the project will help island firms to locate or expand activities in ‘Ewa. No direct resident population impact is anticipated, since few or no employees will need to move from outside O‘ahu to fill positions at Ka Makana Ali`i.

When firms establish offices or stores in a new commercial area, many current employees must commute from other neighborhoods. Over time, the project’s workforce will likely be drawn increasingly from ‘Ewa, since jobs will be convenient for local residents. Also, the regional center will be an amenity for residents, offering a wide range of goods and services.

Consequently, while the project is likely to have little or no impact on resident population, it may contribute to housing demand in the ‘Ewa region, and may make the region more attractive to some residents of other parts of the island.

The hotel component of the project introduces a new facility for non-residents. It will serve travelers on business or visiting family and friends in the region, and will be designed as less upscale than the major hotels in Waikiki and Ko ‘Olina. One market served by these hotels will be sports teams attending tournaments or similar events at the Waipi‘o Peninsula Soccer Park or Central O‘ahu Regional Park. Major tournaments bring teams from other islands in Hawai‘i and from the U.S. Mainland. It is reasonable to expect that hotels near the major sports venues will benefit visiting teams and their supporters, especially ones from the Neighbor Islands.

Presumably, many of the hotel guests would come to the area in any event, staying in resort hotels or with family and friends. The hotels at Ka Makana Ali`i will make it easier for some travelers to come to ‘Ewa and for others to extend their stays. With some 500 rooms, the hotels

can be expected to house, on average, some 700 persons.[19] If approximately 20 percent of these are attracted to stay because of the new facilities, the impact would be an increase of the visitor population by 140 persons.[20] This is small, both in comparison with the number of tourists on O'ahu (80,324 in 2009)[21] and with the resident population of 'Ewa (over 100,000 by 2010), and therefore does not amount to a significant impact.

8.4.5 Fiscal Impacts

Fiscal impacts consist of the revenues and costs for government agencies due to a project. Revenues can be estimated from information about construction and operations of the project, taken with current tax structures. Costs may arise if a project introduces new populations, new calls for service, or new demands for maintenance. Some of these can be quantified, e.g., the cost of supporting a new resident or visitor population, based on recent government spending. Others are not easily estimated, both because costs are not easily associated with a single project and because it is far more difficult to break out specific operations costs than capital improvement costs.

A commercial project responds to demand from the public. It does not generate spending so much as accommodate increased spending in the economy or provide a new location for spending that would go elsewhere if the project were not built. Hence the operations of stores and firms located at Ka Makana Ali`i are not counted here as generating new public revenues. Construction of the project clearly involves new spending, and hence new tax revenues. Similarly, some hotel guests at the project arguably would not come to O'ahu if the project were not built. Both revenues and costs associated with this visitor population growth are treated as project impacts.

Revenues: Public revenue streams associated with the project include transportation impact fees, construction-related taxes, property taxes, and taxes on visitor spending.

The 'Ewa Transportation Impact Fee program (Revised Ordinances of Honolulu Chapter 33A) was created to help develop roadways serving the region in a period of rapid growth. Developers contribute to the program at the time that building permits are obtained, in amounts determined by the type of new development (residential, retail, office, industrial, hotel or timeshare) and the number of units or area being built. Since it became law, road construction costs have increased sharply. Therefore, the current fee structure based on a model of 2020 regional transportation demand and input from developers is now under review and a new fee structure is being developed by the City and County,. Table 11 estimates transportation impact fees according to the current program. A future program to be proposed to the City Council is likely to include higher fees and an escalator clause (so fees rise along with construction costs). Consequently, the fee estimate in Table 11 is likely to be much less than the fees that would be charged in the future.

[19] This assumes average occupancy of 70% of available rooms, and two persons per room.

[20] The 20 percent figure is a high estimate of the likely new visitor impact. It is intended to include both new visits and potentially longer visitor stays.

[21] Hawaii Tourism Authority, *2009 Annual Visitor Research Report*. Honolulu, HI. 2010.

Table 11: Estimate of Transportation Impact Fees for the Project

Project Components			
Retail / Entertainment		Gross SF	927,572
Office		Gross SF	217,000
Hotel		Units	500
Transportation Impact Fee			
Retail	per	1,000 Gross SF	$4,053
Office	per	1,000 Gross SF	$3,403
Hotel	per	Unit	$1,003
Fees for Ka Makana Ali'i			
Retail			$3,759,449
Office			$738,451
Hotel			$501,500
Total			$4,999,400

Construction spending will generate revenues from excise and income taxes as estimated below in Table 12. The City and County of Honolulu collects a share of the excise taxes levied on O‘ahu to cover the cost of the rail transit system. It is assumed here that the County surcharge would still be in force throughout the time of project construction.

Once the site is improved, the City and County of Honolulu will begin to collect property taxes based on the value of the land for commercial use and on the value of the improvements to the land. Table 13 includes calculations of the property taxes levied by the City and County on the property, once each Phase is developed and opened. It shows that taxes on Phase 1 of the project would amount to about $700,000 annually, while taxes on the fully developed project would approach seven million dollars annually. (As DHHL land not in productive use, the land is currently not taxed, so all property taxes on the project are a net impact.)

Lease payments to DHHL will constitute an additional revenue source for the State. These have been set for the first 25 years of the lease. The cumulative ground rent over the first 25 years will amount to $141,846,800 – for an annual average ground rent of $5,673,872. For the following 40 years, the rent will be renegotiated based on an independent appraisal process prior to the commencement of the 26th, 36th, 46th and 56th years.

Table 12: Construction-Related Revenues

	Phase 1	Phase 2	Combined
Construction cost (1)	$40	$310.0	$350.0
Construction-related Wages (2)	$29	$226.6	$255.9
Excise Taxes To State (3)			
On Construction	$2	$12.6	$14.2
On Spending by Workforce (4)	$1	$5.7	$6.5
Excise Taxes to City and County of Honolulu (3)			
On Construction	$0	$1.4	$1.6
On Spending by Workforce (4)	$0	$0.6	$0.7
Income Taxes			
Corporate (5)	$0	$0.5	$0.6
Personal (6)	$2	$13.8	$15.6
Total Revenues from Construction Spending			
State of Hawaii	$4	$32.6	$36.8
City and County of Honolulu	$0	$2.0	$2.3

NOTES:
(1) Estimated by DeBartolo Hawaii LLC.
(2) From Table 3-1 in Appendix I.
(3) The State collects General Excise Tax (4%) and, on O‘ahu, an additional tax for transit (.5%). Act 247 of 2005 directs the State to retain 10% of the County surcharge for administration costs. Hence the State share of excise taxes is 4.05%, while the City and County share is 0.45%
(4) Excise tax is calculated on disposable income, estimated as 62.6% of wages (from historical spending rates).
(5) Corporate income tax estimated (from historical rates) as 0.17% of revenues (data from 2000).
(6) Personal income tax estimated as 6.1% of taxable income (from 2005 data).
SOURCES: Hawaii State Department of Business, Economic Development and Tourism, 2005; Hawaii State Department of Taxation, 2001, 2008

Table 13: Annual Real Property Tax Revenues, Ka Makana Ali`i

		Phase 1	Phase 2	Combined
Land Area (acres)		19.78	47.45	67.23
Land Value				
Estimated value/sq. ft.	$22.00			
Value of Property (Million $s)		$19.0	$45.5	$64.4
Cost of Improvements (Million $s) (1)		$36.0	$279.0	$315.0
		$55.0	$324.5	$379.4
Real Property Tax				
Commercial Rate (2)	$12.40			
Annual Tax (Million $s)		$0.7	$4.0	$4.7

NOTES:
(1) Estimated as 90% of construction cost.
(2) Rate per $1,000 value of land or improvements. Currently, rates for hotel, commercial and industrial properties are all the same. Current rate is for the 2011-2012 tax year.

SOURCES: Honolulu Real Property data downloaded and analyzed by Belt Collins Hawaii from Hawaii Information Service, Inc. City and County of Honolulu, Department of Budget and Finance, Real Property Assessment Division.

New visitors will provide the State and County with tax revenues, while also generating costs for the provision of public services to an additional population. Table 14 estimates direct tax revenues once the hotels are built and occupied.

Table 14: Annual Tax Revenues on Direct Visitor Spending

Persons		
New visitor population (1)		
Rooms		500
Average persons/room		2
Average occupancy (of rooms)		70%
Average number of guests at hotels		700
Share of guests who would not come to O'ahu without the project	up to	20%
High estimate of new visitors		140
Revenues (2)	*2009 $*	*2011 $*
Average daily visitor spending per person, O'ahu, 2009	$174.20	$182.27
Average spending on lodging per person, 2009	$65.50	$68.53
Annual excise tax on visitor spending , new visitors		
State of Hawaii (4.05%)		$377,209
City and County of Honolulu (0.45%)		$41,912
Annual Transient Accommodations Tax, new visitors (2)		$296,511
State of Hawaii (55.2%)		$163,674
City and County of Honolulu (19.8%)		$58,581

NOTES:
(1) Estimates of occupancy, guests per room and share of guests who are new visitors developed by Belt Collins Hawaii.
(2) Average visitor spending for visitors on O'ahu, 2009, from Hawaii Tourism Authority, *Annual Visitor Research Report 2009*. TAT and GET levels, and State and County share of each are calculated on the basis of current practice.

SOURCES: DBEDT, *State of Hawaii Data Book 2009*; Hawaii Tourism Authority, *Annual Visitor Research Report 2009*

Costs: The cost of public services provided to new visitors can be estimated on the basis of average costs, i.e., total costs allocated to all users equally. Tables 15 and 16 show calculations for average costs per visitor (based on government spending in earlier years, adjusted to 2011

dollars). Table 17 applies those calculations to the new visitors associated with the project once it is fully occupied.

Table 15: Average Cost of Public Service Provision to Visitors, State of Hawai`i

	FY 2008 spending ($1,000s)	Spending for residents or all?	Visitor share
General expenditure, by function:			
General government	537,541	All	$387
Education	$3,040,223	Residents	--
Public welfare	$1,857,473	Residents	--
Health	$863,914	All	$622
Highways	$406,795	All	$293
Public safety	$411,152	All	$296
Natural resources	$103,596	All	$75
Culture and recreation	$110,404	All	$75
Urban redevelopment, housing	255,783	Residents	--
Economic development and assistance	$149,075	Residents	--
Debt service	$478,735	All	$345
Other and unallocable	$5,880	All	$4
Total	$8,220,571	Total	$2,098
		Adjusted to 2011	$2,206

NOTES: Average cost calculated for resident or de facto population, depending on function. Spending is for most recent year for which expenditures reported by function in Data Book.

State of Hawaii Population, mid-2008:

Residents 1,287,481

De Facto 1,387,888

Total resident share adjusted to 2011 in line with increase in Consumer Price Index (5.17%)

SOURCE: DBEDT, *State of Hawaii Data Book 2009*; *Quarterly Statistical and Economic Report, Second Quarter, 2011.*

Table 16: Average Cost of Public Service Provision to Visitors, City and County of Honolulu

	FY 2003 Spending ($1,000s)	Spending for residents or all?	Visitor share
General expenditure, by function:			
General government:	$115,067	All	$124
Public safety:	$246,109	All	$266
Highways	$13,831	All	$15
Mass transit	$150,523	Residents	--
Miscellaneous	$101,655	All	$110
Sanitation	$265,331	All	$287
Health and human resources	$52,007	All	$56
Culture and recreation	$62,260	All	$67
Urban redev. and housing	$22,275	Residents	--
Utilities and other enterprises	$22,557	All	$24
Capital outlay	$193,722	All	$209
Debt service	$120,332	All	$130
Total	$1,365,669	Total	$1,289
		Adjusted to 2011	$1,681

NOTES: Average cost calculated for resident or de facto population, depending on function. Spending is for most recent year for which expenditures reported by function in Data Book.

City and County of Honolulu Population, mid-2003:

Residents	888,026
De Facto	925,595

Total resident share adjusted to 2011 in line with increase in Consumer Price Index (30.46%)

SOURCE: DBEDT, *State of Hawaii Data Book 2009; Quarterly Statistical and Economic Report, Second Quarter, 2011.*

Additional costs associated with new demand for public services and maintenance of public utilities may well be generated because the project adds to the urban area on the island. These are not further calculated here.

Table 17: Annual Cost of Public Services for New Visitors Staying at the Project's Hotels

Costs		
Average annual cost of public services per visitor		
State of Hawaii		$2,206
City and County of Honolulu		$1,681
Average annual cost, new visitors at project		
New visitors at project	140	
State of Hawaii		$308,853
City and County of Honolulu		$235,386

NOTES: Average cost per visitor calculated in Tables 15 and 16. Annual cost based on new visitor share estimated in Table 14.

Net Fiscal Impact: The revenues and costs estimated above result in large net benefits for both the State of Hawaii and the City and County of Honolulu, as summarized in Tables 18 and 19. The major cash flow for the State general fund is the one-time tax revenue flow associated with construction. The City and County will also collect revenues during construction, through the transportation impact fee and excise taxes. For the City and County of Honolulu, new property tax revenues provide continuing annual revenue streams in the millions of dollars. DHHL will collect lease rent annually. For both, the State and the City and County, new costs will arise above all once the project has been largely built, and new visitors come to stay at the hotels. The net impacts shown here for annual cash flows cover the years after the project is fully built out, and visitor-related costs have stabilized.

The calculations shown here demonstrate that both the State of Hawaii and the City and County of Honolulu will gain significant benefits from the Ka Makana Ali`i project. Even though some additional costs may arise that have not been estimated here, it is clear that the net fiscal benefit associated with the project far outweighs likely costs.

Table 18: Net Fiscal Impact of the Project for the State of Hawai`i

Costs	
Average annual cost of public services for visitors attracted by the project	$308,853
Revenues	
One-time revenues:	
Associated with construction	$36,846,764
Continuing Revenues (Annual)	
DHHL lease payments	$5,673,872
Income from visitor spending	$540,883
Continuing Net Revenues (Revenues > Costs)	
Annual, after build out	$5,905,902

Table 19: Net Fiscal Impact of the Project for the City and County of Honolulu

Costs	
Average annual cost of public services for visitors attracted by the project	$235,386
Revenues	
One-time revenues:	
Associated with construction	$2,296,054
Transportation Impact Fee	$4,999,400
	$7,295,455
Continuing Revenues (Annual)	
Revenues from Visitor Spending	$100,493
Real Property Tax revenues	$4,704,905
Continuing Net Revenues (Revenues > Costs)	
Annual, after build out	$4,570,013

8.5 EXISTING INFRASTRUCTURE ENCUMBRANCES

Three utilities cross the project site in the northwest corner. Approximately 630 feet of an 8-foot wide by 5-foot high concrete box drain is within the project site, aligned parallel to Kapolei Parkway, which discharges into the Kapolei Lower Channel. This box drain is within a 20-foot wide drainage easement in favor of DHHL with a flowage easement in favor of the City and County of Honolulu (City).

A Board of Water Supply (BWS) 16-inch diameter non-potable water line routed beneath Kapolei Lower Channel enters the subject property approximately 110 feet south of the northwest property corner. The line angles north, parallels the western boundary and crosses into the Kapolei Parkway right-of-way about 50 feet east of the northwest property corner. A 20-foot wide easement for the portion of the water line within the project site is in the process of being granted to BWS.

A 24-inch diameter Navy water line paralleling the Kapolei Lower Channel crosses into the subject property about 15 feet south of the northwest property corner. The Navy water line extends about 15 feet into the subject property then turns north, crossing into the right-of-way and across Kapolei Parkway. The line is within an approximately 750-square foot rectangular easement.

Four easements encumber the property along its eastern boundary. Hawaiian Electric Company (HECO) has a 75-foot wide easement for overhead transmission lines, with the property boundary being the eastern limit of the easement. Within the 75-foot HECO easement are two adjacent BWS easements on the east side, and a City sewer line easement on the west side. Both BWS easements are for non-potable water lines. A 16-inch diameter line is within a 20-foot wide easement, and a 20-inch diameter line is installed in an adjacent 10-foot wide easement to the

east. The sewer easement is 20-feet wide, with the western edge of the easement aligned with the western limit of the HECO easement. The sewer easement accommodates a 42-inch diameter gravity sewer line and associated sanitary manholes.

8.6 INFRASTRUCTURE

Existing water, sewer, and drainage systems in the site area are presented in Figure 16.

8.6.1 Water Demand, Storage and Transmission

HHFDC and DHHL have made regional potable water system improvements for source and storage within East Kapolei that have been dedicated to the BWS. A 12-inch diameter potable water main was installed by DHHL as part of the Kapolei Parkway extension fronting the site. This main is part of the BWS 215-foot service zone.

The BWS 20-inch diameter and 16-inch diameter non-potable water lines provide R1 recycled water from the Honouliuli Wastewater Treatment Plant to the West Loch Golf Course and the Villages of Kapolei, respectively.

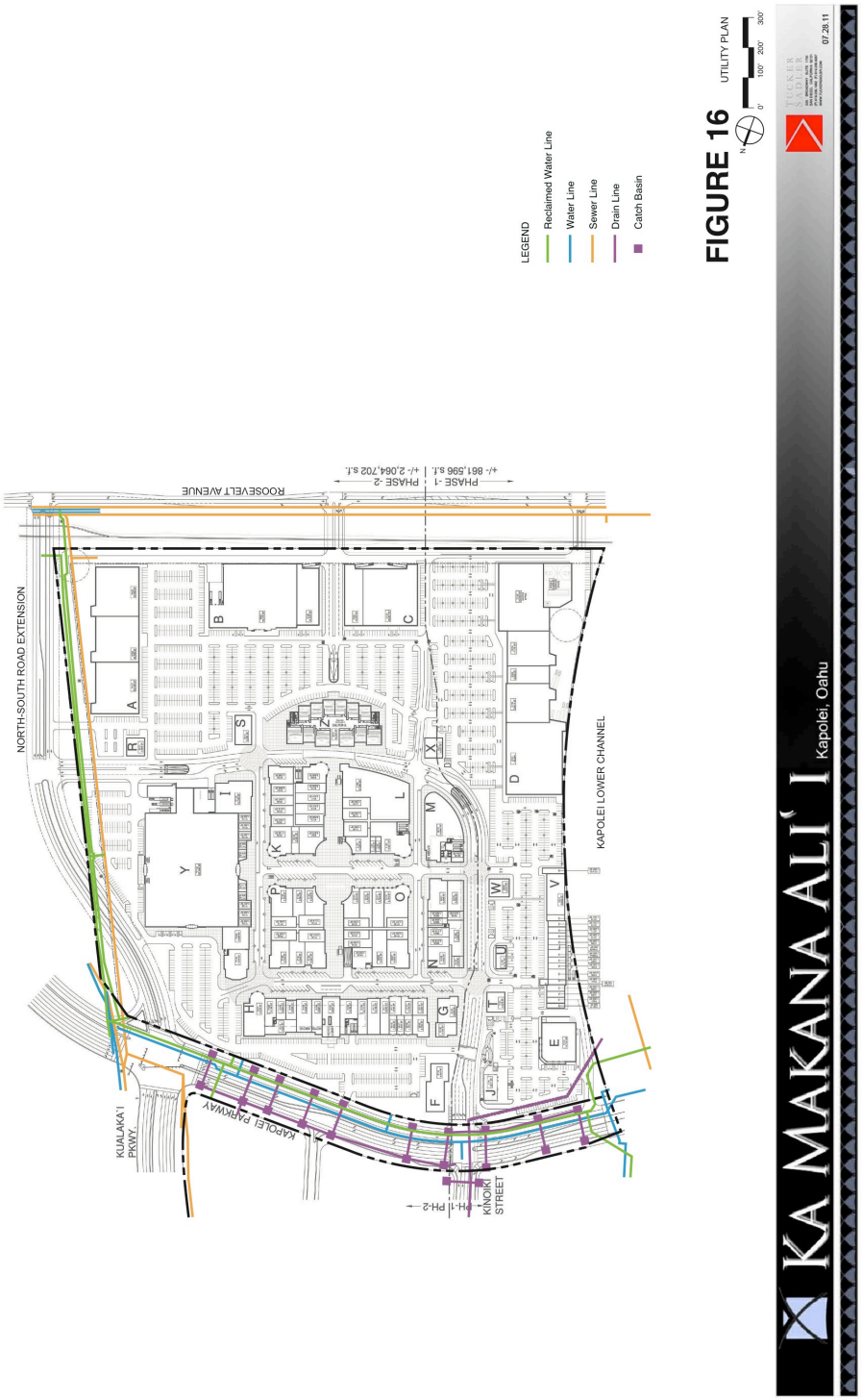
Potential Impacts and Mitigation Measures

Based on the BWS Water System Standards for domestic consumption, the average daily water demand, including irrigation, for the property is 201,000 gallons per day (gpd). Based on the use of non-potable water for landscape irrigation and the criteria stated in the "Ewa Non-Potable Water Master Plan", the total estimated potable water demand is approximately 144,700 gpd.

The fire flow requirement for a large shopping center is 4,000 gallons per minute (gpm) under the BWS Standards. BWS has confirmed their off-site infrastructure is capable of providing the requisite flow in accordance with their Standards. On-site fire protection will require a dedicated, 12-inch diameter, looped fire main. Two stub-out connections to the 12-inch diameter potable main in Kapolei Parkway were provided for the project as part of the Kapolei Parkway extension improvements. One of these connections will also provide domestic water service to the site.

A dual sourced landscape irrigation system is proposed for the project. Potable irrigation would be utilized for the plantings within 50 feet of buildings and other occupied spaces, accounting for approximately 20 percent of the total landscape area. The remaining 80 percent of planting beyond the 50-ft building perimeters would be irrigated with non-potable water. The total landscape irrigation demand is estimated at 78,000 gpd, comprised of 62,000 gpd of non-potable and 16,000 gpd of potable water. A 4-inch diameter stub-out connection to the 16-inch non-potable water main in Kapolei Parkway extension was provided for the project.

BWS indicated that both potable and non-potable water will be available for the project, with payment of the current water system facilities charges. Due to the storage system improvements made by DHHL, the project will need to pay only the portion of the facilities charges associated with resource development and transmission. The project is expected to pay its prorata share of the cost of storage improvements to DHHL.


KA MAKANA ALI`I
Kapolei, Oahu
FIGURE 16
UTILITY PLAN
0' 100' 200' 300'
07.28.11
LEGEND
Reclaimed Water Line
Water Line
Sewer Line
Drain Line
Catch Basin
NORTH-SOUTH ROAD EXTENSION
ROOSEVELT AVENUE
PHASE -1
PHASE -2
+/- 861,596 s.f.
+/- 2,064,702 s.f.
KAPOLEI LOWER CHANNEL
KAPOLEI PARKWAY
KUALAKA'I PKWY.
KINOIKI STREET
PH-1
PH-2

8.6.2 Wastewater Disposal

The City sewerage system serves the project area. The 42-inch diameter sewer main located along the western side of the 75-foot wide HECO easement, conveys wastewater to the Kapolei Interceptor Sewer and thence to the Honouliuli Wastewater Treatment Plant for processing and reuse as R1 water. The interceptor sewer was designed and constructed to serve developments within the Kapolei region. Construction was financed by the State of Hawai‘i, the Estate of James Campbell, Ko Olina Intangibles LLC (Ko Olina Resort), and Finance Realty (Kapolei Knolls), with each contributor provided a wastewater flow allocation in the interceptor. Under the Kapolei Interceptor Sewer Allocation and Usage Agreement, HHFDC has a peak flow allocation of 11.346 million gallons per day (MGD), which needs to be further allocated to their originally owned lands in the region, including the subject property.

An 18-inch diameter stub out from the sewer main into the project site was provided as part of the original construction. The stub-out was installed to serve the sports complex originally planned for the site.

Potential Impacts and Mitigation Measures

The City has granted a conditional approval to connect to their sewer system in December 2008. Based on the proposed use of a 6-inch water meter, the project will require an allocation of 87 equivalent single-family dwelling units (ESDU). The project must obtain the requisite ESDU allocation and pay the applicable Wastewater System Facility Charges before a connection will be allowed. Re-filing of a sewer connection application for the project was done in July 2011.

Connection of the project to the 42-inch diameter sewer main will be through the existing 18-inch diameter stub-out located at the southeast corner of the property. The 18-inch diameter sewer has adequate capacity and is at an elevation to serve most, if not all, of the site, by gravity. A second connection to an existing manhole about 450 feet south of Kapolei Parkway is also proposed. If pumping of wastewater is necessary, it is likely that the on-site pumping station would be within the underground parking garage. Such a pumping station would be privately owned and privately maintained by the regional mixed use center tenants.

8.6.3 Electrical

HECO currently has 138 kilovolt (kV), 46 kV and 12.47 kV facilities supported on wood and/or metal poles along the eastern and southern boundaries of the project site. The 138 kV facilities serve as the main transmission lines for HECO’s system, interconnecting the 3 HECO-owned generating plants, several private generating plants, including the City’s H-Power facility, and switching stations situated throughout the island. From these switching stations, the 46 kV facilities are connected to substations that step the 46 kV sub-transmission voltage down to the 12.47 kV distribution voltage which, in turn, connect to the HECO-owned distribution transformers that provide electric service to the general public. The existing HECO substations located closest to the project site are the Kamokila Substation, located on Makakilo Drive near its intersection with Farrington Highway; the `Ewa Nui Substation, located along Farrington Highway near the future Kualaka`i Parkway intersection; and Ft. Weaver Substation, located along the existing OR&L right-of-way at the boundary between the `Ewa Villages Development and the `Ewa by Gentry Development. The recent Kapolei Parkway construction provided underground conduits crossing the roadway to the property for future electric service.

Potential Impacts and Mitigation Measures

Development of the project is anticipated to add an approximate 20-megawatt (MW) load to HECO's system. The Kapolei area is being heavily developed and HECO has coordinated with the major landowners to identify substation sites to serve the region. To provide electric service to Phase 2 of the project, HECO intends to develop a new substation, tentatively named Kapolei Substation, on a parcel of land owned by HECO (tax map key 9-1-015:118) and located opposite the Kapolei Lower Channel at the southwestern corner of the subject. To support the proposed substation development, HECO has submitted an application to the Public Utilities Commission for permission to expend funds in excess of $2.5M dollars to build the Kapolei Substation. The Consumer Advocate's Office has indicated that it has no objections to the proposed substation development. It is understood that development of HECO's 120 MW bio-diesel generating plant as well as the relatively recent proliferation of localized alternate energy interconnections with HECO's distribution system will facilitate the accommodation of the anticipated project loads.

8.6.4 Telecommunications

Under an agreement with DHHL, Sandwich Isles Communications (SIC) is the sole provider of telecommunications service, i.e., telephone, cable television and broadband, to all developments on DHHL lands. Under this agreement, SIC uses U.S. Department of Agriculture Rural Utility Service loans to construct their underground infrastructure and cable plant.

SIC is currently providing service to two residential subdivisions in the Villages of Kapolei Development, which are adjacent to the project site. SIC is also in the process of constructing a switching station on the site of DHHL's new office building located directly north of the project site.

Potential Impacts and Mitigation Measures

SIC will extend telecommunications service south across Kapolei Parkway to provide service to the project.

8.7 SITE DRAINAGE

The site is undeveloped with scattered scrub brush, but is being used for construction staging, stockpiling, and quarrying by DHHL. The original site topography was relatively flat, with a slight slope in the southeasterly direction. A quarry/borrow pit is located along the southeast end of the site, parallel to Roosevelt Avenue. The pit is approximately 1,200-feet long parallel to Roosevelt Avenue, by 550-feet wide, with elevations in the range of 54.0 to 12.0 above mean sea level (MSL). There is another excavation near the center of the site that was the beginning of foundation excavations for a sports stadium originally planned for the site. Numerous stockpiles are located between the borrow pit and stadium excavation, the largest of which totals about 150,000 cubic yards at the time of this report preparation.

Runoff generated within the project site generally flows in a southerly direction into the existing pits and depressions or into the Kapolei Lower Channel. Runoff contained in the sumps percolates or evaporates. Runoff generated in the north/northeast portion of the site sheet flows off site into the adjacent property. A berm along the southeast boundary directs runoff to the

southern-most corner of the property, which discharges to the Lower Channel through a 24-inch diameter culvert.

The 100-year water surface elevation in the Lower Channel at Kapolei Parkway is 52.30 feet above MSL. This elevation is referenced in the *Drainage Master Plan for East Kapolei I Development,* November 2006 (Drainage Master Plan), prepared by Community Planning and Engineering, and conditionally accepted by the City in a letter dated November 20, 2006, and as established in the *Kapolei Parkway Bridge & 18" Relief Sewer – Kama'aha Avenue* project.

The conditionally accepted Drainage Master Plan concludes that the downstream drainage facilities, consisting of the Barbers Point Naval Air Station Coral Pit and the Kapolei Lower Channel with dry wells, have adequate capacity to accommodate the net increase in storm water runoff from the developed commercial property.

Potential Impacts and Mitigation Measures

In accordance with the Drainage Master Plan, the project will drain to the Kapolei Lower Channel. Based on the on-site drainage master plan prepared for the project and accepted by the City, multiple piped drain systems generally aligned in the east-west direction are proposed to collect surface runoff and discharge collected flows directly to the Kapolei Lower Channel. The proposed discharge pipes range in size from 72-inches to 24-inches in diameter constructed with outlet headwalls. The estimated total discharge from the project site under the 10-year 1-hour rainfall event is about 280 cubic feet per second.

The proposed project drainage system will have no adverse impacts to existing neighboring properties. Hydraulic analysis of the planned drain system indicates the anticipated runoff generated from the project can be discharged to the Lower Channel in compliance with the City Storm Drainage Standards.

Off site runoff is planned to be either diverted away from the project site or routed through the on-site drainage system. The proposed Kapolei Parkway Extension along the *mauka* boundary will intercept and convey runoff to the Kapolei Lower Channel.

The Makakilo Gulch/Kaloi Gulch water shed boundary will be adjusted to include the Kualaka`i/Kapolei Parkway intersection and proposed extension. The Drainage Master Plan for the project computed a net volume increase of 17.49 acre-feet (ac-ft) in storm water runoff. The water shed boundary adjustment under the project will add 8 acres to the Makakilo Gulch water shed resulting in a net volume increase of 18.33 ac-ft.

The regional downstream drainage facilities have adequate capacity to accommodate storm water runoff from the project as proposed. The project is consistent with the land use identified in the East Kapolei I Drainage Master Plan. Computations show the total volume of runoff to the Coral Pit is 1,245.27 acre-feet, well under the 1,675 ac-ft/day capacity identified in Appendix B of the East Kapolei I Drainage Master Plan.

9 ALTERNATIVES TO THE PROPOSED ACTION

Two alternatives to the Proposed Action were considered during the preparation of this environmental assessment: No Action; and development of the Regional Sports Complex originally proposed for the subject property. A residential alternative was not considered because the property has been designated for commercial use by the DHHL pursuant to its East

Kapolei Master Plan. Residential development would be inconsistent with the agency's long range planning for the region.

Implementation of the No Action Alternative would result in the property being left vacant and abandoned. This is inconsistent with the DHHL Master Plan for East Kapolei that identifies the subject property as a significant source of future revenue generation for the agency's beneficiaries. In addition, abandonment of the subject property would result in it becoming a nuisance for surrounding development. The vacant property with its dirt stockpiles and excavated pits would likely generate fugitive dust during the summer and fall months, much to the detriment of neighboring properties. The vacant property would continue to serve as a habitat for mammalian pests and it could become an attractive target for nefarious human activities.

Implementation of the previously proposed Regional Sports Complex is deemed to be impractical given the decision of the UH to relocate its West O`ahu campus from the property mauka of the H-1 Freeway to its current site along Kualaka`i Parkway mauka of the subject property. Sports facilities to serve the UH campus would be best located on the UH property. Development of the subject property with sports facilities would be unnecessary, if not a redundant expenditure of limited State fiscal resources.

In addition to the two land use alternatives considered, alternative designs and site plans for the property have been prepared since the inception of the current project five years ago. The Proposed Action represents the culmination of this design process. Variations in the location of specific buildings, and the design and character of the proposed development have been considered. The Proposed Action represents what is considered to be the most feasible development given the market demand, economic conditions, and the physical requirements of prospective tenants.

10 SECONDARY AND CUMULATIVE IMPACTS

Secondary and cumulative impacts resulting from the Ka Makana Ali‘i project include:

- Construction jobs and associated economic benefits throughout the island economy.
- Development of a neighborhood commercial center, that will serve nearby subdivisions along Kapolei Parkway and beyond, provides a convenient alternative to larger centers at some distance, thereby helping to reduce traffic impacts and reverse traffic patterns.
- Location of a wide range of commercial jobs in ‘Ewa, increasing residents' opportunities to live and work in the same region.
- Introduction of a new visitor amenity; hotels catering to local residents and their guests, that will help to reduce visitor travel between Kapolei and existing resort areas.
- Synergy with new community facilities along Kualaka‘i Parkway – the University of Hawai‘i West O‘ahu campus, the Kroc Center, and the terminus of the new rail transit line – that will help to increase demand for each of these facilities.
- A cumulative impact on the region: development of facilities for residents along the central corridor will help to bring together residents from the separate communities of eastern and western ‘Ewa.
- Significant contributions to revenues for the State of Hawaii and the City and County of Honolulu.

- Lease rent paid to the Department of Hawaiian Homelands that will help that agency serve beneficiaries and add to the stock of housing for Native Hawaiians.

11 UNRESOLVED ISSUES

The traffic study conducted for the Proposed Action demonstrates that the proposed first phase of development only requires vehicular access points on Kapolei Parkway and Roosevelt Avenue. The second phase of development will require an additional two-lane access road (one lane in each direction) extending south from Kapolei Parkway to an entrance point about midway down the property's eastern property boundary. The Proposed Action does not generate enough traffic to warrant the extension of Kualaka`i Parkway from Kapolei Parkway south to Roosevelt Avenue. Construction of the extension is a matter of regional demand for improved access from Roosevelt Avenue to the H-1 Freeway rather than local demand for access to Ka Makana Ali`i. DeBartolo is committed to bearing its fair share of responsibility and will do so by constructing the two lanes needed to extend Kualaka`i Parkway to the project's eastern property entrance. The design of the full Kualaka`i Parkway extension from Roosevelt Avenue to Kapolei Parkway, who will build it, and the timing of its construction are presently unresolved. The issue is complicated by a number of factors that are beyond the control of Hawaii DeBartolo LLC, including:

- The ultimate design of the extension and its phasing depend upon decisions by the State DOT. Will it be a two-lane roadway, or will it require four, or even six, lanes? The extension's design must respond to projected demand generated by future development of projects within Kalaeloa and Ocean Pointe which will benefit from a direct connect to H-1.
- The likely alignment of a future extension would impact not only the subject property, but also the City-owned property abutting it to the east side. However, the City wishes to trade that property to the DHHL in return for a property in Waipahu owned by DHHL that the City proposes to use as a base yard for the proposed rail transit system. Although several years in the offing, the trade has not yet taken place. Whoever becomes the ultimate owner of the property will have a significant stake in the design and phasing of the Kualaka`i Parkway extension. Design and phasing of the roadway cannot proceed until the property ownership issue is resolved.
- The matter of who pays for construction and who maintains the Kualaka`i Parkway extension is also unresolved. Will it be owned by the DHHL or the DOT, or will it be ultimately transferred to the City?
- The Kualaka`i Parkway Extension project is not presently included on the list of projects that are formally recognized by the City's Ewa Impact Fee Ordinance. This means that under present policy, whoever builds a portion or all of the extension will receive no credit for its investment under the ordinance. Thus, there is no incentive to construct it among the parties who would most benefit from it. The Ewa Impact Fee Ordinance is currently under review and its official project list will, as a result, eventually be updated. However, whether the extension project is included is unknown at this time. Hawaii DeBartolo LLC, as the planned lessee of the DHHL property, does not have standing, and therefore has not been invited to participate in the Ewa Impact Fee Ordinance discussions. It will be up to the parties at the table (the DHHL, the HCDA representing

Kalaeloa, Ocean Pointe, and the DOT, among others) to make a decision about the future of the extension.

Over the past five years, Hawaii DeBartolo LLC has been waiting for these issues to be resolved. Rather than continue to wait, Hawaii DeBartolo LLC now wishes to proceed with its development and will construct that portion of the extension (two lanes to its entrance) that its traffic study demonstrates is its responsibility. The determination does not in any way preclude or constrain decision making by other parties on the above issues.

Other unresolved issues include:

- DeBartolo is presently initiating discussions with the Hawaiian Rail Society concerning a design solution for driveways to cross the OR&L tracks at the property's southern boundary. Similar track crossings have been accommodated at Fort Barrette Road at Kalaeloa and at Ko Olina Resort. It is believed that the OR&L operations will compliment the mixed use regional center by increasing the public profile and awareness of an attraction for local residents and visitors that has already existed for twenty years. The final design solution has not yet been determined but will need to be resolved before the opening of Phase 1 of Ka Makana Ali`i.
- The DPP is presently updating the 1997 `Ewa Development Plan. A Public Review Draft of its proposed update was published several years ago and included reference to a regional commercial center proposed at the subject property. Since receiving public comments on its Public Review Draft, the department has been making additional revisions to the document. The date of the release of the Revised Public Review Draft is unknown. Also unknown is whether any revisions to the document will have a substantive effect upon planning for Ka Makana Ali`i. However, as discussed above, because the project will be constructed on lands owned by the DHHL, it is exempt from having to comply with City land use regulations. Although it would appear that the revised `Ewa Development Plan may not have any substantive impact on the proposed project due to this exemption, it remains to be seen how the City wishes to address the proposed development for the purposes of mapping and impact analysis in the context of its own long-range planning.

12 DETERMINATION, FINDINGS, AND SUPPORTING REASONS

HAR, §11-200-12, establishes thirteen significance criteria that agencies shall use in evaluating an action's impacts. An applicant or an agency must determine whether an action may have a significant impact on the environment, including all phases of the project, its expected consequences both primary and secondary, its cumulative impact with other projects and its short- and long-term effects. The HAR establish "significance criteria" to determine whether significant environmental impacts will occur as a result of the proposed action. An action shall be deemed to have a significant impact on the environment if it meets any of the following criteria:

Pursuant to subparagraph 12, ...an action shall be determined to have a significant effect on the environment if it:

(1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;

Discussion: The subject property contains no unique, significant, or critical natural habitat. If fact, it is generally characterized as an extensively disturbed area. Its redevelopment will not result in the loss or destruction of any natural or cultural resource.

The SHPD has previously approved an archaeological inventory survey and the archaeological mitigation plan for the project area and all necessary data recovery work has been completed. No ongoing cultural practices were identified relative to the project site and the reservoir site.

(2) Curtails the range of beneficial uses of the environment;

Discussion: The range of beneficial uses of the property's environment is guided by the County's General Plan, which identifies the general region as the site of the City's Secondary Urban Center. The property was reclassified from the State Agricultural land use district to the State Urban land use district in 1999 in anticipation of its development. The 1997 `Ewa Development Plan identified the subject property for residential development. However, the Public Review Draft of the Revised Development Plan identifies the subject property for regional commercial development.

Thus, the proposed project is consistent with the planned beneficial use of the area. The proposed project increases the range of beneficial uses for the environment by the region with a significant source of new employment opportunities and increased connectivity with surrounding roads, infrastructure, services, and public facilities.

(3) Conflicts with the state's long-term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders;

Discussion: The stated purpose of Chapter 344 is to establish a state policy that will encourage productive and enjoyable harmony between people and their environment, promote efforts that will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, and enrich the understanding of the ecological systems and natural resources important to the people of Hawai'i. The proposed project complies with the policies, goals and guidelines of Chapter 344. The project proposes to create a master planned mixed-use commercial development that will be integrated with regional transportation network and infrastructure systems, and improve the quality of life for residents by providing new employment opportunities within the greater `Ewa region. This development represents a significant contribution to the potential to reverse outward bound traffic during peak morning hours and inbound traffic during peak afternoon hours, both of which will be beneficial to the well-being of area residents.

(4) Substantially affects the economic or social welfare of the community or State;

Discussion: Development of the property for commercial mixed use purposes is consistent with the City and County's desire to focus growth in the `Ewa region. The project will have positive impacts on the social welfare of the `Ewa community by providing new employment opportunities for area residents. The proposed project will also have positive impacts on the

economic welfare of the community and the State through the creation of a diverse range of new land uses, including business-oriented hotels, to serve the growing `Ewa region.

(5) Substantially affects public health;

Discussion: The proposed project is anticipated to have negligible impact on public health. Infrastructure systems necessary for the project have already been constructed and comply with applicable State, DOH, and County standards and regulations.

(6) Involves substantial secondary impacts such as population changes or effects on public facilities;

Discussion: The proposed project does not include a residential component. Located at the center of the rapidly growing East Kapolei community, the proposed project will have a direct beneficial impact upon surrounding residents as the source of new employment opportunities. No significant adverse secondary or cumulative effects are anticipated.

(7) Involves a substantial degradation of environmental quality;

Discussion: The proposed project will involve extensive ground disturbance, including clearing, grubbing, and grading of the property. The site development activities are necessary for the development. Grading and construction activities will be required to comply with applicable regulations. However, no substantial degradation of environmental quality is anticipated because all construction and development activities will be performed in conformance with existing regulations and environmental controls.

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

Discussion: The proposed project involves no commitment for a larger or long-term action. With a construction-phasing schedule limited to four years, its rapid development will benefit the community almost immediately. The proposed project will have a beneficial impact upon the economy by providing a source of new employment and new tax revenues.

(9) Substantially affects a rare, threatened, or endangered species, or its habitat;

Discussion: No rare, threatened, or endangered species or related habitats have been identified on the subject property.

(10) Detrimentally affects air or water quality or ambient noise levels;

The proposed project will generate increased motor vehicle use in the area, which may affect air quality but not significantly. Ambient noise levels will be impacted in the proposed project area during construction, but will be short term in nature. As there are no significant ground water resources in the immediate area, and the project is situated approximately two miles from the coastline, no significant adverse impacts upon water quality are anticipated.

(11) Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;

Discussion: The subject property is situated within a Zone 2a of the seismic volcanic hazard zone (on a scale of 1 to 4 with 4 representing the most hazardous and 1 being the least hazardous), which covers all of O`ahu. Proposed structures in the development will conform to all relevant building code requirements, including applicable seismic design standards. The property is not located within a flood plain and is too far from the shoreline to be affected by storm wave or tsunami inundation. No sensitive environmental resources are associated with the subject property.

(12) Substantially affects scenic vistas and viewplanes identified in county or state plans or studies;

Discussion: The subject property is not identified as a scenic vista or part of a significant view plane on county or the state plans or studies.

(13) Requires substantial energy consumption.

Discussion: Energy consumption will be increased in relation to the proposed commercial development. The proposed project's design will include features to conserve energy and water usage.

For the above stated reason, a determination of No Significant Impact is anticipated for the Proposed Action.

13 CONSULTED PARTIES AND PARTICIPANTS IN THE EA PROCESS

To date, representatives of DeBartolo have consulted with the following agencies and organizations in the preparation of this environmental assessment:

State:

Department of Hawaiian Home Lands

DHHL Residents Association

Office of the Governor

State Department of Transportation

Hawaii Community Development Authority

City and County of Honolulu:

Department of Planning and Permitting (including planning and site development divisions)

Board of Water Supply

Department of Transportation Services

Makakilo, Kapolei & Honokai Hale Neighborhood Board

Ewa Neighborhood Board

Private Organizations:

Hawaiian Railway Society

Kapolei Rotary Club

West Oahu Economic Development Association

Leeward Oahu Transportation Management Association

The Kroc Center

DHHL Residential Communities

14 REFERENCES

Baker, H.L. et al. 1965. *Detailed Land Classification, Island of Hawaii.* L.S. Land Study Bureau, University of Hawai‘i.

B. D. Neal & Associates. 2011. *Air Quality Study for the Proposed Ka Makana Alii Project.*

City and County of Honolulu. 2009. *Public Review Draft, `Ewa Development Plan.*

City and County of Honolulu. 2009. *Annual Report on the Status of Land Use on Oahu, Fiscal Year 2008.*

City and County of Honolulu. 2001. *Pearl Harbor Historic Trail Master Plan.*

City and County of Honolulu. 1997. *`Ewa Development Plan.*

Group 70 International. 1998. *The City of Kapolei Urban Design Plan.*

Harris Miller Miller & Hanson Inc. 1989. *Naval Air Station Barbers Point Air Installations Compatible Use Zones (AICUZ) Noise Contours and Supporting Data.*

Institute of Transportation Engineers (ITE). 2004. *Trip Generation Handbook, 2nd Edition.*

Institute of Transportation Engineers (ITE). 2003. *Trip Generation, 7th Edition.*

Juvik, Sonia P. and James O. Juvik, eds. 1998. *Atlas of Hawai‘i.* 3rd Edition. Honolulu: University of Hawai‘i Press, Honolulu, Hawai‘i.

National Committee on Uniform Traffic Control Devices. 2003. *Manual on Uniform Traffic Control Devices.*

National Oceanic & Atmospheric Administration. National Weather Service Forecast. Western Regional Climate Center. Hawaii Climate Summaries. Website http://www.wrcc.dri.edu/summary/climsmhi.htm.

Oahu Metropolitan Planning Organization. *Oahu Regional Transportation Plan 2030.*

Parsons Brinkerhoff. 2011. *Traffic Evaluation, Ka Makana Alii, Ewa, Oahu, Hawaii.*

PBR Hawaii. 2006. *University of Hawai`i West O`ahu Final Environmental Impact Statement.*

PBR Hawaii. 1998. *East Kapolei Master Plan Final Environmental Impact Statement.*

Rana Biological Consulting, Inc. 2011. *Avian and Terrestrial Surveys Conducted for the Ka Makana Ali`i Project, TMK 9-1-016: portion 108, East Kapolei, `Ewa District, Island of O`ahu.*

State of Hawaii, Department of Agriculture. 1977. *Agricultural Lands of Importance to the State of Hawai'i.*

State of Hawaii, Department of Business, Economic Development and Tourism. 2007. *State of Hawaii Data Book Timeseries.* Posted at http://www.hawaii.gov/dbedt/info/economic/databook/Data_Book_time_series/.

State of Hawaii Department of Business, Economic Development and Tourism. 2006. *Hawaii State Data Book 2005.* Posted at http://www.hawaii.gov/dbedt/info/economic/databook/.

State of Hawaii, Department of Business, Economic Development and Tourism. 2004. *Population and Economic Projections for the State of Hawaii to 2030.* Posted at http://www.hawaii.gov/dbedt/info/economic/data_reports/population-projections/.

State of Hawaii, Department of Environmental Services, City and County of Honolulu. May 1999. Best Management Practices Manual for Construction Sites in Honolulu.

State of Hawaii, Department of Labor and Industrial Relations. 2006. *2005 Employment and Payrolls in Hawaii.* Honolulu, HI. Posted at http://www.hiwi.org/admin/uploadedPublications/1659_ES2005.PDF.

State of Hawaii, Department of Hawaiian Home Lands. 2010. *Kapolei Regional Plan.*

State of Hawai'i, Department of Taxation. 2005. *Hawaii Income Patterns: Individuals 2002.* Posted at http://www.hawaii.gov/tax/pubs/02indinc.pdf

State of Hawaii, Department of Taxation. 2001. *Hawaii Income Patterns: Corporations, Partnerships, Proprietorships.* Posted at http://www.hawaii.gov/tax/pubs/98bus.pdf.

Transit Research Board – National Research Council. 2002. Transit Cooperative Research Program "TCRP Report 74." *Costs of Sprawl—2000*.

U.S. Department of Agriculture, Natural Resource Conservation Service. October 2003. *Soil Survey of the Island of Oahu, State of Hawai'i.*

U.S. Department of Agriculture Soil Conservation Service. 1972. *Island of O`ahu, State of Hawai'i.*

U.S. Department of the Interior, National Park Service. 1990; revised 1992, 1998. "National Register Bulletin." *Evaluating and Documenting Traditional Cultural Properties.*

Y. Ebisu & Associates. 2011. *Acoustic Study for the Ka Makana Ali`i Project, Kapolei, Hawaii.*

Appendix A

2008 Traffic Study

TRAFFIC EVALUATION

Ka Makana Ali'i

Ewa, Oahu, Hawaii

December 2008

Prepared for:
DeBartolo Development
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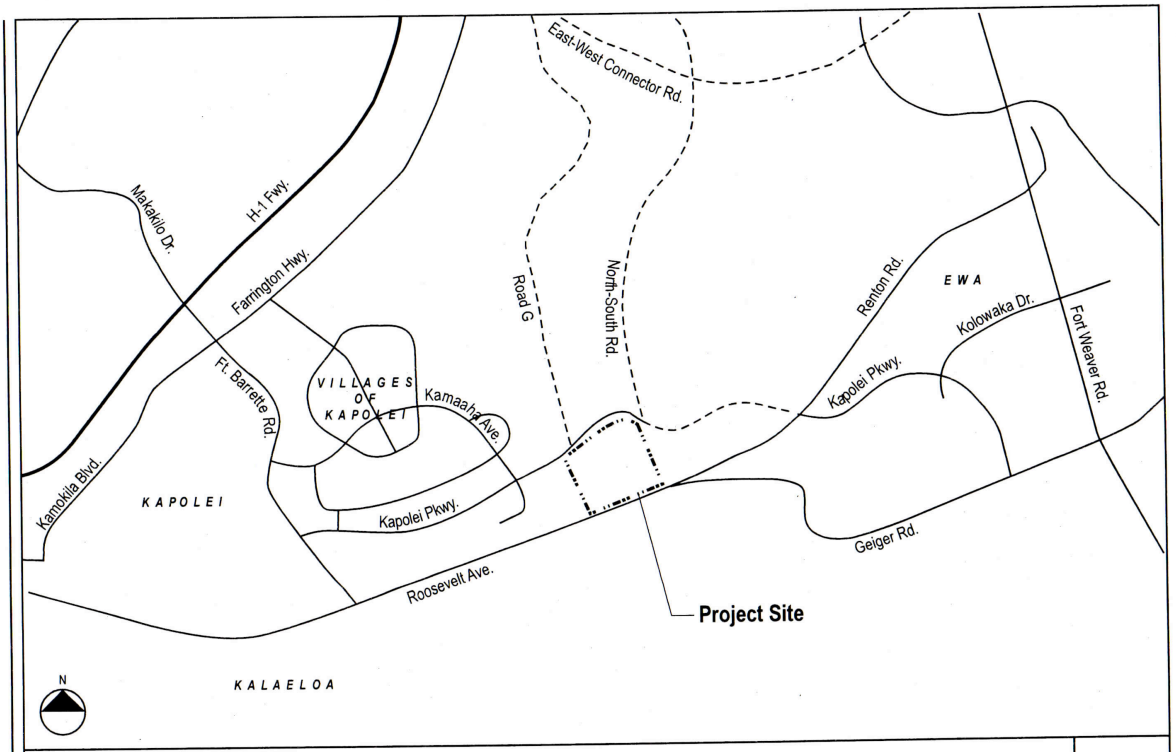
I. INTRODUCTION

The new Ka Makana Ali'i commercial development will be located in the heart of the rapidly growing Ewa plain. This includes the communities of Kapolei, Makakilo, Ko Olina, Ewa, Ewa Beach, and Kalaeloa. There are many planned developments proceeding through the planning, design, and construction phases in the area such as the East Kapolei residential communities planned by the State of Hawaii Department of Hawaiian Home Lands (DHHL), D.R. Horton's Ho'opili development, the University of Hawaii-West Oahu campus and adjacent development, Gentry Homes' Ewa by Gentry Makai, Haseko's Ocean Pointe, the Hawaii Community Development Authority (HCDA) Kalaeloa development, and Aina Nui Corporation's Kapolei, West Kapolei, and Makaiwa Hills developments. The proposed Kroc center is located mauka of Ka Makana Ali'i along North-South Road. A map of the area is shown in Figure 1.

Roadway infrastructure is a key concern in the area, and there are several major roadway projects underway to address this concern. The State of Hawaii Department of Transportation (HDOT) is currently constructing North-South Road, a new arterial roadway with a new interchange on Interstate H-1 Freeway. HDOT is also in the design phase for the Fort Weaver Road widening, Fort Barrette Road widening, and the Kapolei Interchange projects. The City and County of Honolulu has recently completed a new segment of Kapolei Parkway between the OR&L Railroad right-of-way to Renton Road and have recently had a bid opening for the segment of Kapolei Parkway between Renton Road and future North-South Road. DHHL will construct the segment of Kapolei Parkway between future North-South Road and the existing segment of Kapolei Parkway in the Villages of Kapolei in the two to three year future.

The purpose of this report is to determine the impact of the Ka Makana Ali'i shopping center on the roadway network and to identify any improvements or mitigation needed to accommodate the development. The shopping center site plan is shown in Figure 2.

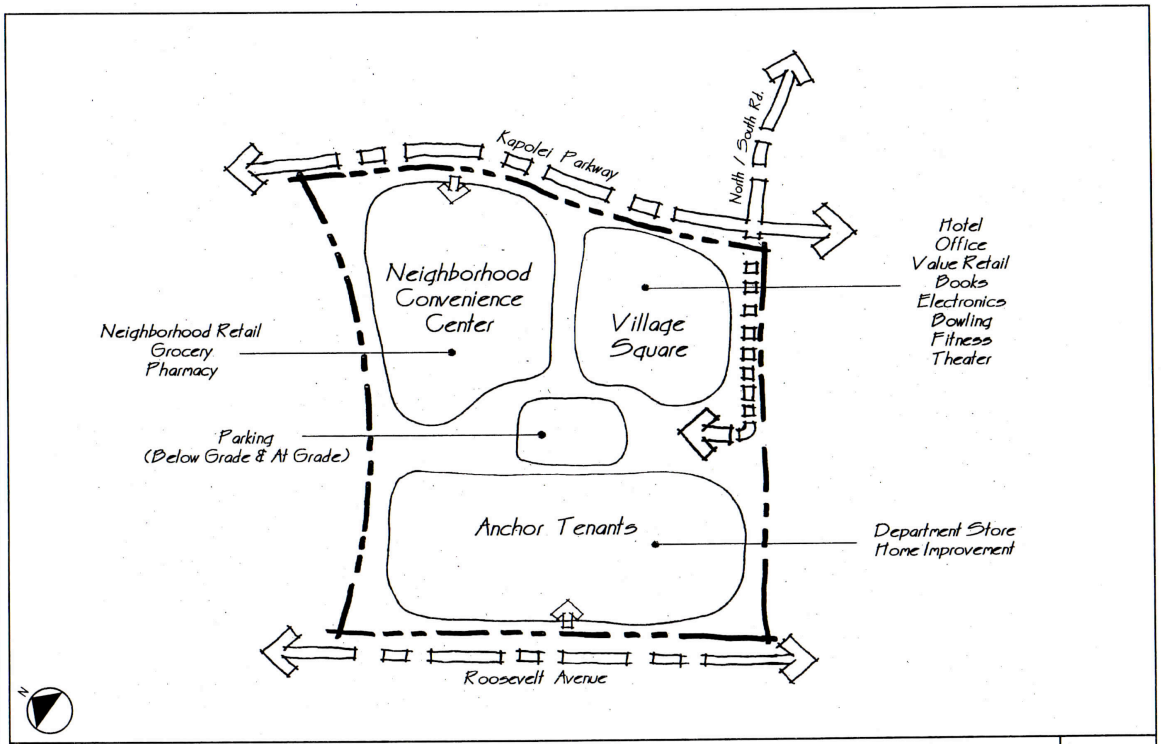


AREA MAP

Figure 1

Parsons Brinckerhoff

Ka Makana Ali'i
December 2008



PROJECT SITE MAP

Figure 2

Parsons Brinckerhoff

Ka Makana Ali'i
December 2008

II. EXISTING CONDITIONS

None of the intersections in the vicinity of the project currently exist, so PB obtained existing data at nearby locations to calibrate traffic simulation models. These intersections and their lane configurations are shown in Figure 3.

A. Existing Roadway Network

1. Kapolei Parkway

Kapolei Parkway is a six-lane, divided major arterial roadway. Ultimately it will provide significant east-west mobility between Kapolei and Ewa. Currently, discontinuous segments of Kapolei Parkway are constructed in Kapolei and in Ewa and Ewa Beach. Within the Kapolei area, Kapolei Parkway extends from Fort Barrette Road to the intersection of the future North-South Road near the new HDDL headquarters building

2. Roosevelt Avenue

Roosevelt Avenue is a collector roadway providing east-west circulation within Kalaeloa (former Barbers Point Naval Air Station). Because it connects to Geiger Road in Ewa and because Kapolei Parkway is currently discontinuous, Roosevelt Avenue functions as a de facto connection between Kapolei and Ewa/Ewa Beach via Fort Weaver Road. Roosevelt Avenue is a rural, two-lane undivided roadway with exclusive left-turn lanes at some intersections. The posted speed limit on Roosevelt Avenue is 35 MPH in the vicinity of Fort Barrette Road.

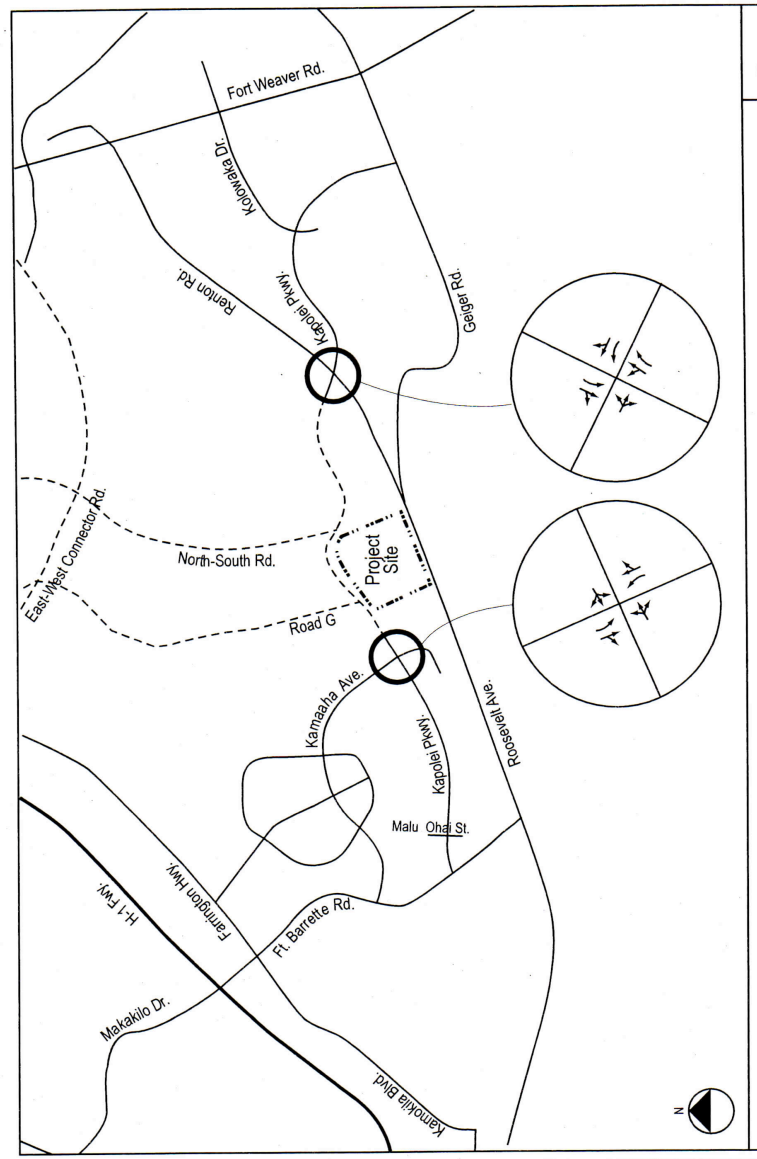


Figure 3

EXISTING LANE CONFIGURATIONS

B. Existing Traffic Volumes

Manual traffic counts were conducted in April, 2008 during the AM and PM peak periods at the following intersections:

- Kapolei Parkway/Kamaaha Avenue
- Kapolei Parkway/Renton Road

This data was supplemented with 2004 and 2007 data at the following intersections:

- Kapolei Parkway/Fort Barrette Road
- Fort Weaver Road/Renton Road

The traffic volumes were then summarized into AM and PM peak hour volumes shown in Figure 4. The AM and PM peak hours were chosen to determine the effect of the shopping center on the periods of maximum congestion on two major Ewa arterials. The study AM and PM peak hours were 7:00-8:00 AM and 4:00-5:00 PM, respectively. Appendix A contains the traffic count data sheets.

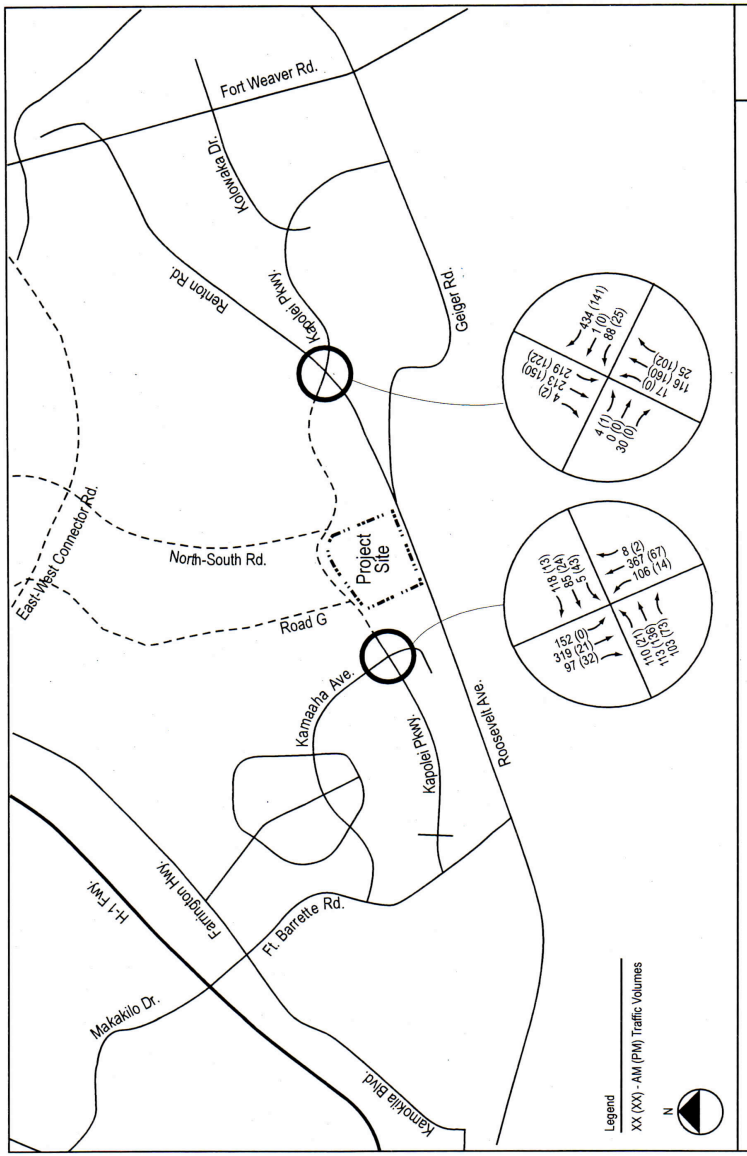


Figure 4

EXISTING TRAFFIC VOLUMES

C. Existing Traffic Operations

The study area intersections were analyzed using the methodologies for unsignalized intersections outlined in the 2000 Highway Capacity Manual (HCM). Operating conditions at an intersection are expressed as a qualitative measure known as Level of Service (LOS) with letter designations ranging from A through F, with LOS A representing free-flow conditions and LOS F representing over-capacity conditions. Level-of-Service criteria are described in Appendix B. Traffic analysis worksheets are located in Appendix C. The results of the intersection analysis are summarized in Table 1.

Table 1 Summary of Existing LOS and Delay

Intersection	AM Peak		PM Peak	
	LOS	Delay	LOS	Delay
Kapolei Parkway/Kamaaha Avenue	**Unsignalized**			
Mauka-bound Kamaaha Left	C	17.0	A	7.8
Mauka-bound Kamaaha Through/Right	F	83.0	A	7.8
Makai-bound Kamaaha Left	B	14.2	A	7.2
Makai-bound Kamaaha Through/Right	F	59.5	A	7.2
Waianae-bound Kapolei Left/Through/Right	C	21.0	A	8.2
KKHD-bound Kapolei Left/Through/Right	E	36.1	A	9.0
Kapolei Parkway/Kolowaka Drive	**Unsignalized**			
Mauka-bound Kolowaka Left/Through	C	24.1	B	14.3
Mauka-bound Kolowaka Right	A	8.9	A	8.7
Makai-bound Kolowaka Left	D	24.7	C	17.5
Makai-bound Kolowaka Through/Right	B	12.4	B	11.9
Waianae-bound Kapolei Left	A	7.6	A	7.6
KKHD-bound Kapolei Right	A	8.6	A	7.9
Kapolei Parkway/Renton Road	**Unsignalized**			
Mauka-bound Renton Left/Through	C	22.7	B	12.2
Mauka-bound Renton Right	A	8.5	A	8.7
Makai-bound Renton Left	F	51.0	C	16.6
Makai-bound Renton Through/Right	C	20.5	B	11.2
Waianae-bound Kapolei Left	A	7.4	A	7.3
KKHD-bound Kapolei Left/Through/Right	A	1.0	A	7.5

Delay is expressed in seconds per vehicle, * Delay exceeds 120 seconds

1. Kapolei Parkway/Kamaaha Avenue

The intersection of Kapolei Parkway and Kamaaha Avenue is an all-way stop controlled intersection. The mauka (toward the mountains, or north in this case) Kamaaha leg leads into the Villages of Kapolei development while the KKHD Kapolei Parkway leg provides access to Kapolei Middle School. During the AM peak hour, the mauka-bound and makai-bound Kamaaha through/right movements operate at LOS F due to volumes exceeding 300 vehicles per lane. Although the Kapolei right of way allows for 6 lanes, the Kapolei Parkway approaches are constrained to a single shared movement lane. As a result, the traffic on Kapolei Parkway in the KKHD-bound direction operates at LOS E. During the PM peak, the intersection operates at LOS A.

2. Kapolei Parkway/Renton Road

This intersection was analyzed as a 4-legged intersection with stop control on the Renton approaches. Currently, due to construction, only construction-related traffic is allowed to use the mauka Kapolei Parkway leg. The makai-bound Renton left turn operates at LOS F due to the high demand for the movement in the AM peak. During the PM peak, all movements operate at LOS C or better.

D. Summary of Existing Operations

Kapolei Parkway is intended to be a major regional arterial but presently consists of only unconnected segments and can only provide limited mobility. As a result, the current traffic volumes are local in nature and drivers don't spend very long on Kapolei Parkway before leaving the roadway. Some of the intersections have failing movements (LOS F) but will no longer fail when all segments of Kapolei Parkway are completed and signalized.

III. PROJECTED 2013 CONDITIONS WITHOUT PROJECT

The base year 2013 represents future conditions within the project area without the Ka Makana Ali'i shopping center. Projected roadways within the Kapolei/Ewa area are shown in Figure 5. By the projected horizon year of 2013, Kapolei Parkway between Kamaaha Avenue and Renton Road is expected to be completed. In addition, North-South Road is also expected to be complete, connecting H-1 and Farrington Highway to Kapolei Parkway. It was also assumed that the East-West Connector would be constructed. Finally, it was assumed that the North-South Road extension would be constructed.

A. Projected 2013 Network Without Project

1. Kapolei Parkway

Kapolei Parkway is projected to be a 6-lane major arterial connecting Kapolei to Ewa, eventually winding its way makai toward Ewa Beach. The intersections along Kapolei Parkway will typically require signals with protected left turns phases.

2. North-South Road

North-South Road is projected to be a 4-lane major arterial connecting H-1 Freeway to Kapolei Parkway.

3. East-West Connector

The East-West Connector is a major collector roadway which would add system redundancy, providing east-west mobility between North-South Road and Fort Weaver Road.

4. Roosevelt Avenue

Roosevelt Avenue is projected to remain a 2-lane collector roadway which would be deemphasized in the future. Its primary function would be to provide system redundancy as well as serving the Kalaeloa community.

Figure 5

EXISTING/FUTURE ROADWAY DEVELOPMENTS

5. Road G

Road G is a mauka-makai collector that runs through the planned University of Hawaii – West Oahu campus and East Kapolei Phase I, eventually connecting Farrington Highway and Kapolei Parkway. In 2013, it is assumed that it does not yet provide this connection.

Future developments in the Ewa plain are shown in Figure 6. It was assumed that in 2013, East Kapolei Phase I and the Kroc Center would be in place.

B. Projected 2013 Traffic Without Project

The 2013 background traffic was estimated using the following sources:

- HDOT 2006 Traffic Data
- August 2007 University of Hawaii West Oahu Traffic Study

With Kapolei Parkway, North South Road, and the East-West Connector in place, traffic volumes were shifted from North-South Road, Farrington Highway, and Roosevelt Avenue. Furthermore, annual growth was applied. Finally, trips associated with the East Kapolei Phase I and Kroc Center developments were generated using trip generation equations published by the Institute of Transportation Engineers in Trip Generation, Seventh Edition.

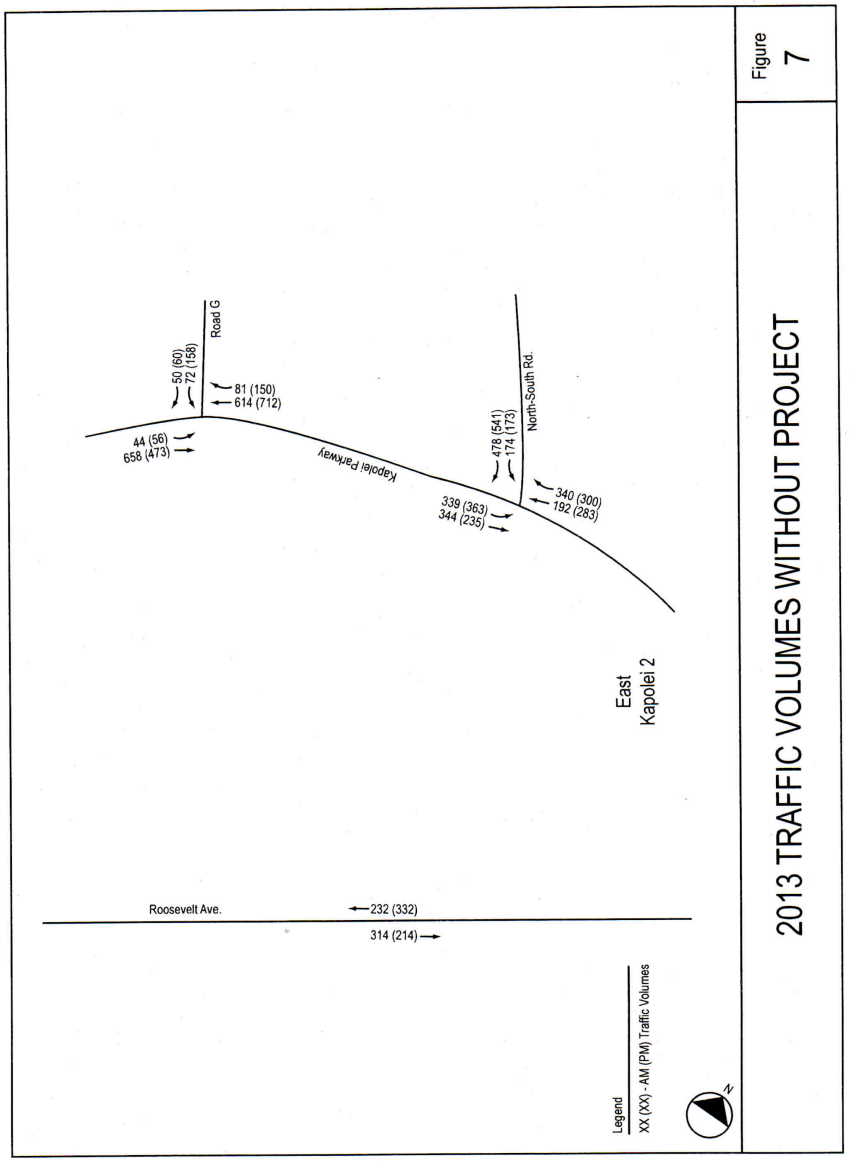
The projected 2013 traffic turning movement volumes without project are shown in Figure 7.

C. Projected 2013 Operations Without Project

The projected 2013 intersection levels of service without the Ka Makana Ali'i shopping center are shown in Table 2. Because Kapolei Parkway is projected to provide a great deal of regional mobility, a 150-second cycle was assumed. Such a long cycle length has a negative impact on the vehicular delay but would eventually be necessary beyond 2013 in order to process the future Kapolei Parkway through movements.

Figure 6

FUTURE DEVELOPMENTS



1. Kapolei Parkway/Road G

This intersection is projected to be a tee-intersection. A 150-second cycle is assumed. During the AM peak hour, the intersection is projected to operate at LOS A. Doing the PM peak, all movements are projected to operate at LOS C or better with the exception of the KKHD-bound Kapolei Parkway left turn, which is projected to operate at LOS D.

2. Kapolei Parkway/North-South Road

The intersection of Kapolei Parkway and North-South Road is expected to be a wide intersection with multiple double left turns. During the AM and PM peaks, the intersection is projected to operate at LOS C with all individual movements operating at LOS D or better.

D. Transit

As of this date, the western terminus first phase of the transit alignment, while not finalized, will not go beyond the East Kapolei Station near the Kroc Center. It is assumed that the alignment continuing down North-South Road will not be in place at this point.

E. Summary of 2013 Operations Without Project

The study area intersections are projected to operate at an acceptable level during the AM and PM peak hours. Both the Kapolei Parkway/North-South Road and Kapolei Parkway/Road G intersections experience consistent LOS D service in the PM peak hour. This is due primarily to control delay associated with the 150-second cycle length.

Table 2 Projected 2013 LOS Without Project

Intersection	AM Peak		PM Peak	
	LOS	Delay	LOS	Delay
Kapolei Parkway/Road G	**A**	**6.6**	**C**	**27.6**
Makai-bound Road G Left	B	12.7	B	11.6
Makai-bound Road G Right	B	11.8	B	10.4
Waianae-bound Kapolei Through	A	7.6	C	34.8
Waianae-bound Kapolei Right	A	6.7	C	29.0
KKHD-bound Kapolei Left	B	17.7	D	43.9
KKHD-bound Kapolei Through	A	3.8	C	21.8
Kapolei Parkway/North-South Road	**C**	**31.0**	**C**	**31.5**
Mauka-bound NSR Extension Left	D	50.7	D	53.2
Mauka-bound NSR Extension Through/Right	B	19.7	B	12.4
Makai-bound NSR Extension Left	D	44.7	D	49.4
Makai-bound NSR Extension Through	B	15.4	B	10.3
Makai-bound NSR Extension Right	B	16.1	B	11.3
Waianae-bound Kapolei Left	D	49.0	D	52.2
Waianae-bound Kapolei Through	D	41.5	D	47.9
Waianae-bound Kapolei Right	D	39.4	D	42.4
KKHD-bound Kapolei Left	D	44.6	D	52.3
KKHD-bound Kapolei Through/Right	C	30.9	D	43.7

Delay is expressed in seconds per vehicle

IV. PROJECTED 2013 CONDITIONS WITH PROJECT

The 2013 "With Project" scenario represents the future conditions within the project area with the Ka Makana Ali'i shopping center development. Similar assumptions were made for the "With Project" scenario. A connected Kapolei Parkway, North-South Road and the North-South Road extension, and the East-West Connector are all assumed to be in place in 2013.

A. Project-Related Traffic Volumes

Future traffic generated by the Ka Makana Ali'i shopping center was estimated using the three step method of trip generation, trip distribution, and trip assignment. The assumed land use and trip generation are shown in Table 3.

1. Trip Generation

Ka Makana Ali'i consists of three uses that can be classified as shopping center, office building, and hotel. Trip generation estimates the number of vehicular trips in and out of the project based on the land use type and density. Trips were estimated using trip generation equations published by the Institute of Transportation Engineers in Trip Generation, Seventh Edition.

Table 3 shows the planned project land use and corresponding trips generated. Pass-by traffic was assumed to be 20% during the PM while transit share was assumed to be 10%. Table 4 shows the actual number of new trips (calculated by subtracting pass-by trips and trips lost to transit from total trips generated) added to the roadway network.

Table 3 Ka Makana Ali'i Trip Generation

				AM Peak			PM Peak		
Land Uses	Units		ITE Code	IN	OUT	TOTAL	IN	OUT	TOTAL
Shopping Center Total	1250000	SF	820	435	278	713	1592	1724	3316
Office Building Total	112000	SF	710	181	25	206	35	170	205
Hotel Total	300	Rooms	320	44	75	119	63	54	117
Project Total				**660**	**378**	**1038**	**1690**	**1948**	**3638**

Volumes expressed in vehicles per hour

Table 4 Ka Makana Ali'i Trip Generation: New Trips

				AM Peak			PM Peak		
Land Uses	Units		ITE Code	IN	OUT	TOTAL	IN	OUT	TOTAL
Shopping Center Sub-Total	1250000	SF	820	435	278	713	1592	1724	3316
Shopping Center Transit Share	10%			-44	-28	-72	-159	-172	-331
Pass-By Traffic	20%						-318	-318	-636
Shopping Center Total				391	250	641	1115	1234	2349
Office Building Total	112000	SF	710	181	25	206	35	170	205
Hotel Sub-Total	300	Rooms	320	44	75	119	63	54	117
Hotel Transit Share	10%			-4	-8	-12	-6	-5	-11
Hotel Total				40	67	107	57	49	106
Project Total				**612**	**342**	**954**	**1207**	**1453**	**2660**

Volumes expressed in vehicles per hour

2. Trip Distribution

The shopping center distribution was calculated using projected 2014 land use data (in lieu of 2013 data, which was unavailable) from the Oahu model. The trip distribution is shown in Table 5. Farrington E and Farrington W refer to the traffic analysis zones (TAZs) located mauka of Farrington east and west of North-South Road.

Table 5 Ka Makana Ali'i Trip Distribution

Area	Household Total	
E. Kapolei 2	34	0.08%
Hoopili	6396	14.24%
UHWO	1892	4.21%
E. Kapolei 1	282	0.63%
Honouliuli	1836	4.09%
Ewa/Ewa Beach	17654	39.30%
Farrington E	1708	3.80%
Farrington W	86	0.19%
Kalaeloa	3318	7.39%
Kapolei	7759	17.27%
Villages of Kapolei	3954	8.80%
Total	44919	100%

3. Trip Assignment

The project-generated traffic volumes were assigned to the future network based using the trip distribution shown in Table 5. Negatives trips are associated with pass-by traffic. As an example, a vehicle heading east on Kapolei Parkway toward Ewa might choose to make the right turn into the shopping center and the right turn out when finished shopping. This vehicle is not a new trip; rather it is an existing trip that was rerouted. In this example, the pass-by trip manifests itself as a negative number for the through movement and an equivalent positive number for the right turn in and right turn out.

The trip assignment is shown in Figure 8. The projected 2013 traffic volumes with project are shown in Figure 9.

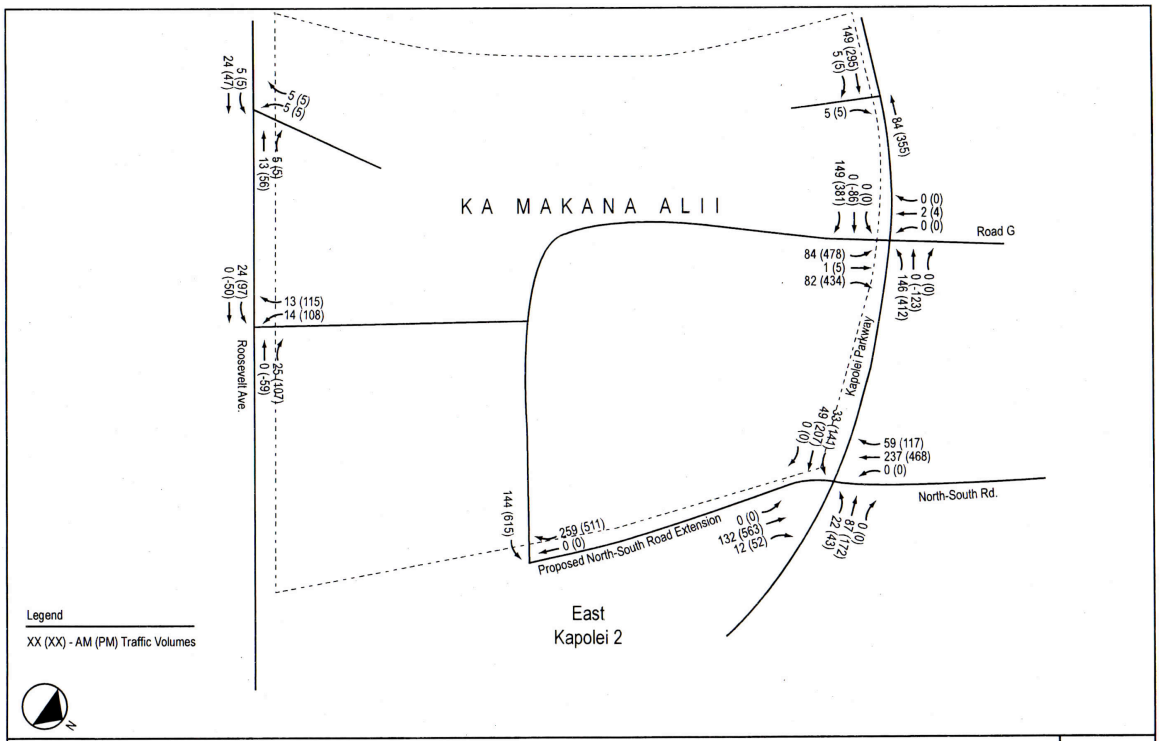
B. Projected 2013 Operations With Project

The projected 2013 intersection levels of service with the Ka Makana Ali'i shopping center are shown in Table 6.

Table 6 Projected 2013 LOS With Project

	AM Peak		PM Peak	
Intersection	LOS	Delay	LOS	Delay
Kapolei Parkway/Road G	**C**	**20.8**	**D**	**44.2**
Mauka-bound Road G Left	D	36.4	D	52.8
Mauka-bound Road G Through	C	20.3	C	26.5
Mauka-bound Road G Right	C	20.8	C	32.0
Makai-bound Road G Left	C	34.0	E	58.6
Makai-bound Road G Through/Right	B	18.4	C	31.6
Waianae-bound Kapolei Left	C	20.3	D	53.7
Waianae-bound Kapolei Through	B	10.5	D	37.0
Waianae-bound Kapolei Right	A	0.8	C	32.1
KKHD-bound Kapolei Left	D	43.8	E	62.3
KKHD-bound Kapolei Through	C	27.7	D	47.8
KKHD-bound Kapolei Right	C	21.6	D	44.2

Delay is expressed in seconds per vehicle

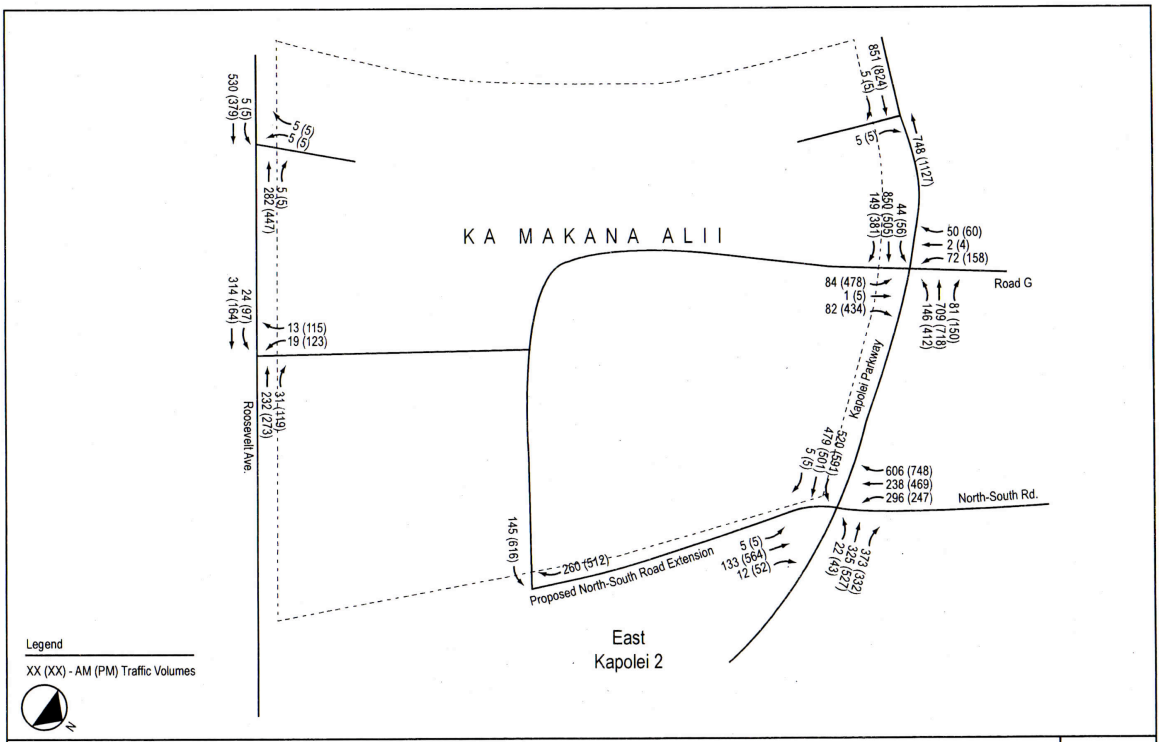


PROJECT-RELATED TRAFFIC VOLUMES

Figure 8

Parsons Brinckerhoff

Ka Makana Ali'i
December 2008



2013 TRAFFIC VOLUMES WITH PROJECT

Figure 9

Parsons Brinckerhoff

Ka Makana Ali'i
December 2008

Table 6 Projected 2013 LOS With Project (continued)

Intersection	AM Peak		PM Peak	
	LOS	Delay	LOS	Delay
Kapolei Parkway/North-South Road	**C**	**20.5**	**D**	**43.5**
Mauka-bound NSR Extension Left	D	44.1	F	128.4
Mauka-bound NSR Extension Through/Right	C	25.8	D	41.4
Makai-bound NSR Extension Left	D	37.2	E	67.8
Makai-bound NSR Extension Through	B	19.3	C	27.2
Makai-bound NSR Extension Right	B	19.5	C	26.7
Waianae-bound Kapolei Left	C	32.6	E	71.8
Waianae-bound Kapolei Through	C	26.0	E	58.9
Waianae-bound Kapolei Right	C	23.8	D	46.0
KKHD-bound Kapolei Left	C	20.4	E	64.1
KKHD-bound Kapolei Through/Right	A	3.9	C	29.2
Roosevelt Avenue/Ka Makana Ali'i Access	**B**	**17.7**	**B**	**14.2**
Makai-bound Ka Makana Ali'i Left	A	5.8	A	6.1
Makai-bound Ka Makana Ali'i Right	A	5.8	A	5.7
Waianae-bound Roosevelt Through	B	16.7	B	19.1
Waianae-bound Roosevelt Right	B	13.9	B	14.5
KKHD-bound Roosevelt Left	B	14.3	B	17.5
KKHD-bound Roosevelt Through	C	20.1	B	16.1
Kapolei Parkway Service Access	**Unsignalized**			
Mauka-bound Service Right	B	10.6	B	10.6
Roosevelt Avenue Service Access	**Unsignalized**			
Makai-bound Service Left	C	17.1	C	17.1
Makai-bound Service Right	B	11.3	B	11.2
KKHD-bound Roosevelt Left	A	8.4	A	8.4

Delay is expressed in seconds per vehicle

1. Kapolei Parkway/Road G

As shown in Figure 2, Ka Makana Ali'i has 3 major accesses, one to Kapolei Parkway at Road G, one on the North-South Road extension, and one to Roosevelt Avenue. Additional service accesses are located on the mauka-Waianae corner of the property adjacent to the drainage canal and on the makai-Waianae corner. The mauka Kapolei Parkway access is projected to be the primary access to serve Kalaeloa, Kapolei, and the Villages of Kapolei. It is also a primary access from Ewa/Ewa Beach and Hoopili. This being the case, the movements in and out of the shopping center are heavy movements. Double left turns out of the shopping center are recommended.

During the AM peak hour, all movements at the intersection are projected to operate at LOS C or better. During the PM peak hour, the intersection is projected to operate at LOS D, however, certain left turn movements are projected to operate at LOS E. LOS D overall with LOS E on left turn movements only is acceptable for this cycle length on a corridor like Kapolei Parkway.

Being the primary access to the shopping center resulting sizable increase in delay per vehicle with the project versus without.

2. Kapolei Parkway/North-South Road

As shown in Figure 2, the intersection of Kapolei Parkway and North-South Road is the major intersection within the study area. A cycle length of 150 seconds was assumed. During the AM peak, the intersection is projected to operate at LOS C overall. Protected left turns are projected to operate at LOS D or better during this time period. During the PM peak, the intersection is projected to operate at LOS D as well with all movements operating at LOS F or better. Like the Kapolei Parkway/Road G intersection, the long cycle length increases the overall delay. The KKHD-bound left turn is the key movement and utilizes a significant portion of green time.

3. Roosevelt Avenue/Makai Ka Makana Ali'i Access

Like the other non-primary Ka Makana Ali'i access, this intersection was analyzed using a 90-second cycle length and is projected to operate at LOS B during both the AM and PM peak hours.

4. Kapolei Parkway/Makai Ka Makana Ali'i Service Access

This intersection was analyzed as an unsignalized right in/right out access with stop control out of the shopping center. The mauka-bound service access is projected to operate at LOS B during both peak periods. This peak hour of activity at this service access is not expected to coincide with peak hour traffic on Kapolei parkway.

5. Roosevelt Avenue/Makai Ka Makana Ali'i Service Access

This intersection was analyzed as a full-movement access with stop control out of the shopping center. All movements are projected to operate at LOS C or better during both

C. Transit

As was mentioned earlier, the western terminus first phase of the transit alignment is projected to be at the East Kapolei Station near the Kroc Center. The alignment continuing down North-South Road is not projected to be in place in 2013. The impact of the transit will depend on the ridership and the associated park and ride lots at the Ewa/Kapolei stations.

D. Summary of 2013 Operations With Project

Overall the Ka Makana Ali'i shopping center has the greatest impact on the Kapolei Parkway/Road G intersection. This is understandable because the intersection would be improved from a tee intersection to a four-legged intersection, one approach of which would be the shopping center's primary access. The center also increases the delay at the Kapolei Parkway/North-South Road intersection but the LOS is unchanged. All other study area intersections are projected to operate acceptably.

V. CONCLUSION AND RECOMMENDATIONS

A. Conclusion

It is concluded that while delays experienced along Kapolei Parkway are expected to increase, the intersections are still projected to operate at an acceptable level during the AM and PM commuter peak hours. The Ka Makana Ali'i shopping center traffic can be accommodated by the adjacent roadway network.

B. Recommendations

Based on the operational analyses of intersections, the following are recommended to be implemented in conjunction with the proposed shopping center:

- Signalize the primary access on Kapolei Parkway using phasing that provides protected left turns on the minor streets.
- It is recommended that the adjacent intersections be configured as shown in Figure 10.
- Investigate the possibility of running a shuttle service between the future North-South Road transit station and the shopping center, particularly during the PM peak period.
- Provide frequent regional and sub-regional bus service connecting major activity centers in the area such as the UHWO campus and the Kroc center as well as with the transit stations in Waipahu and Kapolei.

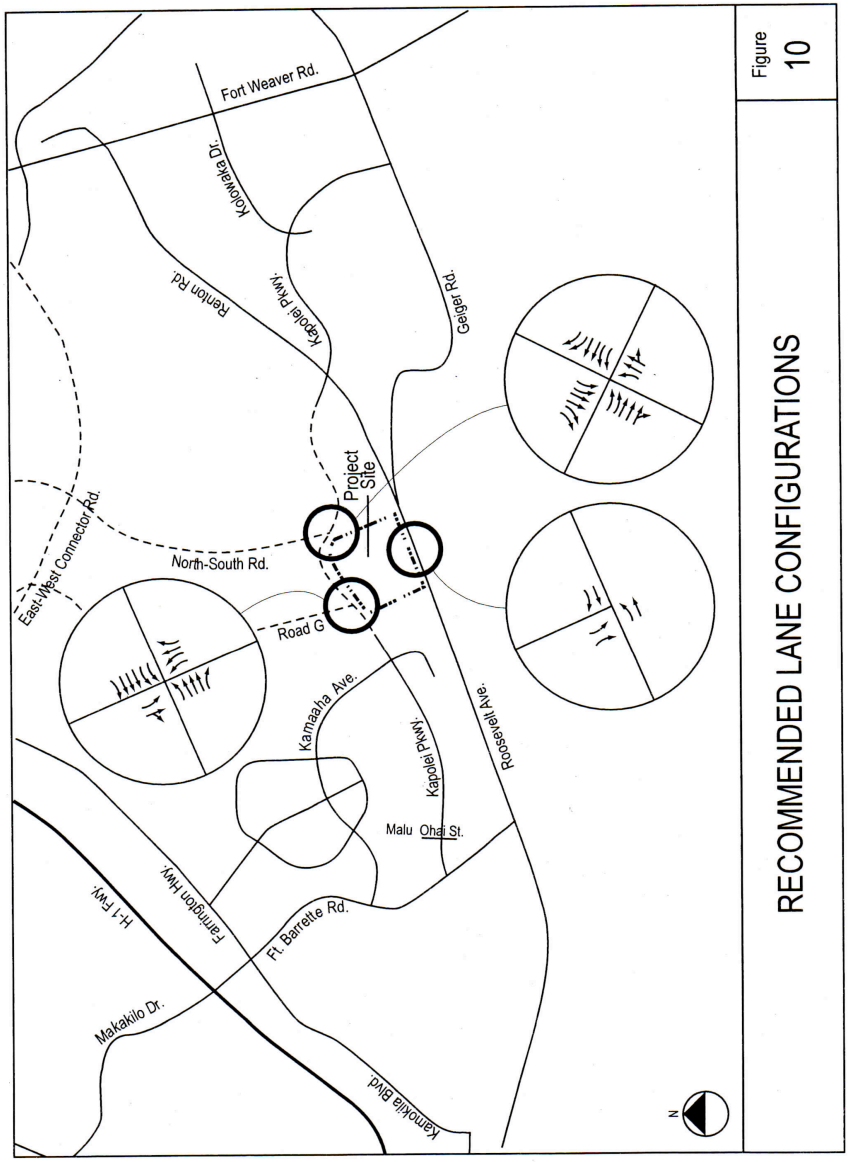


Figure 10

RECOMMENDED LANE CONFIGURATIONS

Draft

Appendix A

Existing Traffic Data

VEHICLE TURNING MOVEMENT COUNT - SUMMARY

Intersection of: Kapolei Parkway
and: Renton Road
Location: Kapolei, Hawaii

Counted by: AM
Date: April 2, 2008
Weather: Sunny, Hot
Entered by: AG

Day: Wednesday

The Traffic Group

TIME	TRAFFIC FROM NORTH on: Construction Site Access					TRAFFIC FROM SOUTH on: Kapolei Parkway					TRAFFIC FROM EAST on: Renton Road					TRAFFIC FROM WEST on: Renton Road					TOTAL N + S + E + W
	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	
AM																					
06:0-15	0	0	0	0	0	73	0	25	0	98	1	45	0	0	46	0	5	1	0	6	150
15-30	0	0	0	0	0	68	0	33	0	101	0	40	7	0	47	5	16	1	0	22	170
30-45	1	0	0	0	1	80	0	30	0	110	1	60	13	0	74	0	15	5	0	20	205
45-00	0	0	0	0	0	92	1	26	0	119	7	48	20	0	75	1	27	6	0	34	228
07:0-15	1	0	1	0	2	80	0	33	0	113	4	55	29	0	88	4	17	7	0	28	231
15-30	6	0	2	0	8	123	0	23	0	146	0	55	38	0	93	6	26	6	0	38	285
30-45	17	0	1	0	18	145	1	22	0	168	0	42	74	0	116	5	39	2	0	46	348
45-00	6	0	0	0	6	86	0	10	0	96	0	61	78	0	139	10	34	2	0	46	287
2 Hr Totals	31	0	4	0	35	747	2	202	0	951	13	406	259	0	678	31	179	30	0	240	1904
1 Hr Totals																					
06-07	1	0	0	0	1	313	1	114	0	428	9	193	40	0	242	6	63	13	0	82	753
615-715	2	0	1	0	3	320	1	122	0	443	12	203	69	0	284	10	75	19	0	104	834
630-730	8	0	3	0	11	375	1	112	0	488	12	218	100	0	330	11	85	24	0	120	949
645-745	24	0	4	0	28	440	2	104	0	546	11	200	161	0	372	16	109	21	0	146	1092
07-08	30	0	4	0	34	434	1	88	0	523	4	213	219	0	436	25	116	17	0	158	1151
PEAK HOUR																					
07-08	30	0	4	0	34	434	1	88	0	523	4	213	219	0	436	25	116	17	0	158	1151
PM																					
04:0-15	0	0	0	0	0	33	0	4	0	37	0	29	37	0	66	26	42	0	0	68	171
15-30	0	0	1	0	1	39	0	6	0	45	1	33	40	0	74	25	44	0	0	69	189
30-45	0	0	0	0	0	34	0	7	0	41	0	36	41	0	77	24	41	0	0	65	183
45-00	0	0	0	0	0	35	0	8	0	43	1	24	32	0	57	27	34	0	0	61	161
05:0-15	0	1	0	0	1	35	0	7	0	42	0	26	39	0	65	19	38	0	0	57	165
15-30	0	1	0	0	1	41	0	12	0	53	0	23	37	0	60	24	30	0	0	54	168
30-45	0	0	0	0	0	37	0	7	0	44	0	24	32	0	56	23	46	1	0	70	170
45-00	0	0	0	0	0	24	0	10	0	34	0	27	25	0	52	21	33	0	0	54	140
2 Hr Totals	0	2	1	0	3	278	0	61	0	339	2	222	283	0	507	189	308	1	0	498	1347
1 Hr Totals																					
04-05	0	0	1	0	1	141	0	25	0	166	2	122	150	0	274	102	161	0	0	263	704
415-515	0	1	1	0	2	143	0	28	0	171	2	119	152	0	273	95	157	0	0	252	698
430-530	0	2	0	0	2	145	0	34	0	179	1	109	149	0	259	94	143	0	0	237	677
445-545	0	2	0	0	2	148	0	34	0	182	1	97	140	0	238	93	148	1	0	242	664
05-06	0	2	0	0	2	137	0	36	0	173	0	100	133	0	233	87	147	1	0	235	643
PEAK HOUR																					
04-05	0	0	1	0	1	141	0	25	0	166	2	122	150	0	274	102	161	0	0	263	704

VEHICLE TURNING MOVEMENT COUNT - SUMMARY

Intersection of: Kapolei Parkway
and: Kamaaha Avenue
Location: Kapolei, Hawaii

Counted by: AM
Date: March 6, 2008
Weather: Sunny, Warm
Entered by: AG

Day: Tuesday

The Traffic Group

TIME	TRAFFIC FROM NORTH on: Kamaaha Avenue					TRAFFIC FROM SOUTH on: Kamaaha Avenue					TRAFFIC FROM EAST on: Kapolei Parkway					TRAFFIC FROM WEST on: Kapolei Parkway					TOTAL N + S + E + W
	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	
AM																					
06:0-15	10	61	12	0	83	0	54	8	0	62	8	9	0	0	17	5	10	1	0	16	178
15-30	16	70	15	0	101	1	66	10	0	77	8	7	1	0	16	4	11	0	0	15	209
30-45	15	81	21	0	117	1	65	11	0	77	12	10	0	0	22	10	12	2	0	24	240
45-00	17	77	25	0	119	3	75	18	0	96	17	14	1	0	32	13	21	7	0	41	288
07:0-15	20	80	32	0	132	2	82	25	0	109	27	18	2	0	47	18	25	10	0	53	341
15-30	18	83	33	0	134	4	87	32	0	123	31	23	0	0	54	26	23	11	0	60	371
30-45	31	89	47	0	167	1	130	27	0	158	37	19	0	0	56	24	34	38	0	96	477
45-00	28	67	40	0	135	1	68	22	0	91	23	25	3	0	51	35	31	51	0	117	394
2 Hr Totals	155	608	225	0	988	13	627	153	0	793	163	125	7	0	295	135	167	120	0	422	2498
1 Hr Totals																					
06-07	58	289	73	0	420	5	260	47	0	312	45	40	2	0	87	32	54	10	0	96	915
615-715	68	308	93	0	469	7	288	64	0	359	64	49	4	0	117	45	69	19	0	133	1078
630-730	70	321	111	0	502	10	309	86	0	405	87	65	3	0	155	67	81	30	0	178	1240
645-745	86	329	137	0	552	10	374	102	0	486	112	74	3	0	189	81	103	66	0	250	1477
07-08	97	319	152	0	568	8	367	106	0	481	118	85	5	0	208	103	113	110	0	326	1583
PEAK HOUR																					
07-08	97	319	152	0	568	8	367	106	0	481	118	85	5	0	208	103	113	110	0	326	1583
PM																					
04:0-15	18	26	3	0	47	1	25	3	0	29	8	4	0	0	12	5	6	14	0	25	113
15-30	12	32	7	0	51	1	17	5	0	23	10	6	0	0	16	3	7	11	0	21	111
30-45	21	40	7	0	68	0	12	4	0	16	5	5	0	0	10	3	6	9	0	18	112
45-00	22	38	4	0	64	0	13	2	0	15	9	6	0	0	15	2	5	9	0	16	110
05:0-15	22	28	7	0	57	0	11	2	0	13	6	4	0	0	10	6	5	15	0	26	106
15-30	13	38	4	0	55	1	12	3	0	16	6	6	4	0	16	3	6	5	0	14	101
30-45	15	39	2	0	56	1	15	3	0	19	3	5	2	0	10	1	7	9	0	17	102
45-00	13	34	3	0	50	0	11	3	0	14	1	4	0	0	5	2	5	2	0	9	78
2 Hr Totals	136	275	37	0	448	4	116	25	0	145	48	40	6	0	94	25	47	74	0	146	833
1 Hr Totals																					
04-05	73	136	21	0	230	2	67	14	0	83	32	21	0	0	53	13	24	43	0	80	446
415-515	77	138	25	0	240	1	53	13	0	67	30	21	0	0	51	14	23	44	0	81	439
430-530	78	144	22	0	244	1	48	11	0	60	26	21	4	0	51	14	22	38	0	74	429
445-545	72	143	17	0	232	2	51	10	0	63	24	21	6	0	51	12	23	38	0	73	419
05-06	63	139	16	0	218	2	49	11	0	62	16	19	6	0	41	12	23	31	0	66	387
PEAK HOUR																					
04-05	73	136	21	0	230	2	67	14	0	83	32	21	0	0	53	13	24	43	0	80	446

Appendix B
Levels of Service Definitions

The *Highway Capacity Manual* defines six Levels of Service (LOS), labeled A through F, from best to worst conditions. Levels of Service for signalized and unsignalized intersections are defined in terms of average user delays. Delay is a measure of driver discomfort, frustration, fuel consumption, and lost travel time.

For unsignalized intersections, the *Highway Capacity Manual* evaluates gaps in the major street traffic flow and calculates available gaps for left-turns across oncoming traffic and for the left and right-turns onto the major roadway from the minor street.

LEVEL-OF-SERVICE A: Little or no delay.

LEVEL-OF-SERVICE B: Short traffic delays.

LEVEL-OF-SERVICE C: Average traffic delays.

LEVEL-OF-SERVICE D: Long traffic delays.

LEVEL-OF-SERVICE E: Very long traffic delays.

LEVEL-OF-SERVICE F: Demand volume exceeds capacity, resulting in extreme delays with queuing that may cause severe congestion and affect other movements at the intersection.

Appendix C
Intersection Capacity Analysis Worksheets

HCM Unsignalized Intersection Capacity Analysis
7: Kapolei Parkway & Kamaaha Avenue

4/28/2008

Movement	WBL2	WBL	WBR	SEL	SET	SER	NWL	NWT	NWR	NEL	NER	NER2
Lane Configurations												
Sign Control		Stop			Stop			Stop		Stop		
Volume (vph)	43	24	13	0	21	32	14	67	2	21	136	73
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)	47	26	14	0	23	35	15	73	2	23	148	79

Direction, Lane #	WB 1	SE 1	SE 2	NW 1	NW 2	NE 1
Volume Total (vph)	87	0	58	15	75	250
Volume Left (vph)	47	0	0	15	0	23
Volume Right (vph)	14	0	35	0	2	79
Hadj (s)	0.04	0.00	-0.39	0.53	0.01	-0.14
Departure Headway (s)	4.6	5.4	5.0	5.9	5.3	4.3
Degree Utilization, x	0.11	0.00	0.08	0.02	0.11	0.30
Capacity (veh/h)	737	631	667	576	630	818
Control Delay (s)	8.2	7.2	7.2	7.8	7.8	9.0
Approach Delay (s)	8.2	7.2		7.8		9.0
Approach LOS	A	A		A		A

Intersection Summary			
Delay	8.4		
HCM Level of Service	A		
Intersection Capacity Utilization	36.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
7: Kamaaha Avenue &

4/28/2008

Movement	WBL2	WBL	WBR	SEL	SET	SER	NWL	NWT	NWR	NEL	NER	NER2
Lane Configurations												
Sign Control		Stop			Stop			Stop		Stop		
Volume (vph)	5	85	118	152	319	97	106	367	8	110	113	103
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)	5	92	128	165	347	105	115	399	9	120	123	112

Direction, Lane #	WB 1	SE 1	SE 2	NW 1	NW 2	NE 1
Volume Total (vph)	226	165	452	115	408	354
Volume Left (vph)	5	165	0	115	0	120
Volume Right (vph)	128	0	105	0	9	112
Hadj (s)	-0.30	0.53	-0.13	0.53	0.02	-0.09
Departure Headway (s)	8.5	9.0	8.3	8.9	8.4	8.1
Degree Utilization, x	0.54	0.41	1.04	0.28	0.95	0.80
Capacity (veh/h)	392	394	436	399	423	433
Control Delay (s)	21.0	17.0	83.0	14.2	59.5	36.1
Approach Delay (s)	21.0	65.4		49.5		36.1
Approach LOS	C	F		E		E

Intersection Summary			
Delay	48.7		
HCM Level of Service	E		
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: Kapolei Parkway & Road G

AM Peak Hour
7/16/2008

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	44	850	149	146	709	81	84	1	82	72	2	50
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	5.0	5.0	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	0.97	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.86	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1593	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1593	
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)	48	924	162	159	771	88	91	1	89	78	2	54
RTOR Reduction (vph)	0	0	121	0	0	59	0	0	65	0	37	0
Lane Group Flow (vph)	48	924	41	159	771	29	91	1	24	78	19	0
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			
Actuated Green, G (s)	3.6	18.9	18.9	9.0	24.3	24.3	4.1	19.9	19.9	7.2	23.0	
Effective Green, g (s)	3.6	18.9	18.9	9.0	24.3	24.3	4.1	19.9	19.9	7.2	23.0	
Actuated g/C Ratio	0.05	0.25	0.25	0.12	0.32	0.32	0.05	0.27	0.27	0.10	0.31	
Clearance Time (s)	5.0	5.0	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	3.0	3.0	
Lane Grp Cap (vph)	85	1281	399	412	1648	513	188	494	420	170	489	
v/s Ratio Prot	0.03	c0.18		0.05	c0.15		c0.03	0.00		c0.04	0.01	
v/s Ratio Perm			0.03			0.02			c0.01			
v/c Ratio	0.56	0.72	0.10	0.39	0.47	0.06	0.48	0.00	0.06	0.46	0.04	
Uniform Delay, d1	34.9	25.6	21.5	30.5	20.2	17.5	34.4	20.3	20.5	32.1	18.2	
Progression Factor	1.00	1.00	1.00	0.65	0.51	0.05	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	8.3	2.0	0.1	0.6	0.2	0.0	2.0	0.0	0.3	2.0	0.1	
Delay (s)	43.3	27.7	21.6	20.3	10.5	0.8	36.4	20.3	20.8	34.0	18.4	
Level of Service	D	C	C	C	B	A	D	C	C	C	B	
Approach Delay (s)		27.5			11.2			28.6			27.5	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM Average Control Delay	20.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	43.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: Kapolei Parkway & NSR Extension

AM Peak Hour
7/16/2008

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	520	479	5	22	325	373	5	133	12	296	238	606
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	5.0
Lane Util. Factor	0.97	0.91		0.97	0.95	0.88	1.00	0.95		0.97	0.95	0.88
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5078		3433	3539	2787	1770	3496		3433	3539	2787
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5078		3433	3539	2787	1770	3496		3433	3539	2787
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)	565	521	5	24	353	405	5	145	13	322	259	659
RTOR Reduction (vph)	0	1	0	0	0	317	0	10	0	0	0	449
Lane Group Flow (vph)	565	525	0	24	353	88	5	148	0	322	259	210
Turn Type	Prot			Prot		Perm	Prot			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	14.0	24.8		5.5	16.3	16.3	0.8	15.0		9.7	23.9	23.9
Effective Green, g (s)	14.0	24.8		5.5	16.3	16.3	0.8	15.0		9.7	23.9	23.9
Actuated g/C Ratio	0.19	0.33		0.07	0.22	0.22	0.01	0.20		0.13	0.32	0.32
Clearance Time (s)	5.0	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	3.0
Lane Grp Cap (vph)	641	1679		252	769	606	19	699		444	1128	888
v/s Ratio Prot	c0.16	0.10		0.01	c0.10		0.00	c0.04		c0.09	0.07	
v/s Ratio Perm						0.03						c0.08
v/c Ratio	0.88	0.31		0.10	0.46	0.15	0.26	0.21		0.73	0.23	0.24
Uniform Delay, d1	29.7	18.7		32.4	25.5	23.7	36.8	25.1		31.4	18.8	18.8
Progression Factor	0.25	0.20		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	13.1	0.1		0.2	0.4	0.1	7.3	0.7		5.8	0.5	0.6
Delay (s)	20.4	3.9		32.6	26.0	23.8	44.1	25.8		37.2	19.3	19.5
Level of Service	C	A		C	C	C	D	C		D	B	B
Approach Delay (s)		12.4			25.1			26.3			24.0	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	20.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	24	314	232	31	17	13
Ideal Flow (vphpl)	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	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)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.55	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1030	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	26	341	252	34	18	14
RTOR Reduction (vph)	0	0	0	25	0	7
Lane Group Flow (vph)	26	341	252	9	18	7
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Actuated Green, G (s)	14.5	14.5	14.5	14.5	28.1	28.1
Effective Green, g (s)	14.5	14.5	14.5	14.5	28.1	28.1
Actuated g/C Ratio	0.28	0.28	0.28	0.28	0.53	0.53
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)	284	514	514	436	946	846
v/s Ratio Prot		c0.18	0.14		c0.01	
v/s Ratio Perm	0.03			0.01		0.00
v/c Ratio	0.09	0.66	0.49	0.02	0.02	0.01
Uniform Delay, d1	14.2	16.9	16.0	13.9	5.8	5.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	3.2	0.7	0.0	0.0	0.0
Delay (s)	14.3	20.1	16.7	13.9	5.8	5.8
Level of Service	B	C	B	B	A	A
Approach Delay (s)		19.7	16.4		5.8	
Approach LOS		B	B		A	

Intersection Summary			
HCM Average Control Delay	17.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.24		
Actuated Cycle Length (s)	52.6	Sum of lost time (s)	10.0
Intersection Capacity Utilization	31.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1004	936	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0			
Lane Util. Factor		0.91	0.91			
Frt		1.00	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		5085	5085			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		5085	5085			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1091	1017	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1091	1017	0	0	0
Turn Type						custom
Protected Phases		4	8			
Permitted Phases						6
Actuated Green, G (s)		51.0	51.0			
Effective Green, g (s)		51.0	51.0			
Actuated g/C Ratio		0.68	0.68			
Clearance Time (s)		4.0	4.0			
Lane Grp Cap (vph)		3458	3458			
v/s Ratio Prot		c0.21	0.20			
v/s Ratio Perm						
v/c Ratio		0.32	0.29			
Uniform Delay, d1		4.9	4.8			
Progression Factor		0.14	1.51			
Incremental Delay, d2		0.2	0.2			
Delay (s)		0.9	7.4			
Level of Service		A	A			
Approach Delay (s)		0.9	7.4		0.0	
Approach LOS		A	A		A	

Intersection Summary			
HCM Average Control Delay	4.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.32		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	22.7%	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)	942	5	0	1256	0	5
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)	1024	5	0	1365	0	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				501		
pX, platoon unblocked					0.90	
vC, conflicting volume			1029		1482	344
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1029		1150	344
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	99
cM capacity (veh/h)			671		173	652

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	410	410	210	455	455	455	5
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	5	0	0	0	5
cSH	1700	1700	1700	1700	1700	1700	652
Volume to Capacity	0.24	0.24	0.12	0.27	0.27	0.27	0.01
Queue Length 95th (ft)	0	0	0	0	0	0	1
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	10.6
Lane LOS							B
Approach Delay (s)	0.0			0.0			10.6
Approach LOS							B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	28.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	5	377	447	5	5	5
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)	5	410	486	5	5	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			1003			
pX, platoon unblocked						
vC, conflicting volume	491				909	489
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	491				909	489
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				98	99
cM capacity (veh/h)	1072				304	579

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	5	410	491	5	5
Volume Left	5	0	0	5	0
Volume Right	0	0	5	0	5
cSH	1072	1700	1700	304	579
Volume to Capacity	0.01	0.24	0.29	0.02	0.01
Queue Length 95th (ft)	0	0	0	1	1
Control Delay (s)	8.4	0.0	0.0	17.1	11.3
Lane LOS	A			C	B
Approach Delay (s)	0.1		0.0	14.2	
Approach LOS				B	

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	33.8%	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 (vph)	56	505	381	412	718	150	478	5	434	158	4	60
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	5.0	5.0	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	0.97	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.86	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1600	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1600	
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)	61	549	414	448	780	163	520	5	472	172	4	65
RTOR Reduction (vph)	0	0	340	0	0	116	0	0	274	0	46	0
Lane Group Flow (vph)	61	549	74	448	780	47	520	5	198	172	23	0
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			
Actuated Green, G (s)	7.6	22.0	22.0	21.4	35.8	35.8	24.0	42.6	42.6	17.3	35.9	
Effective Green, g (s)	7.6	22.0	22.0	21.4	35.8	35.8	24.0	42.6	42.6	17.3	35.9	
Actuated g/C Ratio	0.06	0.18	0.18	0.17	0.29	0.29	0.19	0.35	0.35	0.14	0.29	
Clearance Time (s)	5.0	5.0	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	3.0	3.0	
Lane Grp Cap (vph)	109	907	282	596	1476	460	668	644	547	248	466	
v/s Ratio Prot	0.03	c0.11		c0.13	0.15		c0.15	0.00		0.10	0.01	
v/s Ratio Perm			0.05			0.03			c0.12			
v/c Ratio	0.56	0.61	0.26	0.75	0.53	0.10	0.78	0.01	0.36	0.69	0.05	
Uniform Delay, d1	56.2	46.7	43.7	48.4	36.7	32.0	47.1	26.5	30.2	50.5	31.4	
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	6.1	1.1	0.5	5.3	0.3	0.1	5.7	0.0	1.9	8.1	0.2	
Delay (s)	62.3	47.8	44.2	53.7	37.0	32.1	52.8	26.5	32.0	58.6	31.6	
Level of Service	E	D	D	D	D	C	D	C	C	E	C	
Approach Delay (s)		47.2			41.8			42.9			50.9	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	44.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	123.3	Sum of lost time (s)	15.0
Intersection Capacity Utilization	57.9%	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 (vph)	591	501	5	43	527	332	5	564	52	247	469	748
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	5.0
Lane Util. Factor	0.97	0.91		0.97	0.95	0.88	1.00	0.95		0.97	0.95	0.88
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5078		3433	3539	2787	1770	3494		3433	3539	2787
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5078		3433	3539	2787	1770	3494		3433	3539	2787
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)	642	545	5	47	573	361	5	613	57	268	510	813
RTOR Reduction (vph)	0	1	0	0	0	284	0	4	0	0	0	461
Lane Group Flow (vph)	642	549	0	47	573	77	5	666	0	268	510	352
Turn Type	Prot			Prot		Perm	Prot			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	30.5	55.7		3.9	29.1	29.1	0.7	46.6		15.3	61.2	61.2
Effective Green, g (s)	30.5	55.7		3.9	29.1	29.1	0.7	46.6		15.3	61.2	61.2
Actuated g/C Ratio	0.22	0.39		0.03	0.21	0.21	0.00	0.33		0.11	0.43	0.43
Clearance Time (s)	5.0	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	3.0
Lane Grp Cap (vph)	740	1999		95	728	573	9	1151		371	1531	1205
v/s Ratio Prot	c0.19	0.11		0.01	c0.16		0.00	c0.19		c0.08	0.14	
v/s Ratio Perm						0.03						0.13
v/c Ratio	0.87	0.27		0.49	0.79	0.14	0.56	0.58		0.72	0.33	0.29
Uniform Delay, d1	53.6	29.2		67.8	53.3	45.9	70.2	39.3		61.0	26.6	26.1
Progression Factor	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		4.0	5.6	0.1	58.1	2.1		6.8	0.6	0.6
Delay (s)	64.1	29.2		71.8	58.9	46.0	128.4	41.4		67.8	27.2	26.7
Level of Service	E	C		E	E	D	F	D		E	C	C
Approach Delay (s)		48.0			54.8			42.1			33.8	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	43.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	141.5	Sum of lost time (s)	20.0
Intersection Capacity Utilization	72.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	97	164	273	119	123	115
Ideal Flow (vphpl)	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	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)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.47	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	874	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	105	178	297	129	134	125
RTOR Reduction (vph)	0	0	0	95	0	57
Lane Group Flow (vph)	105	178	297	34	134	68
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Actuated Green, G (s)	13.4	13.4	13.4	13.4	28.1	28.1
Effective Green, g (s)	13.4	13.4	13.4	13.4	28.1	28.1
Actuated g/C Ratio	0.26	0.26	0.26	0.26	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)	227	485	485	412	966	864
v/s Ratio Prot		0.10	c0.16		c0.08	
v/s Ratio Perm	0.12			0.02		0.04
v/c Ratio	0.46	0.37	0.61	0.08	0.14	0.08
Uniform Delay, d1	16.0	15.6	16.8	14.4	5.8	5.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.5	0.5	2.3	0.1	0.3	0.2
Delay (s)	17.5	16.1	19.1	14.5	6.1	5.7
Level of Service	B	B	B	B	A	A
Approach Delay (s)		16.6	17.7		5.9	
Approach LOS		B	B		A	

Intersection Summary			
HCM Average Control Delay	14.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	51.5	Sum of lost time (s)	10.0
Intersection Capacity Utilization	39.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1097	1280	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0			
Lane Util. Factor		0.91	0.91			
Frt		1.00	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		5085	5085			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		5085	5085			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1192	1391	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1192	1391	0	0	0
Turn Type						custom
Protected Phases		4	8			
Permitted Phases						6
Actuated Green, G (s)		16.0	16.0			
Effective Green, g (s)		16.0	16.0			
Actuated g/C Ratio		0.40	0.40			
Clearance Time (s)		4.0	4.0			
Lane Grp Cap (vph)		2034	2034			
v/s Ratio Prot		0.23	c0.27			
v/s Ratio Perm						
v/c Ratio		0.59	0.68			
Uniform Delay, d1		9.4	9.9			
Progression Factor		1.00	1.00			
Incremental Delay, d2		1.2	1.9			
Delay (s)		10.6	11.8			
Level of Service		B	B			
Approach Delay (s)		10.6	11.8		0.0	
Approach LOS		B	B		A	

Intersection Summary			
HCM Average Control Delay	11.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	28.1%	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)	942	5	0	1256	0	5
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)	1024	5	0	1365	0	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				501		
pX, platoon unblocked					0.88	
vC, conflicting volume			1029		1482	344
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1029		1072	344
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	99
cM capacity (veh/h)			671		190	652

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	410	410	210	455	455	455	5
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	5	0	0	0	5
cSH	1700	1700	1700	1700	1700	1700	652
Volume to Capacity	0.24	0.24	0.12	0.27	0.27	0.27	0.01
Queue Length 95th (ft)	0	0	0	0	0	0	1
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	10.6
Lane LOS							B
Approach Delay (s)	0.0			0.0			10.6
Approach LOS							B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	28.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	5	377	447	5	5	5
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)	5	410	486	5	5	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			1003			
pX, platoon unblocked	0.97				0.97	0.97
vC, conflicting volume	491				909	489
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	465				894	462
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				98	99
cM capacity (veh/h)	1068				302	584

Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2
Volume Total	5	410	491	5	5
Volume Left	5	0	0	5	0
Volume Right	0	0	5	0	5
cSH	1068	1700	1700	302	584
Volume to Capacity	0.01	0.24	0.29	0.02	0.01
Queue Length 95th (ft)	0	0	0	1	1
Control Delay (s)	8.4	0.0	0.0	17.1	11.2
Lane LOS	A			C	B
Approach Delay (s)	0.1		0.0	14.2	
Approach LOS				B	

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	33.8%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix B

2011 Traffic Update Report

TRAFFIC EVALUATION

Ka Makana Alii

Ewa, Oahu, Hawaii

June 2011

Over a Century of Engineering Excellence

TRAFFIC EVALUATION

Ka Makana Alii

Ewa, Oahu, Hawaii

June 2011

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I. INTRODUCTION

The new Ka Makana Alii commercial development will be located in the heart of the rapidly growing Ewa plain. This includes the communities of Kapolei, Makakilo, Ko Olina, Ewa, Ewa Beach, and Kalaeloa. There are many planned developments proceeding through the planning, design, and construction phases in the area such as the East Kapolei residential communities planned by the State of Hawaii Department of Hawaiian Home Lands (DHHL), the University of Hawaii-West Oahu (UHWO) campus and adjacent development, Gentry Homes' Ewa by Gentry Makai, Haseko's Ocean Pointe, the Hawaii Community Development Authority (HCDA) Kalaeloa development, and Aina Nui Corporation's Kapolei, West Kapolei, and Makaiwa Hills developments. The proposed Kroc center is located mauka of Ka Makana Alii along North-South Road. A map of the area is shown in Figure 1.

Ka Makana Alii consists of Phase 1 and Phase 2, shown in Figures 2 and 3, respectively. Phase 1 consists of approximately 200,000 SF of retail commercial and will occupy the western portion of the project site. The primary access will be at Kinoiki Street. Phase 1 is projected to be completed in 2013. In Phase 2, the entire project site will be occupied and an additional access will be opened which will form the south leg at Kapolei Parkway/Kualakai Parkway. In addition to nearly 900,000 SF of retail commercial, Ka Makana Alii will include office and hotel land uses along with a movie theater.

Roadway infrastructure is a key concern in the area, and there are several major roadway projects that have been completed or are in progress to address this concern. The State of Hawaii Department of Transportation (HDOT) has constructed Kualakai Parkway (formerly North-South Road); in February 2010 as a new arterial roadway with a new interchange on Interstate H-1 Freeway. DHHL has constructed the segment of Kapolei Parkway between Kualakai Parkway and the Villages of Kapolei. Fort Weaver Road has also been recently widened. Fort Barrette Road widening is planned to be completed within the next 5 years. Phase 1 of the Kapolei Interchange project has been completed in early 2011.

The purpose of this report is to determine the impact of the Ka Makana Alii shopping center on the roadway network and to identify any improvements or mitigation needed to accommodate the development.

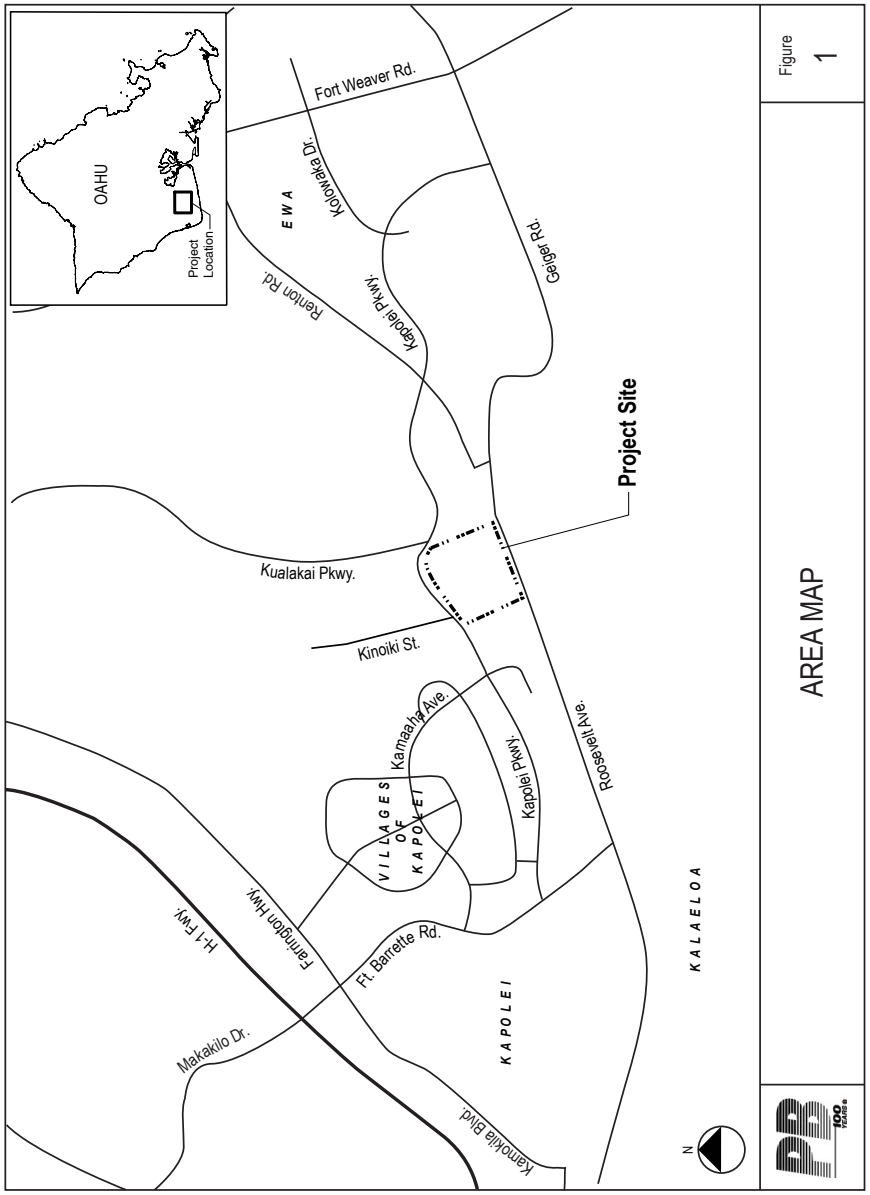
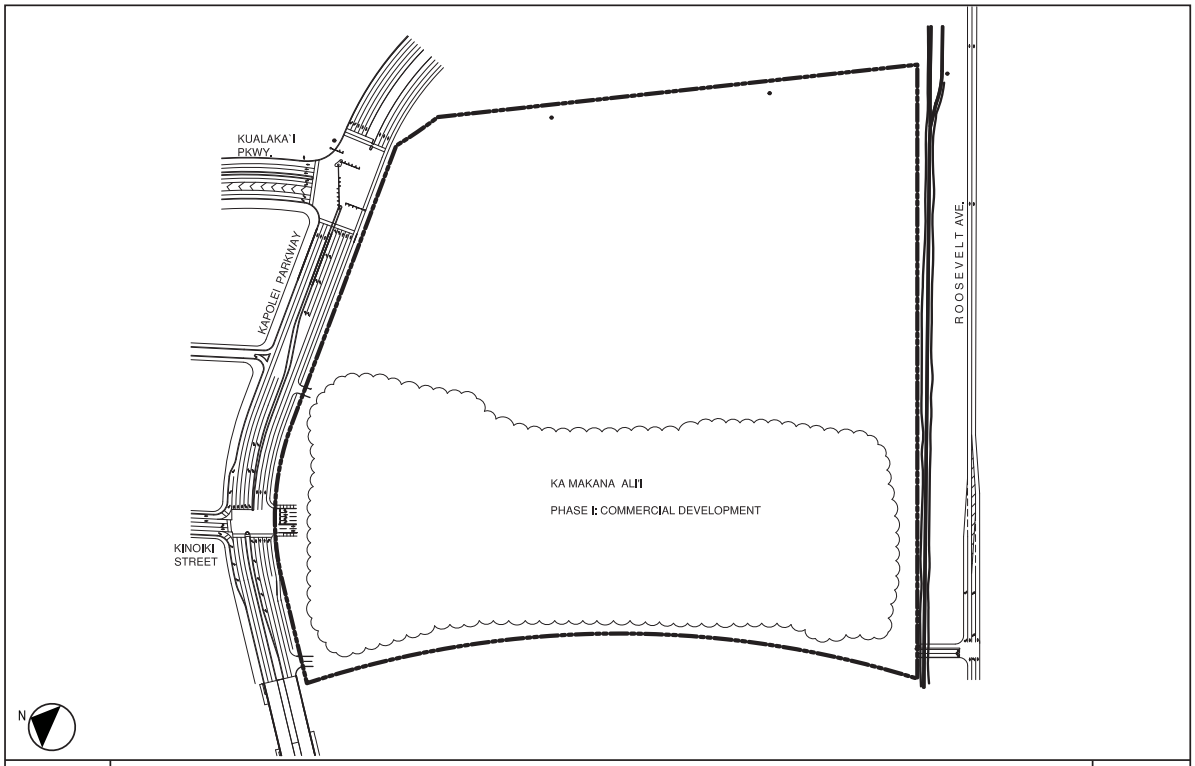


Figure 1

AREA MAP

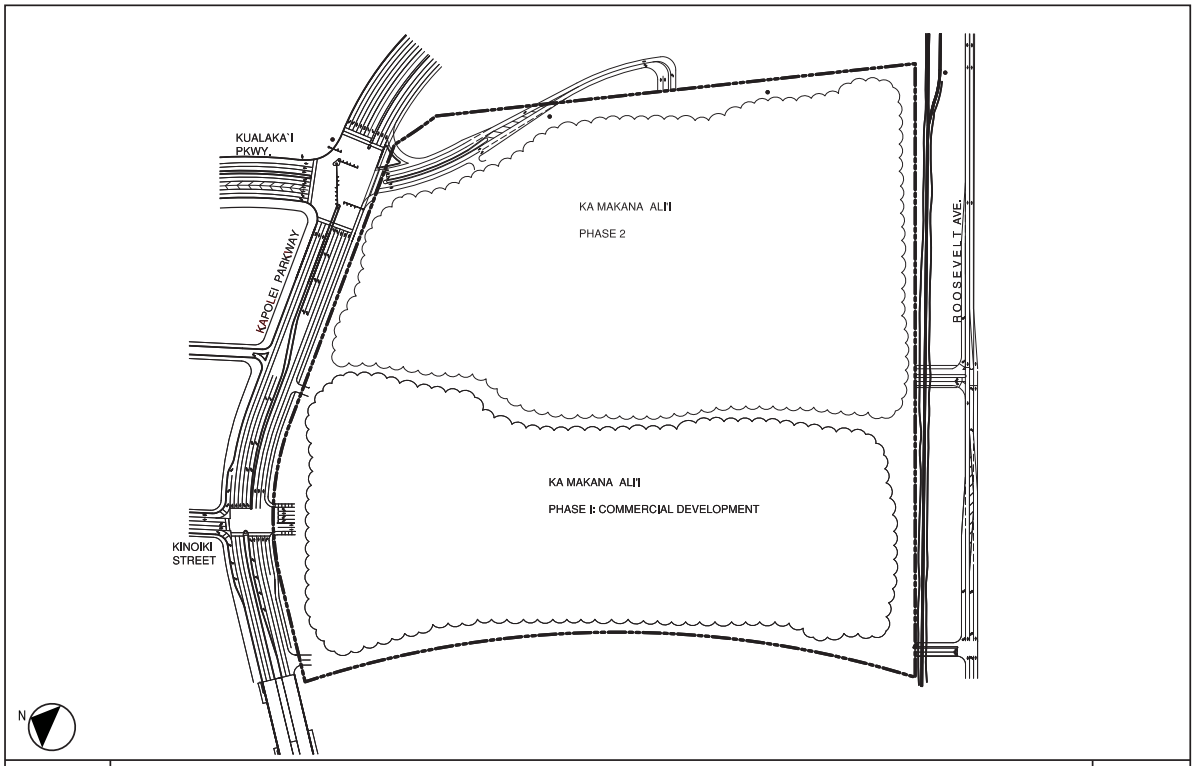


PROJECT SITE PLAN (Phase 1)

Figure 2

PB Americas

Ka Makana Alii
June 2011



PROJECT SITE PLAN (Phase 2)

Figure 3

PB Americas

Ka Makana Alii
June 2011

II. EXISTING CONDITIONS

The proposed Ka Makana Alii development is located makai of the intersection of Kapolei Parkway and Kualakai Parkway. Kualakai Parkway was opened in February of 2010. These intersections and their lane configurations are shown in Figure 4.

A. Existing Roadway Network

1. Kapolei Parkway

Kapolei Parkway is a six-lane, divided major arterial roadway. Ultimately it will provide significant east-west mobility between Kapolei and Ewa. Until 2010, Kapolei Parkway was discontinuous between Kapolei and Ewa. With the opening of Kualakai Parkway, Kapolei Parkway is now continuous between Fort Barrette Road and Papipi Road. The posted speed limit on Kapolei Parkway is 30 miles per hour.

2. Kualakai Parkway

Kualakai Parkway (formerly North-South Road) is a four-lane, divided major arterial roadway. While currently striped for four lanes, it will ultimately be six lanes. Kualakai Parkway connects Kapolei Parkway with H-1 Freeway at a diamond interchange. Its intersection with Farrington Highway is a major signalized intersection. Kualakai Parkway forms a signalized, tee-intersection at Kapolei Parkway. The speed limit on Kualakai Parkway is 35 miles per hour.

3. Roosevelt Avenue

Roosevelt Avenue is a collector roadway providing east-west circulation within Kalaeloa (former Barbers Point Naval Air Station. Roosevelt Avenue is a rural, two-lane undivided roadway with exclusive left-turn lanes at some intersections. The posted speed limit on Roosevelt Avenue is 35 miles per hour in the project vicinity. TheBus Route 41 serving Ewa Beach and East Kapolei runs through Roosevelt Avenue.

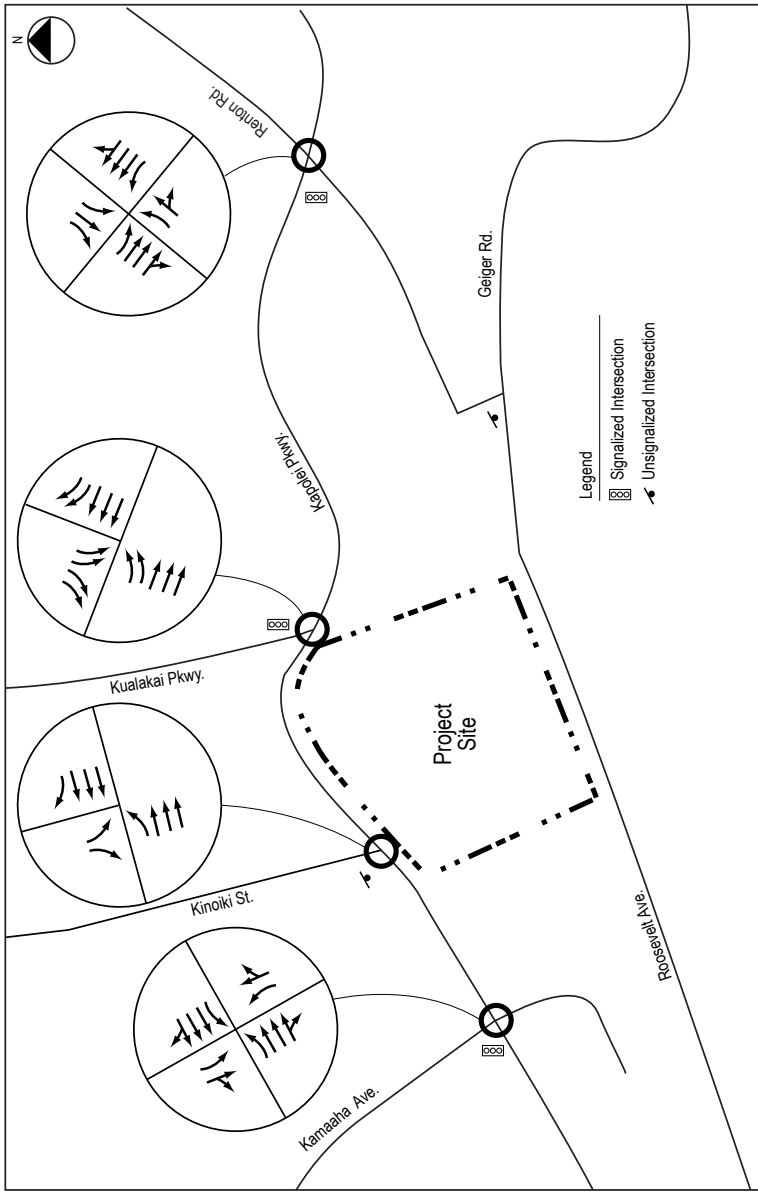


Figure 4

EXISTING LANE CONFIGURATIONS

4. Kamaaha Avenue

Kamaaha Avenue is a four-lane, divided neighborhood collector roadway that provides access to the Villages of Kapolei development along with Kapolei Middle School. The speed limit on Kamaaha Avenue is 25 miles per hour.

5. Kinoiki Street

Kinoiki Street is a collector roadway providing access to the East Kapolei I. While currently terminating within East Kapolei I, Kinoiki Street will eventually continue north, meeting up with the future east-west collector road. The speed limit on Kinoiki Street is 25 miles per hour.

6. Renton Road

Renton Road is a four-lane, divided collector roadway providing east-west circulation and access within Ewa. Its western terminus is at a stop-controlled intersection with Roosevelt Avenue. It crosses both Kapolei Parkway and Fort Weaver Road, terminating just beyond Fort Weaver Road. The speed limit on Renton Road is 25 miles per hour.

B. Existing Traffic Volumes

Manual traffic counts were conducted on Tuesday, March 30, 2010 during the AM and PM peak periods at the following intersections:

- Kapolei Parkway/Kamaaha Avenue
- Kapolei Parkway/Kinoiki Street
- Kapolei Parkway/Kualakai Parkway
- Kapolei Parkway/Renton Road

The traffic volumes were then summarized into AM and PM peak hour volumes shown in Figure 5. The AM and PM peak hours were chosen to determine the effect of the shopping center on the periods of maximum congestion on two major Ewa arterials. The study AM and PM peak hours were 7:00-8:00 AM and 3:30-4:30 PM, respectively. Appendix A contains the traffic count data sheets.

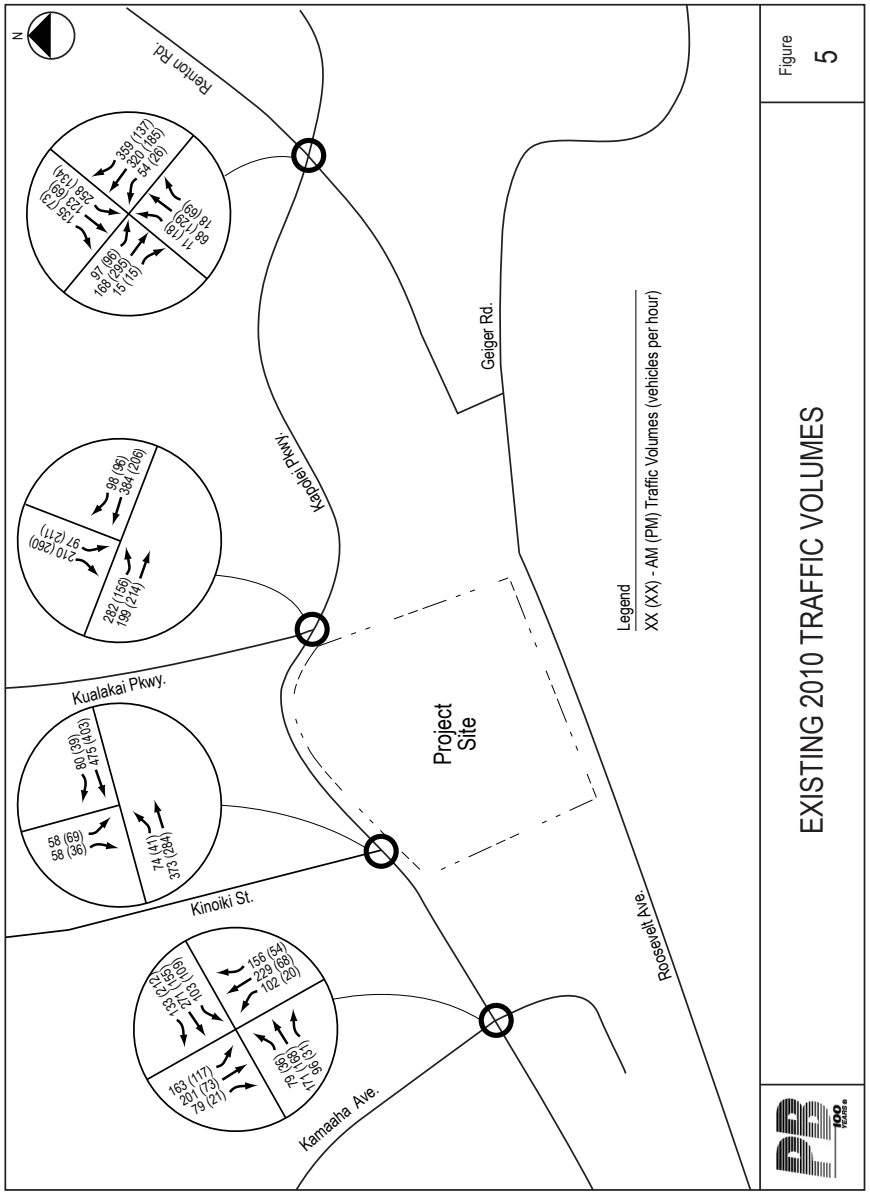


Figure 5

EXISTING 2010 TRAFFIC VOLUMES

C. Existing Traffic Operations

The study area intersections were analyzed using the methodologies for signalized and unsignalized intersections outlined in the 2000 Highway Capacity Manual (HCM). Operating conditions at an intersection are expressed as a qualitative measure known as Level of Service (LOS) with letter designations ranging from A through F, with LOS A representing free-flow conditions and LOS F representing over-capacity conditions. Level-of-Service criteria are described in Appendix B. Traffic analysis worksheets are located in Appendix C. The results of the intersection analysis are summarized in Table 1.

Table 1 Existing LOS

Existing	AM		PM	
	LOS	Delay	LOS	Delay
Kapolei Pkwy & Kamaaha Ave	**C**	**31**	**B**	**20**
Kapolei EB Left	D	42	C	31
Kapolei EB Through-Right	C	35	B	19
Kapolei WB Left	D	39	C	26
Kapolei WB Through-Right	C	33	B	16
Kamaaha NB Left	C	24	C	20
Kamaaha NB Through-Right	C	32	C	22
Kamaaha SB Left	D	38	C	26
Kamaaha SB Through-Right	B	12	B	11
Kapolei Pkwy & Kinoiki St	**Unsignalized**		**Unsignalized**	
Kapolei EB Left	A	9	A	8
Kinoiki SB Left	C	21	C	16
Kinoiki SB Right	A	10	A	9
Kapolei Pkwy & Kualakai Pkwy	**B**	**14**	**B**	**12**
Kapolei EB Left	B	16	B	16
Kapolei EB Through	A	4	A	6
Kapolei WB Through	B	15	B	14
Kapolei WB Right	B	17	B	13
Kualakai SB Left	B	17	B	13
Kualakai SB Right	B	16	B	13

Delay is expressed in seconds per vehicle

Table 1 Existing LOS (cont.)

Existing (continued)	AM		PM	
	LOS	Delay	LOS	Delay
Kapolei Pkwy & Renton Rd	**B**	**17**	**B**	**15**
Kapolei EB Left	C	25	B	20
Kapolei EB Through-Right	B	15	B	10
Kapolei WB Left	C	26	D	41
Kapolei WB Through-Right	B	17	B	14
Renton NB Left	B	12	B	14
Renton NB Through-Right	B	13	B	15
Renton SB Left	B	20	B	16
Renton SB Through	B	13	B	14
Renton SB Right	B	13	B	13

Delay is expressed in seconds per vehicle

1. Kapolei Parkway/Kamaaha Avenue

The intersection of Kapolei Parkway and Kamaaha Avenue has been signalized in the last few years. It was previously an all-way stop-controlled intersection. The northbound Kamaaha leg leads into the Villages of Kapolei development while the east Kapolei Parkway leg provides access to Kapolei Middle School. Due to the school, the intersection can be busy during the school-related peak periods. During the AM peak hour, the intersection operates at LOS C overall. All movements operate at LOS D or better. During the PM peak hour, the intersection operates at LOS B overall. All movements operate at LOS C or better.

2. Kapolei Parkway/Kinoiki Street

The intersection of Kapolei Parkway and Kinoiki Street is an unsignalized tee-intersection. The north Kinoiki leg leads to the East Kapolei I development. The southbound Kinoiki Street left turn operates at LOS C during both peak periods.

3. Kapolei Parkway/Kualakai Parkway

The intersection of Kapolei Parkway and Kualakai Parkway was opened in February of 2010. This intersection operates at LOS B during both peak hours with all individual movements operating at LOS B or better.

4. Kapolei Parkway/Renton Road

This intersection was formerly a four-legged intersection with stop control on the Renton Road approaches. With the last few years, it has been signalized. During the AM peak hour, the intersection operates at LOS B with all movements operating at LOS C or better. During the PM peak hour, the intersection operates at LOS B. The westbound Kapolei Parkway left turn operates at LOS D.

D. Summary of Existing Operations

Kualakai Parkway has been open for a little more than a year. The study area intersections operate at an acceptable LOS during both the AM and PM peak hours. As time passes and the region builds out, Kualakai Parkway will become a more attractive option to access H-1 Freeway.

III. PROJECTED 2013 CONDITIONS WITHOUT PROJECT

The base year 2013 represents future conditions within the project area without the Ka Makana Alii shopping center. No new roadways are projected to be constructed in the vicinity of the project.

A. Projected 2013 Network Without Project

1. Kapolei Parkway

Kapolei Parkway is projected to remain a six-lane major arterial connecting Kapolei at Kamokila Boulevard to Ewa, eventually winding its way makai toward Ewa Beach at its current terminus at Papipi Street. The intersections along Kapolei Parkway will typically require signals with protected left turns phases.

2. Kualakai Parkway

Kualakai Parkway is projected to remain a four-lane major arterial connecting H-1 Freeway to Kapolei Parkway at a tee-intersection.

3. Roosevelt Avenue

Roosevelt Avenue is projected to remain a two-lane collector roadway which would be deemphasized in the future. Its primary function would be to provide system redundancy as well as serving the Kalaeloa community.

4. Kinoiki Street

Kinoiki Street is a mauka-makai collector that runs through the planned University of Hawaii – West Oahu campus and East Kapolei Phase I, eventually connecting Farrington Highway and Kapolei Parkway. In 2013, it is assumed that it will not yet provide this connection.

Future developments in the Ewa plain are shown in Figure 6 (taken from the May 2009 Ewa Roadway Connectivity Study report). It was assumed that in 2013, East Kapolei I – Phase 2, East Kapolei II, the Kroc Center, and UH – West Oahu would be in place.

N

Figure 6

FUTURE DEVELOPMENTS

B. Projected 2013 Traffic Without Project

The 2013 background traffic was estimated using data for the following developments:

- East Kapolei I – Phase 2
- East Kapolei II
- University of Hawaii – West Oahu
- Kroc Center

With Kapolei Parkway and Kualakai Parkway in place, traffic volumes were shifted from Farrington Highway and Roosevelt Avenue. Furthermore, annual growth was applied. Finally, trips associated with the East Kapolei Phase I and Kroc Center developments were generated using trip generation equations published by the Institute of Transportation Engineers in Trip Generation, Eighth Edition.

The projected 2013 traffic turning movement volumes without project are shown in Figure 7.

C. Projected 2013 Operations Without Project

The projected 2013 intersection level of service without the Ka Makana Alii shopping center are shown in Table 2.

1. Kapolei Parkway/Kamaaha Avenue

The intersection of Kapolei Parkway and Kamaaha Avenue is projected to operate at LOS C during the AM peak. All movements are projected to operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS C overall as well. All individual movements are projected to operate at LOS C or better.

2. Kapolei Parkway/Kinoiki Street

The existing intersection of Kapolei Parkway and Kinoiki Street is an unsignalized tee-intersection. In order to provide an accurate comparison between the with and without-project scenarios, it was analyzed as a signalized intersection in both cases. The intersection is projected to operate at LOS B during both the AM and PM peak hours.

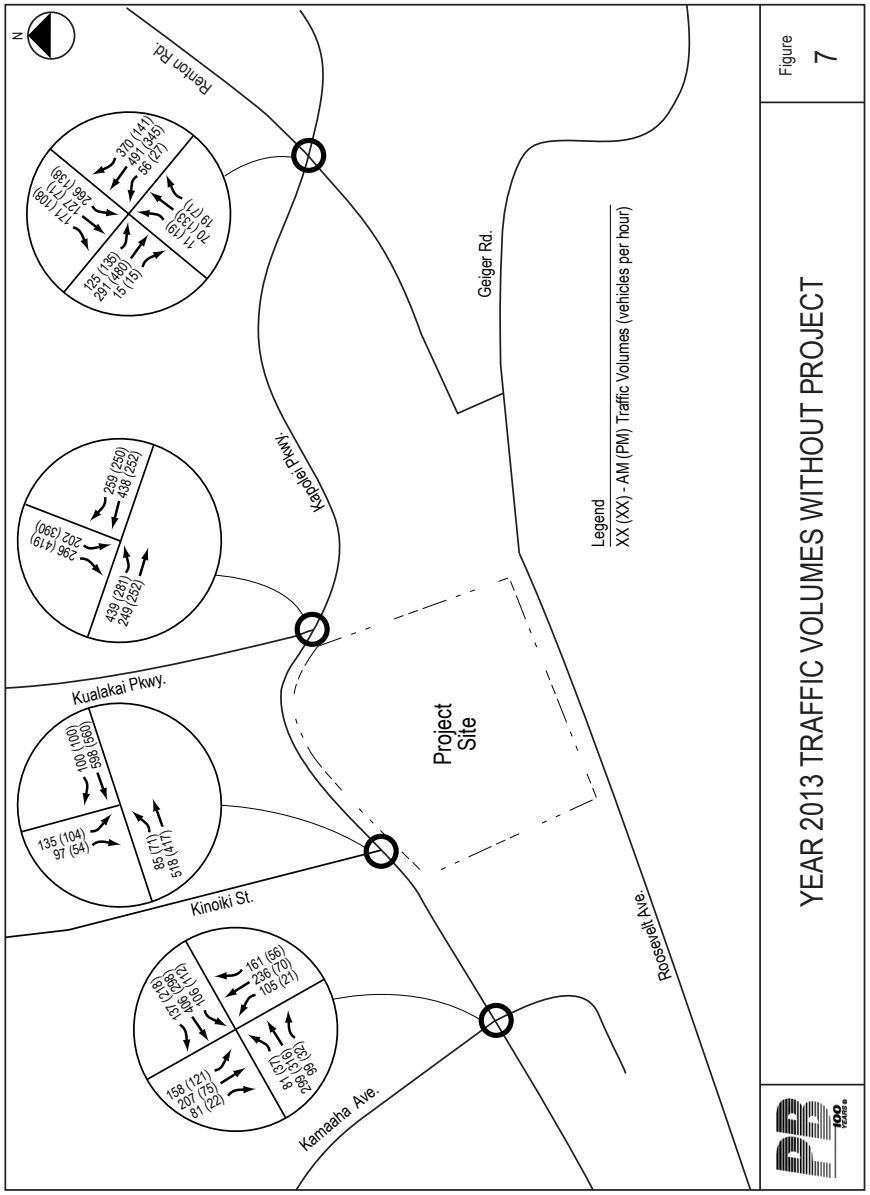


Figure 7

YEAR 2013 TRAFFIC VOLUMES WITHOUT PROJECT

Table 2 Projected 2013 LOS Without Project

2013 background	AM		PM	
	LOS	Delay	LOS	Delay
Kapolei Pkwy & Kamaaha Ave	**C**	**34**	**C**	**22**
Kapolei EB Left	D	47	C	33
Kapolei EB Through-Right	D	37	C	24
Kapolei WB Left	D	42	C	28
Kapolei WB Through-Right	C	35	B	19
Kamaaha NB Left	C	27	C	25
Kamaaha NB Through-Right	D	37	C	27
Kamaaha SB Left	D	42	C	27
Kamaaha SB Through-Right	B	14	B	14
Kapolei Pkwy & Kinoiki St	**B**	**12**	**B**	**12**
Kapolei EB Left	C	21	B	20
Kapolei EB Through	A	6	A	5
Kapolei WB Through	B	15	B	14
Kapolei WB Right	B	13	B	12
Kinoiki SB Left	B	18	B	17
Kinoiki SB Right	B	16	B	15
Kapolei Pkwy & Kualakai Pkwy	**B**	**17**	**B**	**17**
Kapolei EB Left	B	19	B	20
Kapolei EB Through	A	5	A	6
Kapolei WB Through	B	18	B	18
Kapolei WB Right	B	18	B	20
Kualakai SB Left	C	21	B	18
Kualakai SB Right	B	20	B	17
Kapolei Pkwy & Renton Rd	**C**	**24**	**B**	**17**
Kapolei EB Left	C	33	C	23
Kapolei EB Through-Right	B	16	B	12
Kapolei WB Left	D	38	C	33
Kapolei WB Through-Right	C	24	B	18
Renton NB Left	B	20	B	17
Renton NB Through-Right	C	21	B	20
Renton SB Left	C	30	C	22
Renton SB Through	C	21	B	18
Renton SB Right	C	20	B	17

Delay is expressed in seconds per vehicle

3. Kapolei Parkway/Kualakai Parkway

The intersection of Kapolei Parkway and Kualakai Parkway is projected to operate at LOS B during both peak hours. All individual movements are projected to operate at LOS C during the AM peak hour and at LOS B or better during the PM peak hour.

4. Kapolei Parkway/Renton Road

The intersection of Kapolei Parkway and Renton Road is projected to operate at LOS C during the AM peak hour. Left turn movements are projected to operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS B overall with all movements operating at LOS C or better.

D. Summary of 2013 Operations Without Project

The study area intersections are projected to operate at an acceptable level during the AM and PM peak hours. All study area intersections are projected to operate at LOS B or C overall during the AM and PM peak hours.

IV. PROJECTED 2013 CONDITIONS WITH PHASE 1

The 2013 "With Project" scenario represents the future conditions within the project area with Phase 1 of the Ka Makana Alii shopping center development, shown in Figure 2. As shown, Ka Makana Alii would have a main access to Kapolei Parkway and a secondary access to Roosevelt Avenue. An additional right-in/right-out access is also planned on Kapolei Parkway at the northwestern corner of the property which would be used primarily as a service access but would also provide an additional driveway to alleviate pressure on other accesses. The same roadway assumptions were made for this scenario. Kualakai Parkway is assumed to form a tee-intersection with Kapolei Parkway.

A. Project-Related Traffic Volumes

Future traffic generated by the Ka Makana Alii shopping center was estimated using the three step method of trip generation, trip distribution, and trip assignment.

1. Trip Generation

Phase 1 of Ka Makana Alii consists of a shopping center land use. Trip generation estimates the number of vehicular trips in and out of the project based on the land use type and density. Trips were estimated using trip generation equations published by the Institute of Transportation Engineers in Trip Generation, Eighth Edition.

Table 3 shows the trips generated. Pass-by traffic was assumed to be 20% during the PM while transit share was assumed to be 7%.

Table 3 Ka Makana Alii Phase 1 Trip Generation

Volumes expressed in vehicles per hour

2. Trip Assignment

The shopping center distribution was calculated according to the Oahu Metropolitan Planning Organization model. The project-generated traffic volumes were assigned to the future network based using this trip distribution. The project-generated trips are shown in Figure 8. The projected 2013 traffic volumes with Phase 1 are shown in Figure 9.

B. Projected 2013 Operations With Project

The projected 2013 intersection level of service with Phase 1 of the Ka Makana Alii shopping center are shown in Table 4.

1. Kapolei Parkway/Kamaaha Avenue

The intersection of Kapolei Parkway and Kamaaha Avenue is projected to operate at LOS C during the AM peak. All movements operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS C overall as well. All individual movements are projected to operate at LOS C or better.

2. Kapolei Parkway/Kinoiki Street

The existing intersection of Kapolei Parkway and Kinoiki Street is an unsignalized tee-intersection. Phase 1 of Ka Makana Alii is projected to access Kapolei Parkway at Kinoiki Street, forming a signalized cross intersection. The movements in and out of the shopping center are heavy movements. Double left turns into and out of the shopping center are recommended.

The intersection is projected to operate at LOS C during both the AM and PM peak hours. During the AM peak hour, all movements are expected to operate at LOS D or better. During the PM peak hour, all movements are projected to operate at LOS C or better.

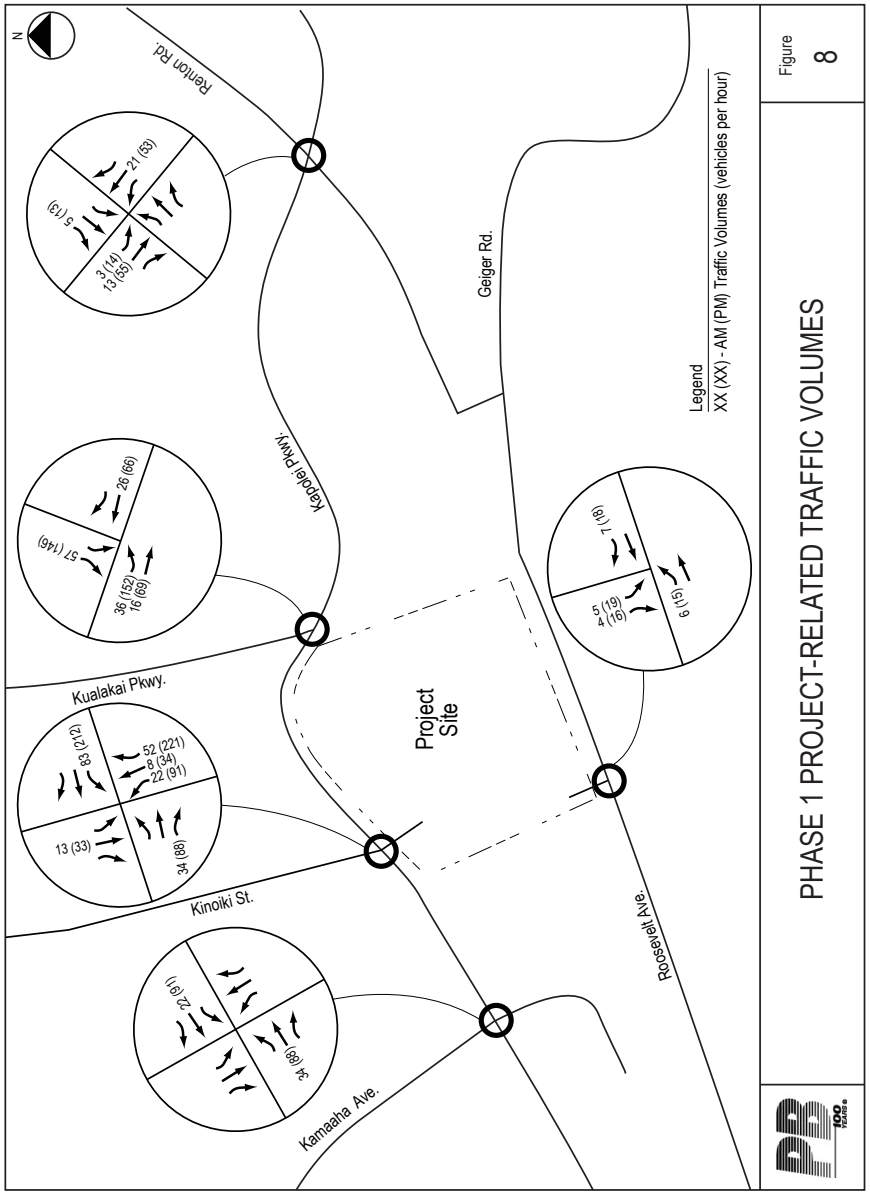


Figure 8

PHASE 1 PROJECT-RELATED TRAFFIC VOLUMES

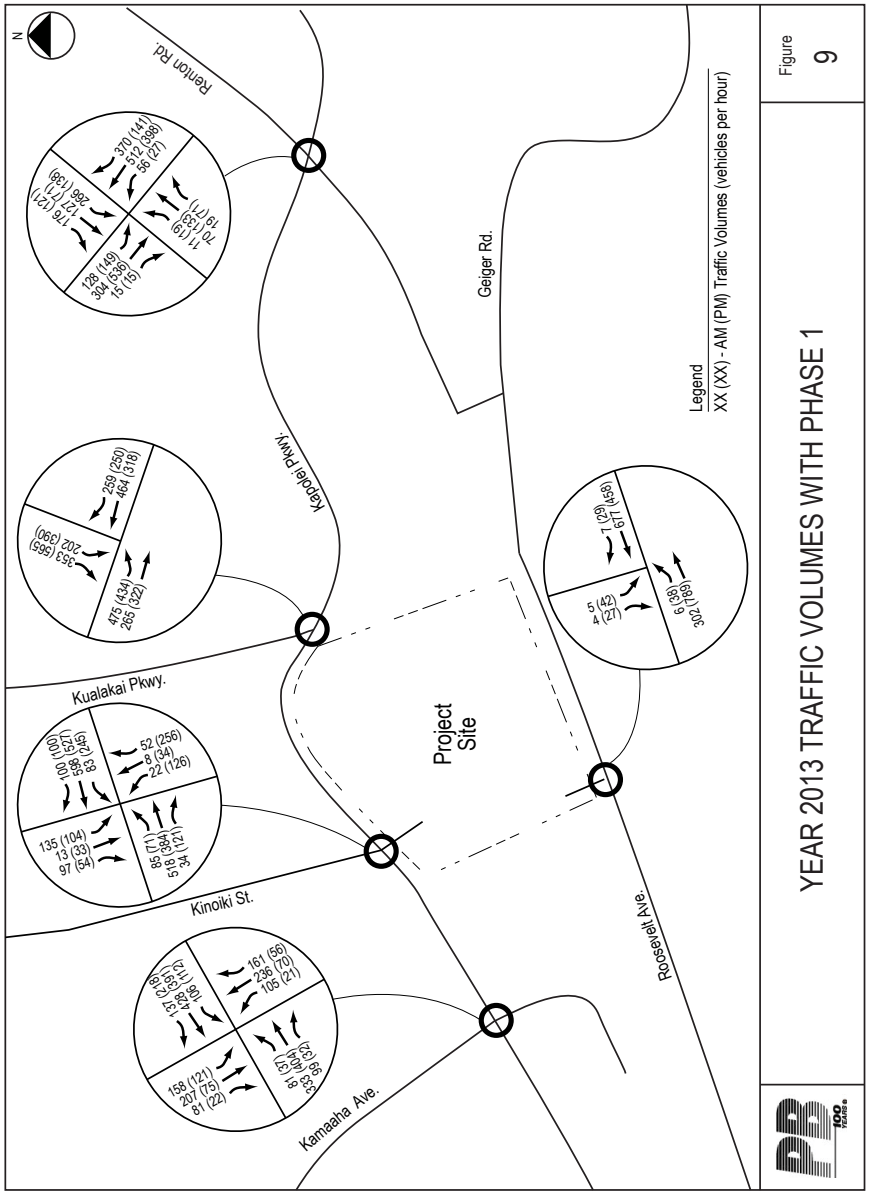


Table 4 Projected 2013 LOS With Project

Total 2013 with Phase 1	AM		PM	
	LOS	Delay	LOS	Delay
Kapolei Pkwy & Kamaaha Ave	**C**	**34**	**C**	**23**
Kapolei EB Left	D	47	C	34
Kapolei EB Through-Right	D	37	C	24
Kapolei WB Left	D	43	C	29
Kapolei WB Through-Right	C	35	B	19
Kamaaha NB Left	C	27	C	26
Kamaaha NB Through-Right	D	37	C	29
Kamaaha SB Left	D	43	C	29
Kamaaha SB Through-Right	B	14	B	15
Kapolei Pkwy & Kinoiki St	**C**	**24**	**C**	**24**
Kapolei EB Left	C	32	C	30
Kapolei EB Through	C	22	C	24
Kapolei EB Right	B	20	C	22
Kapolei WB Left	C	32	C	26
Kapolei WB Through	C	24	C	20
Kapolei WB Right	C	21	B	18
Kinoiki NB Left	D	35	C	28
Kinoiki NB Through	C	26	C	28
Kinoiki NB Right	C	26	C	28
Kinoiki SB Left	C	28	C	28
Kinoiki SB Through	B	18	C	26
Kinoiki SB Right	B	19	C	26
Kapolei Pkwy & Kualakai Pkwy	**B**	**18**	**B**	**19**
Kapolei EB Left	B	20	C	22
Kapolei EB Through	A	5	A	7
Kapolei WB Through	B	18	C	21
Kapolei WB Right	B	18	C	22
Kualakai SB Left	C	22	C	21
Kualakai SB Right	C	21	B	19

Delay is expressed in seconds per vehicle

Table 4 Projected 2013 LOS With Project (cont.)

Total 2013 with Phase 1	AM		PM	
	LOS	Delay	LOS	Delay
Kapolei Pkwy & Renton Rd	**C**	**24**	**B**	**18**
Kapolei EB Left	C	34	C	25
Kapolei EB Through-Right	B	16	B	12
Kapolei WB Left	D	38	C	35
Kapolei WB Through-Right	C	24	B	18
Renton NB Left	B	20	B	18
Renton NB Through-Right	C	21	C	21
Renton SB Left	C	31	C	24
Renton SB Through	C	21	B	19
Renton SB Right	C	21	B	18
Roosevelt Ave & West Entrance	**Unsignalized**		**Unsignalized**	
Roosevelt EB Left	A	9	A	9
West Entrance SB Left	C	20	E	42
West Entrance SB Right	B	14	B	12

Delay is expressed in seconds per vehicle

3. Kapolei Parkway/Kualakai Parkway

The intersection of Kapolei Parkway and Kualakai Parkway is projected to operate at LOS B during both peak hours. All individual movements are projected to operate at LOS C during both the AM and PM peak hours.

4. Kapolei Parkway/Renton Road

The intersection of Kapolei Parkway and Renton Road is projected to operate at LOS C during the AM peak hour. Left turn movements are projected to operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS B overall with all movements operating at LOS D.

5. Roosevelt Avenue/West Entrance

The west Ka Makana Alii access is projected to be stop-controlled with a refuge lane on Roosevelt Avenue. The southbound left turn out is projected to operate at LOS C during the AM peak hour and at LOS E during the PM peak hour.

C. Transit

Honolulu High-Capacity Transit Corridor Project (HHCTCP) has started its first phase of construction connecting East Kapolei to Pearl Highlands via Waipahu. The Phase 1 segment is expected to be operational in 2013. The western terminus of the first phase of the transit alignment is located at East Kapolei Station near the Kroc Center. The existing bus services will be rerouted to serve East Kapolei Station and Ka Makana Alii.

D. Summary of 2013 Operations With Phase 1

Overall the Ka Makana Alii shopping center has the greatest impact on the Kapolei Parkway/Kinoiki Street intersection. This is understandable because the intersection would be improved from a tee intersection to a four-legged intersection, one approach of which would be the shopping center's primary access. The center also increases the delay at the Kapolei Parkway/North-South Road intersection but the LOS is unchanged. All other study area intersections are projected to operate acceptably.

V. PROJECTED 2015 CONDITIONS WITHOUT PROJECT

The base year 2015 represents future conditions within the project area without the Ka Makana Alii shopping center. No new roadways are projected to be constructed in the vicinity of the project.

A. Projected 2015 Network Without Project

The 2015 roadway network is assumed to be the same as the 2013 roadway network. Configurations at the study area intersections and roads are expected to be the same in both the 2013 and 2015 scenarios.

B. Projected 2015 Traffic Without Project

The 2015 background traffic was estimated using data for the following developments:

- East Kapolei I – Phase 2
- East Kapolei II
- University of Hawaii – West Oahu
- Kroc Center

With Kapolei Parkway and Kualakai Parkway in place, traffic volumes were shifted from Farrington Highway and Roosevelt Avenue. Furthermore, annual growth was applied. Finally, trips associated with the East Kapolei Phase I and Kroc Center developments were generated using trip generation equations published by the Institute of Transportation Engineers in Trip Generation, Eighth Edition.

The projected 2015 traffic turning movement volumes without project are shown in Figure 10.

C. Projected 2015 Operations Without Project

The projected 2015 intersection level of service without the Ka Makana Alii shopping center are shown in Table 5.

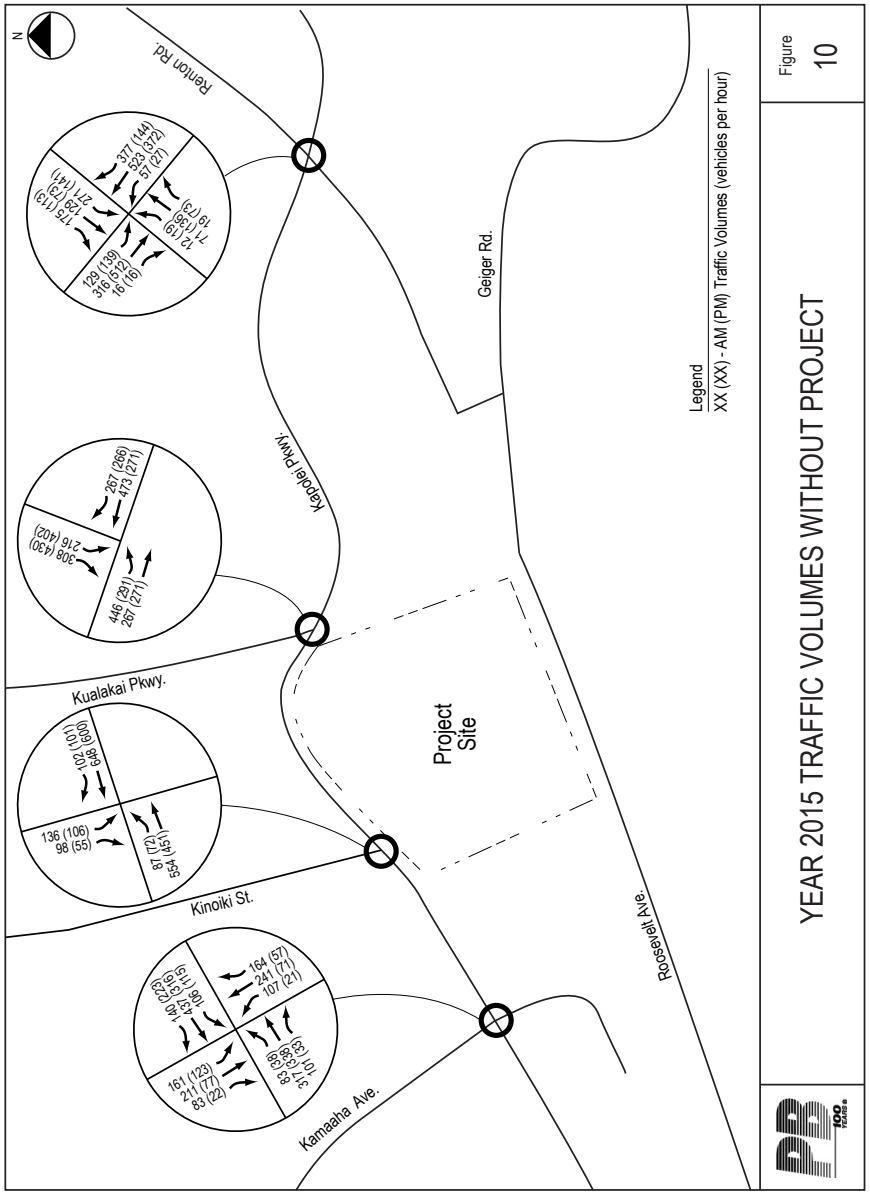


Figure 10

YEAR 2015 TRAFFIC VOLUMES WITHOUT PROJECT

Table 5 Projected 2015 LOS Without Project

2015 background without NSR Extension	AM		PM	
	LOS	Delay	LOS	Delay
Kapolei Pkwy & Kamaaha Ave	**C**	**35**	**C**	**23**
Kapolei EB Left	D	49	C	33
Kapolei EB Through-Right	D	38	C	24
Kapolei WB Left	D	44	C	28
Kapolei WB Through-Right	D	36	B	19
Kamaaha NB Left	C	27	C	26
Kamaaha NB Through-Right	D	37	C	28
Kamaaha SB Left	D	44	C	28
Kamaaha SB Through-Right	B	14	B	14
Kapolei Pkwy & Kinoiki St	**B**	**12**	**B**	**12**
Kapolei EB Left	C	22	C	21
Kapolei EB Through	A	6	A	6
Kapolei WB Through	B	15	B	14
Kapolei WB Right	B	13	B	12
Kinoiki SB Left	B	19	B	17
Kinoiki SB Right	B	17	B	16
Kapolei Pkwy & Kualakai Pkwy	**B**	**17**	**B**	**17**
Kapolei EB Left	B	20	C	21
Kapolei EB Through	A	5	A	7
Kapolei WB Through	B	18	B	19
Kapolei WB Right	B	18	B	20
Kualakai SB Left	C	22	B	19
Kualakai SB Right	C	20	B	17
Kapolei Pkwy & Renton Rd	**C**	**25**	**B**	**18**
Kapolei EB Left	D	35	C	24
Kapolei EB Through-Right	B	17	B	12
Kapolei WB Left	D	40	C	34
Kapolei WB Through-Right	C	24	B	18
Renton NB Left	C	20	B	18
Renton NB Through-Right	C	21	C	20
Renton SB Left	C	32	C	23
Renton SB Through	C	22	B	18
Renton SB Right	C	21	B	18

Delay is expressed in seconds per vehicle

1. Kapolei Parkway/Kamaaha Avenue

The intersection of Kapolei Parkway and Kamaaha Avenue is projected to operate at LOS C during the AM peak. All movements are projected to operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS C overall as well. All individual movements are projected to operate at LOS C or better.

2. Kapolei Parkway/Kinoiki Street

The existing intersection of Kapolei Parkway and Kinoiki Street is an unsignalized tee-intersection. In order to provide an accurate comparison between the with and without-project scenarios, it was analyzed as a signalized intersection in both cases. The intersection is projected to operate at LOS B during both the AM and PM peak hours.

3. Kapolei Parkway/Kualakai Parkway Street

The intersection of Kapolei Parkway and Kualakai Parkway is projected to operate at LOS B during both peak hours. All individual movements are projected to operate at LOS C during the AM peak hour and at LOS B or better during the PM peak hour.

4. Kapolei Parkway/Renton Road

The intersection of Kapolei Parkway and Renton Road is projected to operate at LOS C during the AM peak hour. Left turn movements are projected to operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS B overall with all movements operating at LOS C.

D. Summary of 2015 Operations Without Project

The study area intersections are projected to operate at an acceptable level during the AM and PM peak hours. All study area intersections are projected to operate at LOS B or C overall during the AM and PM peak hours.

VI. PROJECTED 2015 CONDITIONS WITH PHASE 2

The 2015 "With Project" scenario represents the future conditions within the project area with Phase 2 of the Ka Makana Alii shopping center development, shown in Figure 3. As shown, a fourth leg would be constructed at the intersection of Kapolei Parkway and Kualakai Parkway which would access the site. This would be Ka Makana Alii's new main access, deemphasizing the access at Kinoiki Street. This new leg would terminate at the shopping center's driveway. The access to Roosevelt Avenue from Phase 1 would remain but would be deemphasized in favor of an additional eastern Roosevelt Avenue access constructed during Phase 2.

Additional right-in/right-out service accesses are also planned to be added in Phase 2. One is planned to be located on Kapolei Parkway midway between Kinoiki Street and Kualakai Parkway. The other is planned to be located on Kualakai Parkway just south of Kapolei Parkway. While the additional accesses are primarily intended to be service accesses, they would also provide an additional driveway to alleviate pressure on other accesses.

A. Project-Related Traffic Volumes

Future traffic generated by the Ka Makana Alii shopping center was estimated.

1. Trip Generation

Ka Makana Alii consists of four uses that can be classified as shopping center, office building, hotel, and cinema. Trip generation estimates the number of vehicular trips in and out of the project based on the land use type and density. Trips were estimated using trip generation equations published by the Institute of Transportation Engineers in Trip Generation, Eighth Edition.

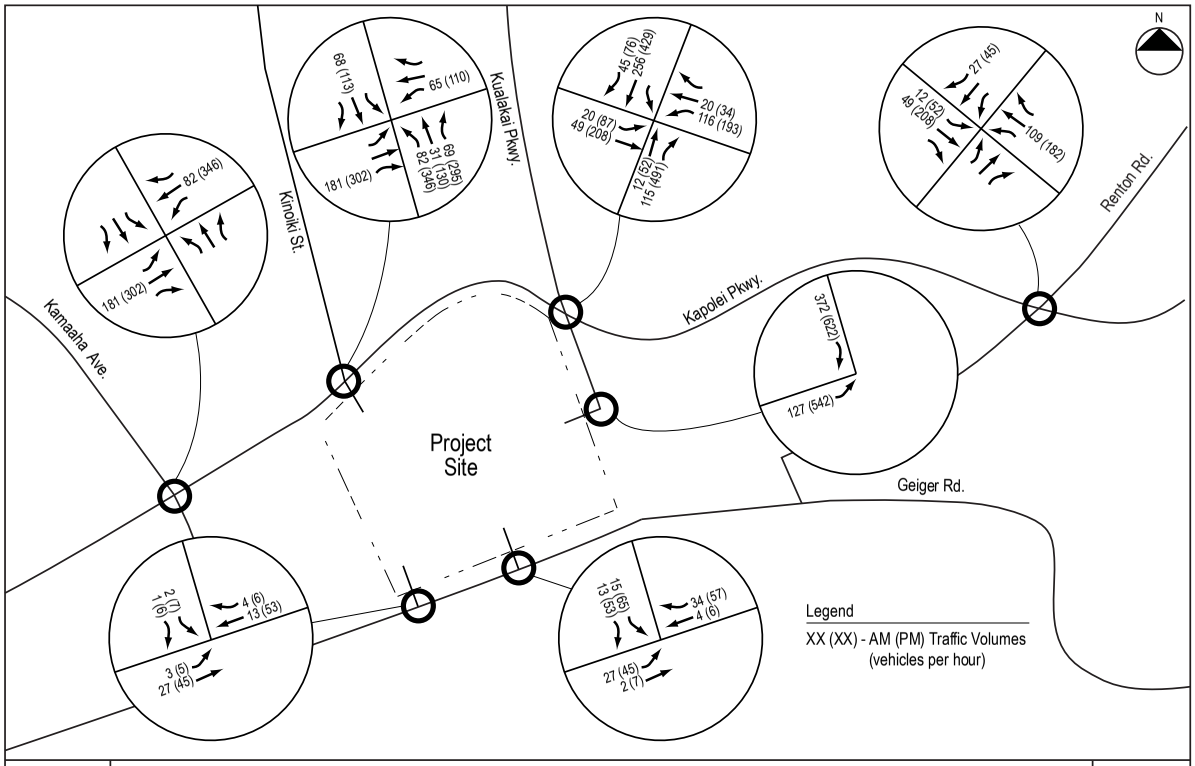
Table 6 shows the planned project land use and corresponding trips generated. Pass-by traffic was assumed to be 20% during the PM while transit share was assumed to be 7%.

Table 6 Ka Makana Alii Phase 2 Trip Generation

Volumes expressed in vehicles per hour

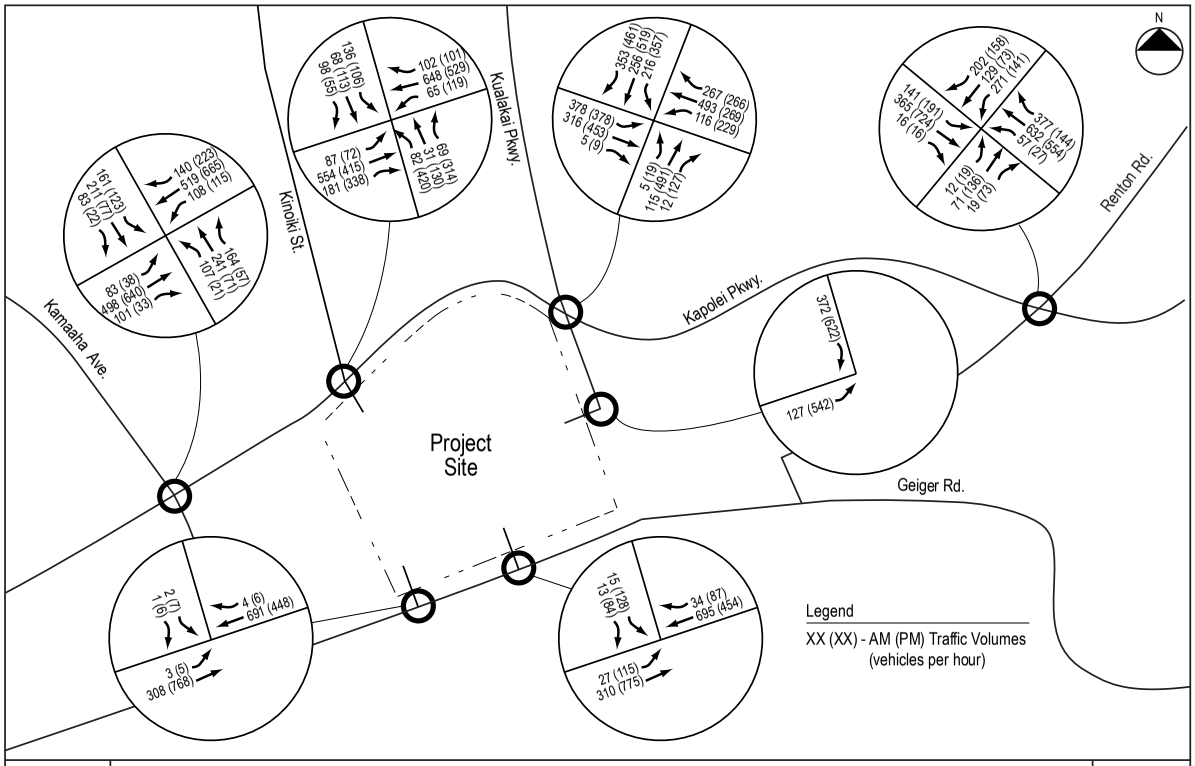
2. Trip Assignment

The shopping center distribution was calculated according to the Oahu Metropolitan Planning Organization model. The project-generated traffic volumes were assigned to the future network based using this trip distribution. The project-generated trips are shown in Figure 11. The projected 2015 traffic volumes with Phase 2 are shown in Figure 12.



PHASE 2 PROJECT-RELATED TRAFFIC VOLUMES

Figure 11



YEAR 2015 TOTAL TRAFFIC VOLUMES WITH PROJECT PHASE 2

Figure 12

B. Projected 2015 Operations With Phase 2

The projected 2015 intersection level of service with Phase 1 of the Ka Makana Alii shopping center are shown in Table 7.

Table 7 Projected 2015 LOS With Project

Total 2015 with Phase 2	AM		PM	
	LOS	Delay	LOS	Delay
Kapolei Pkwy & Kamaaha Ave	**D**	**36**	**C**	**24**
Kapolei EB Left	D	51	D	39
Kapolei EB Through-Right	D	39	C	25
Kapolei WB Left	D	46	C	33
Kapolei WB Through-Right	D	36	B	20
Kamaaha NB Left	C	29	C	30
Kamaaha NB Through-Right	D	41	C	33
Kamaaha SB Left	D	47	C	33
Kamaaha SB Through-Right	B	16	B	18
Kapolei Pkwy & Kinoiki St	**C**	**24**	**C**	**28**
Kapolei EB Left	C	32	D	36
Kapolei EB Through	C	21	C	26
Kapolei EB Right	B	19	C	25
Kapolei WB Left	C	32	C	34
Kapolei WB Through	C	23	C	26
Kapolei WB Right	C	20	C	23
Kinoiki NB Left	C	32	C	31
Kinoiki NB Through	C	29	C	28
Kinoiki NB Right	C	28	C	26
Kinoiki SB Left	C	28	C	33
Kinoiki SB Through	C	24	C	33
Kinoiki SB Right	C	23	C	30

Delay is expressed in seconds per vehicle

Table 7 Projected 2015 LOS With Project (cont.)

Total 2015 with Phase 2 (continued)	AM		PM	
	LOS	Delay	LOS	Delay
Kapolei Pkwy & Kualakai Pkwy	**C**	**27**	**D**	**37**
Kapolei EB Left	C	31	D	47
Kapolei EB Through-Right	B	20	D	39
Kapolei WB Left	C	34	D	49
Kapolei WB Through	C	29	D	42
Kapolei WB Right	C	29	D	47
Kualakai SB Left	C	33	D	48
Kualakai SB Through	B	20	C	22
Kualakai SB Right	B	19	B	20
Kualakai NB Left	A	0	E	61
Kualakai NB Through-Right	C	34	D	36
Kapolei Pkwy & Renton Rd	**C**	**26**	**B**	**20**
Kapolei EB Left	D	40	C	29
Kapolei EB Through-Right	B	17	B	12
Kapolei WB Left	D	44	D	42
Kapolei WB Through-Right	C	26	C	21
Renton NB Left	C	22	C	21
Renton NB Through-Right	C	24	C	25
Renton SB Left	D	35	C	30
Renton SB Through	C	24	C	22
Renton SB Right	C	23	C	22
Roosevelt Ave & West Entrance	**Unsignalized**		**Unsignalized**	
Roosevelt EB Left	A	9	A	8
West Entrance SB Left	C	20	D	27
West Entrance SB Right	B	14	B	11
Roosevelt Ave & East Entrance	**B**	**12**	**B**	**15**
Roosevelt EB Left	C	31	C	26
Roosevelt EB Through	A	4	A	9
Roosevelt WB Left	B	15	B	19
Roosevelt WB Right	A	7	B	13
East Entrance SB Left	C	22	C	26
East Entrance SB Right	C	22	C	23

Delay is expressed in seconds per vehicle

1. Kapolei Parkway/Kamaaha Avenue

The intersection of Kapolei Parkway and Kamaaha Avenue is projected to operate at LOS D overall during the AM peak. All movements operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS C overall. All individual movements are projected to operate at LOS D or better.

2. Kapolei Parkway/Kinoiki Street

With the opening of the new access to Kualakai Parkway as part of Phase 2, the Kinoiki Street access will be deemphasized. The intersection is projected to operate at LOS C during both the AM and PM peak hours. During the AM peak hour, all movements are expected to operate at LOS C or better. During the PM peak hour, all movements are projected to operate at LOS C or better with the exception of the eastbound Kapolei Parkway left.

3. Kapolei Parkway/Kualakai Parkway

The intersection of Kapolei Parkway and Kualakai Parkway is projected to operate at LOS C during the AM peak hour. All movements are projected to operate at LOS C or better. During the PM peak hour, the intersection is projected to operate at LOS D overall. The northbound left from the shopping center is projected to operate at LOS E but all other movements are projected to operate at LOS D or better.

4. Kapolei Parkway/Renton Road

The intersection of Kapolei Parkway and Renton Road is projected to operate at LOS C during the AM peak hour. All movements are projected to operate at LOS D or better. During the PM peak hour, the intersection is projected to operate at LOS B overall with all movements operating at LOS C or better with the exception of the westbound Kapolei Parkway left which is projected to operate at LOS D.

5. Roosevelt Avenue/West Entrance

The west Ka Makana Alii access is projected to be stop-controlled with a refuge lane on Roosevelt Avenue. The southbound left turn out is projected to operate at LOS C during the AM peak hour and at LOS D during the PM peak hour.

6. Roosevelt Avenue/East Entrance

The east Ka Makana Alii access is projected to be signalized tee-intersection with Roosevelt Avenue. The intersection is projected to operate at LOS B for the AM and PM peak hours, with all movements operating at LOS C or better.

C. Transit

By Year 2015, HHCTCP will further extend the alignment to Aloha Stadium. The transit ridership will increase significantly from 2013. The bus routes serving Ka Makana Alii include Route 41 connecting Ewa Beach, UHWO, and Kapolei City; Route 411 connecting Makakilo, Kapolei City, and East Kapolei; Route 416 connecting Kapolei City and East Kapolei; Route 418 connecting Kapolei City, Kalaeloa, and East Kapolei; Route 421 connecting West Loch, Hoopili, UHWO, and East Kapolei; Route 422 connecting Hoopili and East Kapolei,

D. Summary of 2015 Operations With Phase 2

With the extension of Kualakai Parkway beyond Kapolei Parkway, the Kinoiki Street intersection is expected to process less project-related traffic. Ka Makana Alii would have the greatest impact on the Kapolei Parkway/Kualakai Parkway intersection. All other study area intersections are projected to operate acceptably.

VII. CONCLUSION AND RECOMMENDATIONS

A. Conclusion

It is concluded that while delays experienced along Kapolei Parkway are expected to increase, the intersections are still projected to operate at an acceptable level during the AM and PM commuter peak hours. The Ka Makana Alii shopping center traffic can be accommodated by the adjacent roadway network.

B. Recommendations

Based on the operational analyses of intersections, the following are recommended to be implemented in conjunction with the proposed shopping center:

Phase 1 Recommendations

- Signalize the north Ka Makana Alii access to Kapolei Parkway at the intersection with Kinoiki Street.
- Configure the intersection of Kapolei Parkway and Kinoiki Street as follows:
    - Eastbound Kapolei Parkway approach as a left turn lane, 3 through lanes, and a right turn lane;
    - Westbound Kapolei Parkway approach as 2 left turn lanes, 3 through lanes, and a right turn lane;
    - Northbound Ka Makana Alii driveway approach as 2 left turn lanes, a through lane, and a right turn lane;
    - Southbound Kinoiki Street approach as a left turn lane, a through lane, and a right turn lane.
- Configure the west Roosevelt Avenue driveway's intersection with Roosevelt Avenue as stop-controlled at the driveway approach. An eastbound left turn and a westbound right turn lane from Roosevelt Avenue into the shopping center are desirable. A refuge lane for southbound left turns exiting the shopping center is also desirable.

- Provide a right-in/right-out driveway at the western edge of the property along Kapolei Parkway.

Phase 2 Recommendations

- Configure the intersection of Kapolei Parkway and Kualakai Parkway as follows:
    - Eastbound Kapolei Parkway approach as 2 left turn lanes, 2 through lanes, and a shared through/right turn lane;
    - Westbound Kapolei Parkway approach as 2 left turn lanes, 3 through lanes, and 2 right turn lanes;
    - Northbound Kualakai Parkway approach as a left turn lane, a through lane, and a shared through/right turn lane;
    - Southbound Kualakai Parkway approach as 2 left turn lanes, 2 through lanes, and 2 right turn lanes.
- Install a traffic signal at the east Roosevelt Avenue driveway's intersection with Roosevelt Avenue. An eastbound left turn lane into the shopping center and right turn lane from Roosevelt Avenue into the shopping center are desirable.
- Coordinate with theBus to provide frequent regional and sub-regional bus services connecting major activity centers in the area such as Kapolei City, Makakilo, Waipahu, UHWO, and Ewa as well as with the transit stations in Waipahu and Kapolei.
- Provide right-in/right-out driveways on Kualakai Parkway south of Kapolei Parkway and on Kapolei Parkway between Kinoiki Street and Kualakai Parkway. These driveways will alleviate some of the traffic load at the main accesses.

Appendix A

Existing Traffic Data

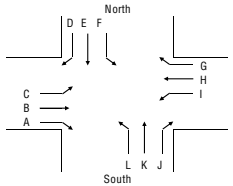
AM COUNT SHEET

Intersection: Kapolei Pkwy/Kamaaha Ave

Date: Tuesday 3/30/2010

By: Jonathan

Weather: Windy/Drizzly



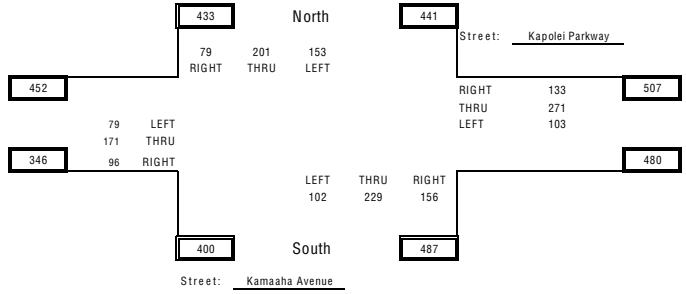
Street: Kapolei Parkway

Street: Kamaaha Avenue

TIME	A	B	C	D	E	F	G	H	I	J	K	L	Total Mvmt	Total Hour
6:30 AM - 6:45 AM	3	33	0	3	7	48	23	22	6	43	11	2	201	1175
6:45 AM - 7:00 AM	9	25	2	7	14	44	28	21	14	39	14	5	222	1548
7:00 AM - 7:15 AM	20	23	7	3	21	40	28	46	22	51	33	16	310	1773
7:15 AM - 7:30 AM	27	45	13	14	68	34	26	58	28	40	69	20	442	1631
7:30 AM - 7:45 AM	24	61	25	41	71	34	41	100	34	24	80	39	574	1335
7:45 AM - 8:00 AM	25	42	34	21	41	45	38	67	19	41	47	27	447	
8:00 AM - 8:15 AM	6	24	6	1	4	23	32	34	11	15	11	1	168	
8:15 AM - 8:30 AM	4	22	7	4	5	22	22	31	8	18	2	1	146	
Phf	0.889	0.701	0.581	0.482	0.708	0.850	0.811	0.678	0.757	0.765	0.716	0.654	Peak	Phf
7:00 AM - 8:00 AM	96	171	79	79	201	153	133	271	103	156	229	102	1773	0.772

Peak Hour

7:00 AM - 8:00 AM



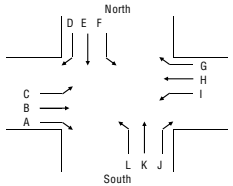
AM COUNT SHEET

Intersection: Kapolei Pkwy/Kamaaha Ave

Date: Tuesday 3/30/2010

By: Jonathan

Weather: Windy/Drizzly



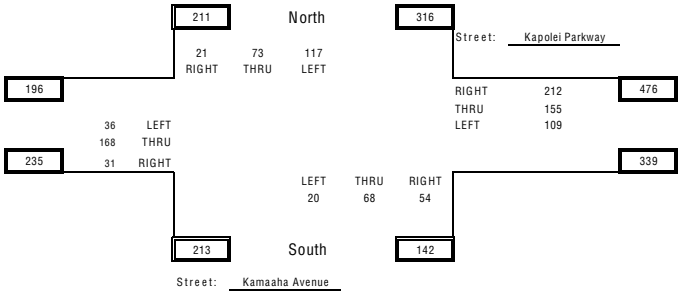
Street: Kapolei Parkway

Street: Kamaaha Avenue

TIME	A	B	C	D	E	F	G	H	I	J	K	L	Total Mvmt	Total Hour
3:30 PM - 3:45 PM	9	43	10	7	21	44	57	42	33	13	22	7	308	1064
3:45 PM - 4:00 PM	6	29	8	4	18	27	59	26	22	17	16	3	235	981
4:00 PM - 4:15 PM	6	52	8	7	17	29	39	44	28	15	14	5	264	972
4:15 PM - 4:30 PM	10	44	10	3	17	17	57	43	26	9	16	5	257	918
4:30 PM - 4:45 PM	9	47	2	7	15	24	44	26	28	8	10	5	225	897
4:45 PM - 5:00 PM	5	29	11	9	14	23	51	45	21	8	8	2	226	
5:00 PM - 5:15 PM	3	34	6	5	11	22	38	38	26	12	14	1	210	
5:15 PM - 5:30 PM	6	37	14	7	15	31	42	35	24	9	12	4	236	
Phf	0.775	0.808	0.900	0.750	0.869	0.665	0.898	0.881	0.826	0.794	0.773	0.714	Peak	Phf
3:30 PM - 4:30 PM	31	168	36	21	73	117	212	155	109	54	68	20	1064	0.864

Peak Hour

3:30 PM - 4:30 PM



Street: Kapolei Parkway

Street: Kamaaha Avenue

PARSONS
BRINCKERHOFF

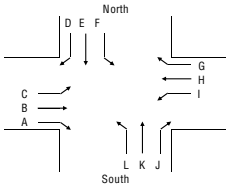
AM COUNT SHEET

Intersection: Kapolei Pkwy/Kinoiki St

Date: Tuesday 3/30/2010

By: Herbert

Weather: Windy, Drizzly



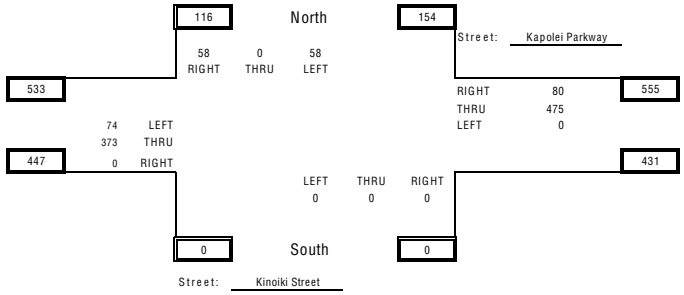
Street: Kapolei Parkway

Street: Kinoiki Street

TIME	A	B	C	D	E	F	G	H	I	J	K	L	Total Mvmt	Total Hour
6:30 AM - 6:45 AM	0	97	12	4	0	18	37	44	0	0	0	0	212	920
6:45 AM - 7:00 AM	0	84	6	4	0	16	18	60	0	0	0	0	188	1026
7:00 AM - 7:15 AM	0	93	19	8	0	19	20	90	0	0	0	0	249	1118
7:15 AM - 7:30 AM	0	97	9	15	0	14	18	118	0	0	0	0	271	1000
7:30 AM - 7:45 AM	0	88	21	21	0	11	20	157	0	0	0	0	318	883
7:45 AM - 8:00 AM	0	95	25	14	0	14	22	110	0	0	0	0	280	
8:00 AM - 8:15 AM	0	48	7	6	0	12	15	43	0	0	0	0	131	
8:15 AM - 8:30 AM	0	58	5	5	0	10	11	65	0	0	0	0	154	
Phf	#DIV/0!	0.961	0.740	0.690	#DIV/0!	0.763	0.909	0.756	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	Peak	Phf
7:00 AM - 8:00 AM	0	373	74	58	0	58	80	475	0	0	0	0	1118	0.879

Peak Hour

7:00 AM - 8:00 AM



Street: Kapolei Parkway

Street: Kinoiki Street

PARSONS
BRINCKERHOFF

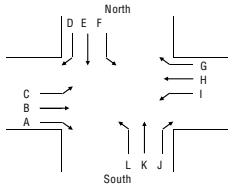
AM COUNT SHEET

Intersection: Kapolei Pkwy/Kinoiki St

Date: Tuesday 3/30/2010

By: Herbert

Weather: Windy, Drizzly



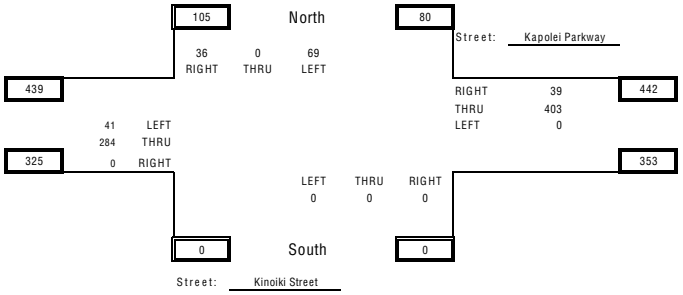
Street: Kapolei Parkway

Street: Kinoiki Street

TIME	A	B	C	D	E	F	G	H	I	J	K	L	Total Mvmt	Total Hour
3:30 PM - 3:45 PM	0	90	11	13	0	37	8	110	0	0	0	0	269	872
3:45 PM - 4:00 PM	0	60	8	10	0	13	14	99	0	0	0	0	204	816
4:00 PM - 4:15 PM	0	68	15	5	0	11	8	96	0	0	0	0	203	809
4:15 PM - 4:30 PM	0	66	7	8	0	8	9	98	0	0	0	0	196	798
4:30 PM - 4:45 PM	0	73	6	6	0	19	11	98	0	0	0	0	213	802
4:45 PM - 5:00 PM	0	54	3	5	0	15	12	108	0	0	0	0	197	
5:00 PM - 5:15 PM	0	63	8	12	0	13	9	87	0	0	0	0	192	
5:15 PM - 5:30 PM	0	72	6	11	0	9	10	92	0	0	0	0	200	
Phf	#DIV/0!	0.789	0.683	0.692	#DIV/0!	0.466	0.696	0.916	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	Peak	Phf
3:30 PM - 4:30 PM	0	284	41	36	0	69	39	403	0	0	0	0	872	0.810

Peak Hour

3:30 PM - 4:30 PM



Street: Kapolei Parkway

Street: Kinoiki Street

PARSONS
BRINCKERHOFF

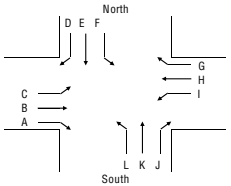
AM COUNT SHEET

Intersection: Kapolei Pkwy/Kualakai Pkwy

Date: Tuesday 3/30/2010

By: Shenghong

Weather: Windy/Drizzly



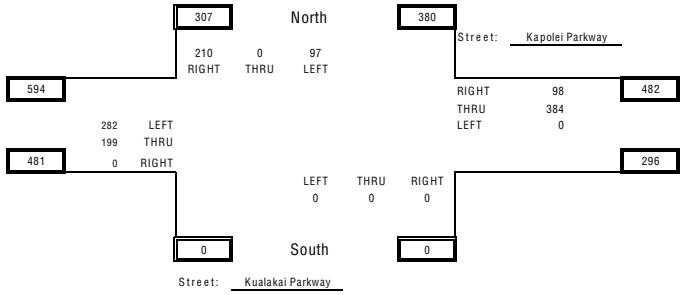
Street: Kapolei Parkway

Street: Kualakai Parkway

TIME	A	B	C	D	E	F	G	H	I	J	K	L	Total Mvmt	Total Hour
6:30 AM - 6:45 AM		47	77	31		28	30	38					251	1073
6:45 AM - 7:00 AM		34	74	24		17	31	61					241	1186
7:00 AM - 7:15 AM		38	71	37		27	17	79					269	1270
7:15 AM - 7:30 AM		44	78	51		25	27	87					312	1183
7:30 AM - 7:45 AM		65	55	71		22	25	126					364	1032
7:45 AM - 8:00 AM		52	78	51		23	29	92					325	
8:00 AM - 8:15 AM		24	47	32		17	23	39					182	
8:15 AM - 8:30 AM		21	43	32		8	21	36					161	
Phf	#DIV/0!	0.765	0.904	0.739	#DIV/0!	0.898	0.845	0.762	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	Peak	Phf
7:00 AM - 8:00 AM	0	199	282	210	0	97	98	384	0	0	0	0	1270	0.872

Peak Hour

7:00 AM - 8:00 AM



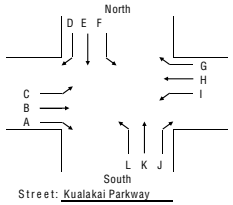
Street: Kapolei Parkway

Street: Kualakai Parkway

PARSONS
BRINCKERHOFF

AM COUNT SHEET

Intersection: Kapolei Pkwy/Kualakai Pkwy
Date: Tuesday 3/30/2010
By: Shenghong
Weather: Windy/Drizzly

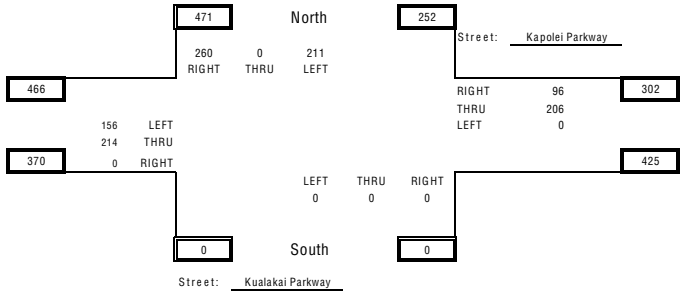


Street: Kapolei Parkway
Street: Kualakai Parkway

TIME	A	B	C	D	E	F	G	H	I	J	K	L	Total Mvmt	Total Hour
3:30 PM - 3:45 PM		70	64	53		43	37	65					332	1143
3:45 PM - 4:00 PM		38	35	70		54	22	42					261	1079
4:00 PM - 4:15 PM		53	32	71		57	19	40					272	1098
4:15 PM - 4:30 PM		53	25	66		57	18	59					278	1067
4:30 PM - 4:45 PM		49	46	66		60	14	33					268	1079
4:45 PM - 5:00 PM		49	29	81		58	15	48					280	
5:00 PM - 5:15 PM		48	23	58		56	15	41					241	
5:15 PM - 5:30 PM		59	32	62		71	18	48					290	
Phf	#DIV/0!	0.764	0.609	0.915	#DIV/0!	0.925	0.649	0.792	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	Peak	Phf
3:30 PM - 4:30 PM	0	214	156	260	0	211	96	206	0	0	0	0	1143	0.861

Peak Hour

3:30 PM - 4:30 PM

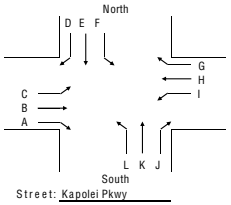


Street: Kapolei Parkway
Street: Kualakai Parkway

PARSONS
BRINCKERHOFF

AM COUNT SHEET

Intersection: Kapolei Pkwy/Renton Rd
Date: Tuesday 3/30/2010
By: Russ
Weather: Windy/Drizzly

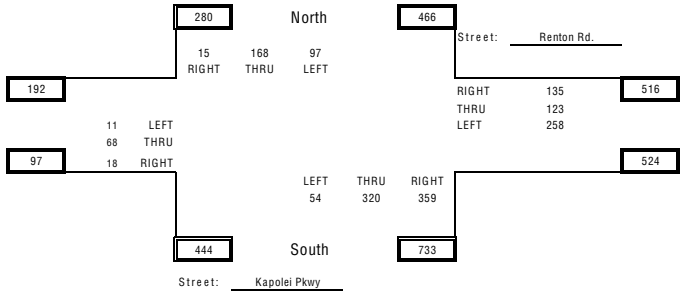


Street: Renton Rd.
Street: Kapolei Pkwy

TIME	A	B	C	D	E	F	G	H	I	J	K	L	Total Mvmt	Total Hour
6:30 AM - 6:45 AM														
6:45 AM - 7:00 AM	5	9	4	4	35	10	25	25	28	44	58	7	254	1477
7:00 AM - 7:15 AM	2	11	2	8	38	14	23	25	30	64	76	17	310	1626
7:15 AM - 7:30 AM	4	24	1	0	47	26	29	29	50	90	88	13	401	1509
7:30 AM - 7:45 AM	3	14	4	5	41	31	49	37	104	124	86	14	512	1269
7:45 AM - 8:00 AM	9	19	4	2	42	26	34	32	74	81	70	10	403	
8:00 AM - 8:15 AM	6	18	2	4	24	13	20	15	16	24	45	6	193	
8:15 AM - 8:30 AM	9	5	7	2	23	5	24	11	9	28	32	6	161	
Phf	0.500	0.708	0.688	0.469	0.894	0.782	0.689	0.831	0.620	0.724	0.909	0.794	Peak	Phf
7:00 AM - 8:00 AM	18	68	11	15	168	97	135	123	258	359	320	54	1626	0.794

Peak Hour

7:00 AM - 8:00 AM



Street: Renton Rd.
Street: Kapolei Pkwy

PARSONS
BRINCKERHOFF

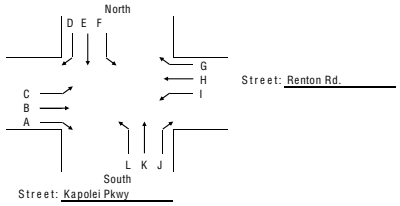
AM COUNT SHEET

Intersection: Kapolei Pkwy/Renton Rd

Date: Tuesday 3/30/2010

By: Russ

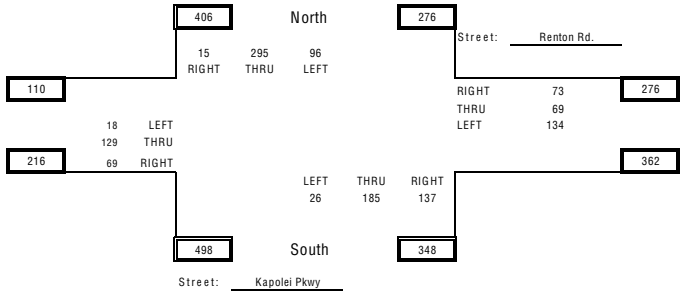
Weather: Windy/Drizzly



TIME	A	B	C	D	E	F	G	H	I	J	K	L	Total Mvmt	Total Hour
3:30 PM - 3:45 PM	12	28	9	0	86	21	19	18	25	39	61	7	325	1246
3:45 PM - 4:00 PM	18	29	5	8	61	26	14	24	32	27	35	4	283	1235
4:00 PM - 4:15 PM	16	42	1	3	77	20	23	9	37	28	42	9	307	1237
4:15 PM - 4:30 PM	23	30	3	4	71	29	17	18	40	43	47	6	331	1219
4:30 PM - 4:45 PM	22	25	6	6	84	22	16	22	36	34	35	6	314	1189
4:45 PM - 5:00 PM	10	21	4	8	81	11	20	21	34	31	35	9	285	
5:00 PM - 5:15 PM	18	24	4	10	83	12	16	13	30	26	43	10	289	
5:15 PM - 5:30 PM	13	25	1	1	96	19	15	18	33	31	38	11	301	
Phf	0.750	0.768	0.500	0.469	0.858	0.828	0.793	0.719	0.838	0.797	0.758	0.722	Peak	Phf
3:30 PM - 4:30 PM	69	129	18	15	295	96	73	69	134	137	185	26	1246	0.941

Peak Hour

3:30 PM - 4:30 PM



PARSONS BRINCKERHOFF

Appendix B
Level of Service Definitions

The Highway Capacity Manual defines six Level of Service (LOS), labeled A through F, from best to worst conditions. Level of Service for signalized and unsignalized intersections are defined in terms of average user delays. Delay is a measure of driver discomfort, frustration, fuel consumption, and lost travel time.

For unsignalized intersections, the Highway Capacity Manual evaluates gaps in the major street traffic flow and calculates available gaps for left-turns across oncoming traffic and for the left and right-turns onto the major roadway from the minor street.

LEVEL-OF-SERVICE A: Little or no delay.

LEVEL-OF-SERVICE B: Short traffic delays.

LEVEL-OF-SERVICE C: Average traffic delays.

LEVEL-OF-SERVICE D: Long traffic delays.

LEVEL-OF-SERVICE E: Very long traffic delays.

LEVEL-OF-SERVICE F: Demand volume exceeds capacity, resulting in extreme delays with queuing that may cause severe congestion and affect other movements at the intersection.

Appendix C

Intersection Capacity Analysis Worksheets

HCM Signalized Intersection Capacity Analysis
7: Kapolei Parkway & Kamaaha Avenue

Existing AM
6/2/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	79	171	96	103	271	133	102	229	156	153	201	79
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.95		1.00	0.95		1.00	0.94		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4812		1770	4834		1770	1749		1770	1784	
Flt Permitted	0.95	1.00		0.95	1.00		0.57	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4812		1770	4834		1071	1749		1770	1784	
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)	86	186	104	112	295	145	111	249	170	166	218	86
RTOR Reduction (vph)	0	83	0	0	70	0	0	15	0	0	8	0
Lane Group Flow (vph)	86	207	0	112	370	0	111	404	0	166	296	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	8.6	13.6		11.7	16.7		29.2	29.2		14.8	49.0	
Effective Green, g (s)	8.6	13.6		11.7	16.7		29.2	29.2		14.8	49.0	
Actuated g/C Ratio	0.09	0.15		0.13	0.18		0.32	0.32		0.16	0.54	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	167	717		227	884		343	559		287	957	
v/s Ratio Prot	0.05	0.04		c0.06	c0.08			c0.23		c0.09	0.17	
v/s Ratio Perm							0.10					
v/c Ratio	0.51	0.29		0.49	0.42		0.32	0.72		0.58	0.31	
Uniform Delay, d1	39.4	34.5		37.0	33.0		23.6	27.5		35.4	11.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.7	0.2		1.7	0.3		0.6	4.6		2.8	0.2	
Delay (s)	42.0	34.8		38.7	33.3		24.1	32.1		38.2	11.9	
Level of Service	D	C		D	C		C	C		D	B	
Approach Delay (s)		36.4			34.4			30.4			21.2	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM Average Control Delay	30.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	91.3	Sum of lost time (s)	22.0
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	74	373	475	80	58	58
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	80	405	516	87	63	63
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			1124			
pX, platoon unblocked						
vC, conflicting volume	516				812	172
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	516				812	172
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				78	93
cM capacity (veh/h)	1046				292	842

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	SB 1	SB 2
Volume Total	80	135	135	135	172	172	172	87	63	63
Volume Left	80	0	0	0	0	0	0	0	63	0
Volume Right	0	0	0	0	0	0	0	87	0	63
cSH	1046	1700	1700	1700	1700	1700	1700	1700	292	842
Volume to Capacity	0.08	0.08	0.08	0.08	0.10	0.10	0.10	0.05	0.22	0.07
Queue Length 95th (ft)	6	0	0	0	0	0	0	0	20	6
Control Delay (s)	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.7	9.6
Lane LOS	A								C	A
Approach Delay (s)	1.4				0.0				15.1	
Approach LOS									C	

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	26.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	97	168	15	54	320	359	11	68	18	258	123	135
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.92		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5024		1770	4682		1770	1803		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.67	1.00		0.70	1.00	1.00
Satd. Flow (perm)	1770	5024		1770	4682		1250	1803		1297	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)	105	183	16	59	348	390	12	74	20	280	134	147
RTOR Reduction (vph)	0	11	0	0	294	0	0	11	0	0	0	99
Lane Group Flow (vph)	105	188	0	59	444	0	12	83	0	280	134	48
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	6.2	15.2		4.2	13.2		17.5	17.5		17.5	17.5	17.5
Effective Green, g (s)	6.2	15.2		4.2	13.2		17.5	17.5		17.5	17.5	17.5
Actuated g/C Ratio	0.12	0.28		0.08	0.24		0.32	0.32		0.32	0.32	0.32
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	204	1417		138	1147		406	585		421	605	514
v/s Ratio Prot	c0.06	0.04		0.03	c0.09			0.05			0.07	
v/s Ratio Perm							0.01			c0.22		0.03
v/c Ratio	0.51	0.13		0.43	0.39		0.03	0.14		0.67	0.22	0.09
Uniform Delay, d1	22.4	14.4		23.7	17.0		12.4	12.9		15.7	13.2	12.7
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.2	0.0		2.1	0.2		0.0	0.1		3.9	0.2	0.1
Delay (s)	24.6	14.5		25.8	17.2		12.4	13.0		19.6	13.4	12.8
Level of Service	C	B		C	B		B	B		B	B	B
Approach Delay (s)		18.0			17.8			12.9			16.3	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	53.9	Sum of lost time (s)	17.0
Intersection Capacity Utilization	54.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
28: Kapolei Parkway & Kualakai Parkway

Existing AM
6/2/2011

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	282	199	384	98	97	210
Ideal Flow (vphpl)	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	0.97	0.91	0.91	0.88	0.97	0.88
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	5085	5085	2787	3433	2787
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	5085	2787	3433	2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	307	216	417	107	105	228
RTOR Reduction (vph)	0	0	0	0	0	190
Lane Group Flow (vph)	307	216	417	107	105	38
Turn Type	Prot			Over		Perm
Protected Phases	7	4	8	6	6	
Permitted Phases						6
Actuated Green, G (s)	9.9	26.0	10.1	7.6	7.6	7.6
Effective Green, g (s)	9.9	26.0	10.1	7.6	7.6	7.6
Actuated g/C Ratio	0.22	0.57	0.22	0.17	0.17	0.17
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)	745	2899	1126	465	572	465
v/s Ratio Prot	c0.09	0.04	c0.08	c0.04	0.03	
v/s Ratio Perm						0.01
v/c Ratio	0.41	0.07	0.37	0.23	0.18	0.08
Uniform Delay, d1	15.3	4.4	15.1	16.5	16.3	16.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.0	0.2	0.3	0.2	0.1
Delay (s)	15.7	4.4	15.3	16.7	16.5	16.1
Level of Service	B	A	B	B	B	B
Approach Delay (s)		11.0	15.6		16.2	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	45.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	33.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
7: Kapolei Parkway & Kamaaha Avenue

Existing PM
6/2/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	36	168	31	109	155	212	20	68	54	117	73	21
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.91		1.00	0.93		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4966		1770	4644		1770	1739		1770	1800	
Flt Permitted	0.95	1.00		0.95	1.00		0.69	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4966		1770	4644		1287	1739		1770	1800	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	39	183	34	118	168	230	22	74	59	127	79	23
RTOR Reduction (vph)	0	27	0	0	168	0	0	33	0	0	14	0
Lane Group Flow (vph)	39	190	0	118	230	0	22	100	0	127	88	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	2.6	10.9		7.0	15.3		9.4	9.4		7.5	21.9	
Effective Green, g (s)	2.6	10.9		7.0	15.3		9.4	9.4		7.5	21.9	
Actuated g/C Ratio	0.05	0.19		0.12	0.27		0.17	0.17		0.13	0.39	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	81	953		218	1251		213	288		234	694	
v/s Ratio Prot	0.02	0.04		c0.07	c0.05			c0.06		c0.07	0.05	
v/s Ratio Perm							0.02					
v/c Ratio	0.48	0.20		0.54	0.18		0.10	0.35		0.54	0.13	
Uniform Delay, d1	26.4	19.3		23.4	16.0		20.1	21.0		23.0	11.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.5	0.1		2.7	0.1		0.2	0.7		2.6	0.1	
Delay (s)	30.9	19.4		26.1	16.0		20.3	21.7		25.6	11.4	
Level of Service	C	B		C	B		C	C		C	B	
Approach Delay (s)		21.1			18.3			21.5			19.3	
Approach LOS		C			B			C			B	

Intersection Summary			
HCM Average Control Delay	19.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	56.8	Sum of lost time (s)	22.0
Intersection Capacity Utilization	42.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	41	284	403	39	69	36
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	45	309	438	42	75	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			1124			
pX, platoon unblocked						
vC, conflicting volume	438				630	146
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	438				630	146
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				81	96
cM capacity (veh/h)	1118				397	875

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	SB 1	SB 2
Volume Total	45	103	103	103	146	146	146	42	75	39
Volume Left	45	0	0	0	0	0	0	0	75	0
Volume Right	0	0	0	0	0	0	0	42	0	39
cSH	1118	1700	1700	1700	1700	1700	1700	1700	397	875
Volume to Capacity	0.04	0.06	0.06	0.06	0.09	0.09	0.09	0.02	0.19	0.04
Queue Length 95th (ft)	3	0	0	0	0	0	0	0	17	4
Control Delay (s)	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2	9.3
Lane LOS	A								C	A
Approach Delay (s)	1.1				0.0				13.8	
Approach LOS									B	

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	24.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	96	295	15	26	185	137	18	129	69	134	69	73
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.94		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5049		1770	4761		1770	1765		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.71	1.00		0.62	1.00	1.00
Satd. Flow (perm)	1770	5049		1770	4761		1319	1765		1162	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)	104	321	16	28	201	149	20	140	75	146	75	79
RTOR Reduction (vph)	0	6	0	0	112	0	0	26	0	0	0	59
Lane Group Flow (vph)	104	331	0	28	238	0	20	189	0	146	75	20
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	6.5	17.1		1.3	11.9		12.0	12.0		12.0	12.0	12.0
Effective Green, g (s)	6.5	17.1		1.3	11.9		12.0	12.0		12.0	12.0	12.0
Actuated g/C Ratio	0.14	0.36		0.03	0.25		0.25	0.25		0.25	0.25	0.25
Clearance Time (s)	6.0	6.0		6.0	6.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		4.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	243	1821		49	1195		334	447		294	472	401
v/s Ratio Prot	c0.06	c0.07		0.02	0.05			0.11			0.04	
v/s Ratio Perm							0.02			c0.13		0.01
v/c Ratio	0.43	0.18		0.57	0.20		0.06	0.42		0.50	0.16	0.05
Uniform Delay, d1	18.7	10.4		22.8	14.0		13.4	14.8		15.1	13.8	13.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.2	0.0		17.8	0.1		0.1	0.6		1.3	0.2	0.1
Delay (s)	20.0	10.4		40.6	14.1		13.5	15.4		16.4	13.9	13.4
Level of Service	B	B		D	B		B	B		B	B	B
Approach Delay (s)		12.7			16.0			15.3			15.0	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	14.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	47.4	Sum of lost time (s)	17.0
Intersection Capacity Utilization	48.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	156	214	206	96	211	260
Ideal Flow (vphpl)	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	0.97	0.91	0.91	0.88	0.97	0.88
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	5085	5085	2787	3433	2787
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	5085	2787	3433	2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	170	233	224	104	229	283
RTOR Reduction (vph)	0	0	0	0	0	220
Lane Group Flow (vph)	170	233	224	104	229	63
Turn Type	Prot			Over		Perm
Protected Phases	7	4	8	6	6	
Permitted Phases						6
Actuated Green, G (s)	5.8	19.3	7.5	8.9	8.9	8.9
Effective Green, g (s)	5.8	19.3	7.5	8.9	8.9	8.9
Actuated g/C Ratio	0.14	0.48	0.19	0.22	0.22	0.22
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)	495	2441	949	617	760	617
v/s Ratio Prot	c0.05	0.05	c0.04	0.04	c0.07	
v/s Ratio Perm						0.02
v/c Ratio	0.34	0.10	0.24	0.17	0.30	0.10
Uniform Delay, d1	15.5	5.7	13.9	12.7	13.1	12.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.0	0.1	0.1	0.2	0.1
Delay (s)	15.9	5.7	14.0	12.8	13.3	12.5
Level of Service	B	A	B	B	B	B
Approach Delay (s)		10.0	13.6		12.9	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	12.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	40.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	29.5%	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 (vph)	81	299	99	106	406	137	105	236	161	158	207	81
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.96		1.00	0.94		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4895		1770	4893		1770	1750		1770	1784	
Flt Permitted	0.95	1.00		0.95	1.00		0.57	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4895		1770	4893		1062	1750		1770	1784	
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)	88	325	108	115	441	149	114	257	175	172	225	88
RTOR Reduction (vph)	0	38	0	0	38	0	0	19	0	0	12	0
Lane Group Flow (vph)	88	395	0	115	552	0	114	413	0	172	301	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	8.9	17.5		12.5	21.1		30.7	30.7		15.8	51.5	
Effective Green, g (s)	8.9	17.5		12.5	21.1		30.7	30.7		15.8	51.5	
Actuated g/C Ratio	0.09	0.18		0.13	0.21		0.31	0.31		0.16	0.52	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	160	870		225	1048		331	545		284	933	
v/s Ratio Prot	0.05	0.08		c0.06	c0.11			c0.24		c0.10	0.17	
v/s Ratio Perm							0.11					
v/c Ratio	0.55	0.45		0.51	0.53		0.34	0.76		0.61	0.32	
Uniform Delay, d1	42.9	36.2		40.1	34.3		26.1	30.5		38.5	13.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.0	0.4		2.0	0.5		0.6	6.0		3.6	0.2	
Delay (s)	46.9	36.6		42.1	34.8		26.8	36.5		42.1	13.7	
Level of Service	D	D		D	C		C	D		D	B	
Approach Delay (s)		38.3			36.0			34.5			23.8	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	33.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	98.5	Sum of lost time (s)	22.0
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	85	518	598	100	135	97
Ideal Flow (vphpl)	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	0.91	0.91	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)	1770	5085	5085	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	5085	5085	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	563	650	109	147	105
RTOR Reduction (vph)	0	0	0	77	0	82
Lane Group Flow (vph)	92	563	650	32	147	23
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	6.8	27.9	15.1	15.1	11.0	11.0
Effective Green, g (s)	6.8	27.9	15.1	15.1	11.0	11.0
Actuated g/C Ratio	0.13	0.55	0.30	0.30	0.22	0.22
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)	236	2787	1509	470	383	342
v/s Ratio Prot	c0.05	0.11	c0.13		c0.08	
v/s Ratio Perm				0.02		0.01
v/c Ratio	0.39	0.20	0.43	0.07	0.38	0.07
Uniform Delay, d1	20.2	5.8	14.4	12.9	17.1	15.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.1	0.0	0.2	0.1	0.6	0.1
Delay (s)	21.2	5.9	14.6	12.9	17.7	15.9
Level of Service	C	A	B	B	B	B
Approach Delay (s)		8.0	14.4		17.0	
Approach LOS		A	B		B	

Intersection Summary			
HCM Average Control Delay	12.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	50.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	38.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	128	291	15	56	491	370	11	70	19	266	127	176
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.94		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5049		1770	4758		1770	1802		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.67	1.00		0.69	1.00	1.00
Satd. Flow (perm)	1770	5049		1770	4758		1246	1802		1293	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)	139	316	16	61	534	402	12	76	21	289	138	191
RTOR Reduction (vph)	0	4	0	0	101	0	0	7	0	0	0	130
Lane Group Flow (vph)	139	328	0	61	835	0	12	90	0	289	138	61
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	13.1	32.7		6.9	26.5		26.3	26.3		26.3	26.3	26.3
Effective Green, g (s)	13.1	32.7		6.9	26.5		26.3	26.3		26.3	26.3	26.3
Actuated g/C Ratio	0.16	0.39		0.08	0.32		0.32	0.32		0.32	0.32	0.32
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	280	1992		147	1521		395	572		410	591	502
v/s Ratio Prot	c0.08	0.06		0.03	c0.18			0.05			0.07	
v/s Ratio Perm							0.01			c0.22		0.04
v/c Ratio	0.50	0.16		0.41	0.55		0.03	0.16		0.70	0.23	0.12
Uniform Delay, d1	31.9	16.3		36.1	23.3		19.5	20.3		24.9	20.9	20.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.4	0.0		1.9	0.4		0.0	0.1		5.4	0.2	0.1
Delay (s)	33.3	16.3		38.0	23.7		19.5	20.5		30.3	21.1	20.2
Level of Service	C	B		D	C		B	C		C	C	C
Approach Delay (s)		21.3			24.6			20.4			25.1	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	23.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	82.9	Sum of lost time (s)	17.0
Intersection Capacity Utilization	60.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	439	249	438	259	202	296
Ideal Flow (vphpl)	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	0.97	0.91	0.91	0.88	0.97	0.88
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	5085	5085	2787	3433	2787
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	5085	2787	3433	2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	477	271	476	282	220	322
RTOR Reduction (vph)	0	0	0	0	0	265
Lane Group Flow (vph)	477	271	476	282	220	57
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	14.5	35.0	14.5	14.5	10.1	10.1
Effective Green, g (s)	14.5	35.0	14.5	14.5	10.1	10.1
Actuated g/C Ratio	0.25	0.61	0.25	0.25	0.18	0.18
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)	872	3117	1291	708	607	493
v/s Ratio Prot	c0.14	0.05	0.09		c0.06	
v/s Ratio Perm				c0.10		0.02
v/c Ratio	0.55	0.09	0.37	0.40	0.36	0.12
Uniform Delay, d1	18.5	4.5	17.5	17.7	20.7	19.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	0.0	0.2	0.4	0.4	0.1
Delay (s)	19.2	4.5	17.7	18.0	21.0	19.9
Level of Service	B	A	B	B	C	B
Approach Delay (s)		13.9	17.8		20.3	
Approach LOS		B	B		C	

Intersection Summary			
HCM Average Control Delay	17.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	57.1	Sum of lost time (s)	18.0
Intersection Capacity Utilization	41.7%	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 (vph)	37	316	32	112	298	218	21	70	56	121	75	22
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.93		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5015		1770	4763		1770	1738		1770	1799	
Flt Permitted	0.95	1.00		0.95	1.00		0.69	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5015		1770	4763		1283	1738		1770	1799	
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)	40	343	35	122	324	237	23	76	61	132	82	24
RTOR Reduction (vph)	0	9	0	0	98	0	0	20	0	0	7	0
Lane Group Flow (vph)	40	369	0	122	463	0	23	117	0	132	99	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	4.5	14.2		10.7	20.4		10.8	10.8		11.1	26.9	
Effective Green, g (s)	4.5	14.2		10.7	20.4		10.8	10.8		11.1	26.9	
Actuated g/C Ratio	0.07	0.21		0.16	0.30		0.16	0.16		0.16	0.39	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	116	1035		275	1412		201	273		286	703	
v/s Ratio Prot	0.02	0.07		c0.07	c0.10			c0.07		c0.07	0.05	
v/s Ratio Perm							0.02					
v/c Ratio	0.34	0.36		0.44	0.33		0.11	0.43		0.46	0.14	
Uniform Delay, d1	30.7	23.4		26.4	18.9		24.9	26.2		26.1	13.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.8	0.2		1.1	0.1		0.3	1.1		1.2	0.1	
Delay (s)	32.5	23.6		27.5	19.0		25.1	27.3		27.3	13.6	
Level of Service	C	C		C	B		C	C		C	B	
Approach Delay (s)		24.5			20.5			27.0			21.2	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	22.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	68.8	Sum of lost time (s)	22.0
Intersection Capacity Utilization	46.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	71	417	560	100	104	54
Ideal Flow (vphpl)	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	0.91	0.91	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)	1770	5085	5085	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	5085	5085	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	77	453	609	109	113	59
RTOR Reduction (vph)	0	0	0	77	0	47
Lane Group Flow (vph)	77	453	609	32	113	12
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	6.2	26.0	13.8	13.8	9.5	9.5
Effective Green, g (s)	6.2	26.0	13.8	13.8	9.5	9.5
Actuated g/C Ratio	0.13	0.55	0.29	0.29	0.20	0.20
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)	231	2783	1477	460	354	317
v/s Ratio Prot	c0.04	0.09	c0.12		c0.06	
v/s Ratio Perm				0.02		0.01
v/c Ratio	0.33	0.16	0.41	0.07	0.32	0.04
Uniform Delay, d1	18.8	5.3	13.6	12.2	16.2	15.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.0	0.2	0.1	0.5	0.0
Delay (s)	19.6	5.4	13.8	12.3	16.8	15.4
Level of Service	B	A	B	B	B	B
Approach Delay (s)		7.4	13.5		16.3	
Approach LOS		A	B		B	

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	47.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	35.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	135	480	15	27	345	141	19	133	71	138	71	121
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5063		1770	4864		1770	1766		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.71	1.00		0.56	1.00	1.00
Satd. Flow (perm)	1770	5063		1770	4864		1317	1766		1051	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)	147	522	16	29	375	153	21	145	77	150	77	132
RTOR Reduction (vph)	0	2	0	0	52	0	0	14	0	0	0	98
Lane Group Flow (vph)	147	536	0	29	476	0	21	208	0	150	77	34
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	11.4	26.2		2.5	17.3		16.0	16.0		16.0	16.0	16.0
Effective Green, g (s)	11.4	26.2		2.5	17.3		16.0	16.0		16.0	16.0	16.0
Actuated g/C Ratio	0.18	0.42		0.04	0.28		0.26	0.26		0.26	0.26	0.26
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	327	2150		72	1364		342	458		273	483	411
v/s Ratio Prot	c0.08	0.11		0.02	c0.10			0.12			0.04	
v/s Ratio Perm							0.02			c0.14		0.02
v/c Ratio	0.45	0.25		0.40	0.35		0.06	0.45		0.55	0.16	0.08
Uniform Delay, d1	22.4	11.4		28.9	17.7		17.2	19.2		19.7	17.7	17.3
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.0	0.1		3.7	0.2		0.1	0.7		2.3	0.2	0.1
Delay (s)	23.3	11.5		32.5	17.9		17.3	19.9		22.0	17.8	17.4
Level of Service	C	B		C	B		B	B		C	B	B
Approach Delay (s)		14.0			18.6			19.7			19.4	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	17.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	61.7	Sum of lost time (s)	17.0
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
28: Kapolei Parkway & Kualakai Parkway

2013 background
PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	281	252	252	250	390	419
Ideal Flow (vphpl)	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	0.97	0.91	0.91	0.88	0.97	0.88
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	5085	5085	2787	3433	2787
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	5085	2787	3433	2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	305	274	274	272	424	455
RTOR Reduction (vph)	0	0	0	0	0	338
Lane Group Flow (vph)	305	274	274	272	424	117
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	11.5	30.2	12.7	12.7	14.6	14.6
Effective Green, g (s)	11.5	30.2	12.7	12.7	14.6	14.6
Actuated g/C Ratio	0.20	0.53	0.22	0.22	0.26	0.26
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)	695	2704	1137	623	882	716
v/s Ratio Prot	c0.09	0.05	0.05		c0.12	
v/s Ratio Perm				c0.10		0.04
v/c Ratio	0.44	0.10	0.24	0.44	0.48	0.16
Uniform Delay, d1	19.8	6.6	18.1	19.0	17.9	16.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.0	0.1	0.5	0.4	0.1
Delay (s)	20.3	6.6	18.2	19.5	18.3	16.5
Level of Service	C	A	B	B	B	B
Approach Delay (s)		13.8	18.8		17.4	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	16.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	56.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	39.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
7: Kapolei Parkway & Kamaaha Avenue

Total 2013 with project
AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	81	333	99	106	428	137	105	236	161	158	207	81
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.94		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4910		1770	4900		1770	1750		1770	1784	
Flt Permitted	0.95	1.00		0.95	1.00		0.57	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4910		1770	4900		1062	1750		1770	1784	
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)	88	362	108	115	465	149	114	257	175	172	225	88
RTOR Reduction (vph)	0	34	0	0	35	0	0	19	0	0	12	0
Lane Group Flow (vph)	88	436	0	115	579	0	114	413	0	172	301	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	8.9	18.0		12.5	21.6		30.8	30.8		15.8	51.6	
Effective Green, g (s)	8.9	18.0		12.5	21.6		30.8	30.8		15.8	51.6	
Actuated g/C Ratio	0.09	0.18		0.13	0.22		0.31	0.31		0.16	0.52	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	159	892		223	1068		330	544		282	929	
v/s Ratio Prot	0.05	0.09		c0.06	c0.12			c0.24		c0.10	0.17	
v/s Ratio Perm							0.11					
v/c Ratio	0.55	0.49		0.52	0.54		0.35	0.76		0.61	0.32	
Uniform Delay, d1	43.2	36.4		40.5	34.4		26.4	30.8		38.8	13.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.1	0.4		2.0	0.6		0.6	6.0		3.7	0.2	
Delay (s)	47.3	36.8		42.5	34.9		27.0	36.8		42.5	13.9	
Level of Service	D	D		D	C		C	D		D	B	
Approach Delay (s)		38.5			36.1			34.8			24.0	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	33.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	99.1	Sum of lost time (s)	22.0
Intersection Capacity Utilization	65.2%	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 (vph)	85	518	34	83	598	100	22	8	52	135	13	97
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	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	3433	1863	1583	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)	92	563	37	90	650	109	24	9	57	147	14	105
RTOR Reduction (vph)	0	0	27	0	0	83	0	0	48	0	0	75
Lane Group Flow (vph)	92	563	10	90	650	26	24	9	9	147	14	30
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	7.7	19.1	19.1	5.9	17.3	17.3	2.2	10.8	10.8	12.1	20.7	20.7
Effective Green, g (s)	7.7	19.1	19.1	5.9	17.3	17.3	2.2	10.8	10.8	12.1	20.7	20.7
Actuated g/C Ratio	0.11	0.27	0.27	0.08	0.24	0.24	0.03	0.15	0.15	0.17	0.29	0.29
Clearance Time (s)	6.0	6.0	6.0	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	3.0	3.0	3.0
Lane Grp Cap (vph)	190	1351	421	282	1224	381	105	280	238	298	536	456
v/s Ratio Prot	c0.05	0.11		0.03	c0.13		0.01	0.00		c0.08	0.01	
v/s Ratio Perm			0.01			0.02			0.01			c0.02
v/c Ratio	0.48	0.42	0.02	0.32	0.53	0.07	0.23	0.03	0.04	0.49	0.03	0.07
Uniform Delay, d1	30.2	21.8	19.5	31.1	23.8	21.1	34.0	26.1	26.1	27.1	18.4	18.6
Progression Factor	1.00	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	0.4	0.1	1.1	0.0	0.1	1.3	0.0	0.1
Delay (s)	32.2	22.0	19.5	31.8	24.2	21.2	35.1	26.1	26.2	28.4	18.4	18.6
Level of Service	C	C	B	C	C	C	D	C	C	C	B	B
Approach Delay (s)		23.2			24.6			28.6			24.0	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	71.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	45.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	128	304	15	56	512	370	11	70	19	266	127	176
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.94		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5050		1770	4766		1770	1802		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.67	1.00		0.69	1.00	1.00
Satd. Flow (perm)	1770	5050		1770	4766		1246	1802		1293	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)	139	330	16	61	557	402	12	76	21	289	138	191
RTOR Reduction (vph)	0	4	0	0	96	0	0	7	0	0	0	131
Lane Group Flow (vph)	139	342	0	61	863	0	12	90	0	289	138	60
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	13.2	33.4		7.0	27.2		26.5	26.5		26.5	26.5	26.5
Effective Green, g (s)	13.2	33.4		7.0	27.2		26.5	26.5		26.5	26.5	26.5
Actuated g/C Ratio	0.16	0.40		0.08	0.32		0.32	0.32		0.32	0.32	0.32
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	278	2010		148	1545		394	569		408	588	500
v/s Ratio Prot	c0.08	0.07		0.03	c0.18			0.05			0.07	
v/s Ratio Perm							0.01			c0.22		0.04
v/c Ratio	0.50	0.17		0.41	0.56		0.03	0.16		0.71	0.23	0.12
Uniform Delay, d1	32.3	16.3		36.5	23.4		19.8	20.7		25.3	21.2	20.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.4	0.0		1.9	0.4		0.0	0.1		5.6	0.2	0.1
Delay (s)	33.7	16.3		38.4	23.8		19.9	20.8		30.8	21.4	20.5
Level of Service	C	B		D	C		B	C		C	C	C
Approach Delay (s)		21.3			24.7			20.7			25.5	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	83.9	Sum of lost time (s)	17.0
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	475	265	464	259	202	353
Ideal Flow (vphpl)	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	0.97	0.91	0.91	0.88	0.97	0.88
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	5085	5085	2787	3433	2787
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	5085	2787	3433	2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	516	288	504	282	220	384
RTOR Reduction (vph)	0	0	0	0	0	317
Lane Group Flow (vph)	516	288	504	282	220	67
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	15.4	36.4	15.0	15.0	10.2	10.2
Effective Green, g (s)	15.4	36.4	15.0	15.0	10.2	10.2
Actuated g/C Ratio	0.26	0.62	0.26	0.26	0.17	0.17
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)	902	3159	1302	713	598	485
v/s Ratio Prot	c0.15	0.06	0.10		c0.06	
v/s Ratio Perm				c0.10		0.02
v/c Ratio	0.57	0.09	0.39	0.40	0.37	0.14
Uniform Delay, d1	18.7	4.5	18.0	18.0	21.4	20.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.0	0.2	0.4	0.4	0.1
Delay (s)	19.6	4.5	18.2	18.4	21.7	20.6
Level of Service	B	A	B	B	C	C
Approach Delay (s)		14.2	18.3		21.0	
Approach LOS		B	B		C	

Intersection Summary			
HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	58.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	43.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	6	302	677	7	5	4
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)	7	328	736	8	5	4
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	743				1077	736
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	743				1077	736
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				98	99
cM capacity (veh/h)	864				241	419

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	7	328	736	8	5	4
Volume Left	7	0	0	0	5	0
Volume Right	0	0	0	8	0	4
cSH	864	1700	1700	1700	241	419
Volume to Capacity	0.01	0.19	0.43	0.00	0.02	0.01
Queue Length 95th (ft)	1	0	0	0	2	1
Control Delay (s)	9.2	0.0	0.0	0.0	20.3	13.7
Lane LOS	A				C	B
Approach Delay (s)	0.2		0.0		17.4	
Approach LOS					C	

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	45.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
7: Kapolei Parkway & Kamaaha Avenue

Total 2013 with project
PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	37	404	32	112	391	218	21	70	56	121	75	22
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.95		1.00	0.93		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5029		1770	4812		1770	1738		1770	1799	
Flt Permitted	0.95	1.00		0.95	1.00		0.69	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5029		1770	4812		1283	1738		1770	1799	
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)	40	439	35	122	425	237	23	76	61	132	82	24
RTOR Reduction (vph)	0	6	0	0	72	0	0	20	0	0	7	0
Lane Group Flow (vph)	40	468	0	122	590	0	23	117	0	132	99	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	4.5	16.2		11.0	22.7		11.0	11.0		11.4	27.4	
Effective Green, g (s)	4.5	16.2		11.0	22.7		11.0	11.0		11.4	27.4	
Actuated g/C Ratio	0.06	0.23		0.15	0.32		0.15	0.15		0.16	0.38	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	111	1138		272	1526		197	267		282	688	
v/s Ratio Prot	0.02	0.09		c0.07	c0.12			c0.07		c0.07	0.05	
v/s Ratio Perm							0.02					
v/c Ratio	0.36	0.41		0.45	0.39		0.12	0.44		0.47	0.14	
Uniform Delay, d1	32.2	23.6		27.5	19.0		26.1	27.5		27.3	14.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.0	0.2		1.2	0.2		0.3	1.1		1.2	0.1	
Delay (s)	34.2	23.9		28.7	19.2		26.4	28.6		28.6	14.5	
Level of Service	C	C		C	B		C	C		C	B	
Approach Delay (s)		24.7			20.7			28.3			22.3	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM Average Control Delay	22.8	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.45			
Actuated Cycle Length (s)	71.6	Sum of lost time (s)	22.0	
Intersection Capacity Utilization	47.9%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
10: Kapolei Parkway & Kinoiki Street

Total 2013 with project
PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	71	384	121	245	527	100	126	34	256	104	33	54
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	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	3433	1863	1583	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)	77	417	132	266	573	109	137	37	278	113	36	59
RTOR Reduction (vph)	0	0	104	0	0	78	0	0	246	0	0	51
Lane Group Flow (vph)	77	417	28	266	573	31	137	37	32	113	36	8
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	7.4	14.6	14.6	12.1	19.3	19.3	8.6	7.8	7.8	10.3	9.5	9.5
Effective Green, g (s)	7.4	14.6	14.6	12.1	19.3	19.3	8.6	7.8	7.8	10.3	9.5	9.5
Actuated g/C Ratio	0.11	0.21	0.21	0.18	0.28	0.28	0.12	0.11	0.11	0.15	0.14	0.14
Clearance Time (s)	6.0	6.0	6.0	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	3.0	3.0	3.0
Lane Grp Cap (vph)	190	1079	336	604	1426	444	429	211	179	265	257	219
v/s Ratio Prot	0.04	0.08		c0.08	c0.11		0.04	0.02		c0.06	0.02	
v/s Ratio Perm			0.02			0.02			c0.02			0.01
v/c Ratio	0.41	0.39	0.08	0.44	0.40	0.07	0.32	0.18	0.18	0.43	0.14	0.04
Uniform Delay, d1	28.6	23.3	21.7	25.3	20.1	18.2	27.4	27.6	27.6	26.6	26.1	25.7
Progression Factor	1.00	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	1.4	0.2	0.1	0.5	0.2	0.1	0.4	0.4	0.5	1.1	0.3	0.1
Delay (s)	30.1	23.5	21.8	25.8	20.3	18.2	27.9	28.0	28.1	27.7	26.3	25.8
Level of Service	C	C	C	C	C	B	C	C	C	C	C	C
Approach Delay (s)		23.9			21.6			28.0			26.9	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM Average Control Delay	24.0	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.41			
Actuated Cycle Length (s)	68.8	Sum of lost time (s)	24.0	
Intersection Capacity Utilization	44.0%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	149	536	15	27	398	141	19	133	71	138	71	121
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5065		1770	4886		1770	1766		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.71	1.00		0.55	1.00	1.00
Satd. Flow (perm)	1770	5065		1770	4886		1317	1766		1031	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)	162	583	16	29	433	153	21	145	77	150	77	132
RTOR Reduction (vph)	0	2	0	0	45	0	0	14	0	0	0	98
Lane Group Flow (vph)	162	597	0	29	541	0	21	208	0	150	77	34
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	12.2	28.6		2.5	18.9		16.6	16.6		16.6	16.6	16.6
Effective Green, g (s)	12.2	28.6		2.5	18.9		16.6	16.6		16.6	16.6	16.6
Actuated g/C Ratio	0.19	0.44		0.04	0.29		0.26	0.26		0.26	0.26	0.26
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	334	2239		68	1427		338	453		265	478	406
v/s Ratio Prot	c0.09	0.12		0.02	c0.11			0.12			0.04	
v/s Ratio Perm							0.02			c0.15		0.02
v/c Ratio	0.49	0.27		0.43	0.38		0.06	0.46		0.57	0.16	0.08
Uniform Delay, d1	23.4	11.4		30.4	18.2		18.2	20.3		20.9	18.7	18.3
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.1	0.1		4.3	0.2		0.1	0.7		2.8	0.2	0.1
Delay (s)	24.6	11.5		34.7	18.4		18.2	21.0		23.7	18.8	18.4
Level of Service	C	B		C	B		B	C		C	B	B
Approach Delay (s)		14.3			19.2			20.8			20.7	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	64.7	Sum of lost time (s)	17.0
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	432	322	318	250	390	565
Ideal Flow (vphpl)	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	0.97	0.91	0.91	0.88	0.97	0.88
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	5085	5085	2787	3433	2787
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	5085	2787	3433	2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	470	350	346	272	424	614
RTOR Reduction (vph)	0	0	0	0	0	457
Lane Group Flow (vph)	470	350	346	272	424	157
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	15.5	35.6	14.1	14.1	16.3	16.3
Effective Green, g (s)	15.5	35.6	14.1	14.1	16.3	16.3
Actuated g/C Ratio	0.24	0.56	0.22	0.22	0.26	0.26
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)	833	2833	1122	615	876	711
v/s Ratio Prot	c0.14	0.07	0.07		c0.12	
v/s Ratio Perm				c0.10		0.06
v/c Ratio	0.56	0.12	0.31	0.44	0.48	0.22
Uniform Delay, d1	21.2	6.7	20.8	21.5	20.2	18.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.0	0.2	0.5	0.4	0.2
Delay (s)	22.1	6.7	21.0	22.0	20.6	18.9
Level of Service	C	A	C	C	C	B
Approach Delay (s)		15.6	21.4		19.6	
Approach LOS		B	C		B	

Intersection Summary			
HCM Average Control Delay	18.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	63.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	44.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
35: Roosevelt Avenue & West Entrance

Total 2013 with project
PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	38	789	458	29	42	27
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)	41	858	498	32	46	29
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	529				1438	498
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	529				1438	498
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				68	95
cM capacity (veh/h)	1038				141	572

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	41	858	498	32	46	29
Volume Left	41	0	0	0	46	0
Volume Right	0	0	0	32	0	29
cSH	1038	1700	1700	1700	141	572
Volume to Capacity	0.04	0.50	0.29	0.02	0.32	0.05
Queue Length 95th (ft)	3	0	0	0	32	4
Control Delay (s)	8.6	0.0	0.0	0.0	42.4	11.6
Lane LOS	A				E	B
Approach Delay (s)	0.4		0.0		30.3	
Approach LOS					D	

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	51.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
7: Kapolei Parkway & Kamaaha Avenue

2015 background without NS extension
AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	83	317	101	108	437	140	107	241	164	161	211	83
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.96		1.00	0.94		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4901		1770	4900		1770	1750		1770	1784	
Flt Permitted	0.95	1.00		0.95	1.00		0.57	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4901		1770	4900		1056	1750		1770	1784	
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)	90	345	110	117	475	152	116	262	178	175	229	90
RTOR Reduction (vph)	0	36	0	0	35	0	0	18	0	0	12	0
Lane Group Flow (vph)	90	419	0	117	592	0	116	422	0	175	307	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	9.1	18.2		12.8	21.9		32.1	32.1		16.2	53.3	
Effective Green, g (s)	9.1	18.2		12.8	21.9		32.1	32.1		16.2	53.3	
Actuated g/C Ratio	0.09	0.18		0.13	0.22		0.32	0.32		0.16	0.53	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	159	881		224	1059		335	555		283	939	
v/s Ratio Prot	0.05	0.09		c0.07	c0.12			c0.24		c0.10	0.17	
v/s Ratio Perm							0.11					
v/c Ratio	0.57	0.48		0.52	0.56		0.35	0.76		0.62	0.33	
Uniform Delay, d1	44.2	37.3		41.4	35.4		26.5	31.1		39.7	13.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.6	0.4		2.2	0.6		0.6	5.9		4.0	0.2	
Delay (s)	48.8	37.7		43.6	36.0		27.2	37.1		43.7	13.9	
Level of Service	D	D		D	D		C	D		D	B	
Approach Delay (s)		39.5			37.2			35.0			24.5	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	34.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	101.3	Sum of lost time (s)	22.0
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	87	554	648	102	136	98
Ideal Flow (vphpl)	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	0.91	0.91	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)	1770	5085	5085	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	5085	5085	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	95	602	704	111	148	107
RTOR Reduction (vph)	0	0	0	77	0	84
Lane Group Flow (vph)	95	602	704	34	148	23
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	7.0	29.3	16.3	16.3	11.3	11.3
Effective Green, g (s)	7.0	29.3	16.3	16.3	11.3	11.3
Actuated g/C Ratio	0.13	0.56	0.31	0.31	0.21	0.21
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)	236	2833	1576	491	380	340
v/s Ratio Prot	c0.05	0.12	c0.14		c0.08	
v/s Ratio Perm				0.02		0.01
v/c Ratio	0.40	0.21	0.45	0.07	0.39	0.07
Uniform Delay, d1	20.9	5.9	14.5	12.8	17.7	16.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.1	0.0	0.2	0.1	0.7	0.1
Delay (s)	22.0	5.9	14.7	12.9	18.4	16.5
Level of Service	C	A	B	B	B	B
Approach Delay (s)		8.1	14.5		17.6	
Approach LOS		A	B		B	

Intersection Summary			
HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	52.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	39.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	129	316	16	57	523	377	12	71	19	271	129	175
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.94		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5049		1770	4766		1770	1803		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.67	1.00		0.69	1.00	1.00
Satd. Flow (perm)	1770	5049		1770	4766		1244	1803		1292	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)	140	343	17	62	568	410	13	77	21	295	140	190
RTOR Reduction (vph)	0	4	0	0	95	0	0	7	0	0	0	129
Lane Group Flow (vph)	140	356	0	62	883	0	13	91	0	295	140	61
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	13.4	34.9		7.1	28.6		27.6	27.6		27.6	27.6	27.6
Effective Green, g (s)	13.4	34.9		7.1	28.6		27.6	27.6		27.6	27.6	27.6
Actuated g/C Ratio	0.15	0.40		0.08	0.33		0.32	0.32		0.32	0.32	0.32
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	274	2035		145	1574		396	575		412	594	505
v/s Ratio Prot	c0.08	0.07		0.04	c0.19			0.05			0.08	
v/s Ratio Perm							0.01			c0.23		0.04
v/c Ratio	0.51	0.18		0.43	0.56		0.03	0.16		0.72	0.24	0.12
Uniform Delay, d1	33.6	16.6		37.8	23.8		20.3	21.2		26.0	21.7	20.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.6	0.0		2.0	0.5		0.0	0.1		5.8	0.2	0.1
Delay (s)	35.2	16.6		39.8	24.3		20.3	21.3		31.9	21.9	21.0
Level of Service	D	B		D	C		C	C		C	C	C
Approach Delay (s)		21.8			25.2			21.2			26.3	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	86.6	Sum of lost time (s)	17.0
Intersection Capacity Utilization	61.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	446	267	473	267	216	308
Ideal Flow (vphpl)	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	0.97	0.91	0.91	0.88	0.97	0.88
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	5085	5085	2787	3433	2787
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	5085	2787	3433	2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	485	290	514	290	235	335
RTOR Reduction (vph)	0	0	0	0	0	275
Lane Group Flow (vph)	485	290	514	290	235	60
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	14.8	36.2	15.4	15.4	10.6	10.6
Effective Green, g (s)	14.8	36.2	15.4	15.4	10.6	10.6
Actuated g/C Ratio	0.25	0.62	0.26	0.26	0.18	0.18
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)	864	3131	1332	730	619	502
v/s Ratio Prot	c0.14	0.06	0.10		c0.07	
v/s Ratio Perm				c0.10		0.02
v/c Ratio	0.56	0.09	0.39	0.40	0.38	0.12
Uniform Delay, d1	19.2	4.6	17.8	17.9	21.2	20.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.8	0.0	0.2	0.4	0.4	0.1
Delay (s)	20.0	4.6	18.0	18.2	21.6	20.3
Level of Service	C	A	B	B	C	C
Approach Delay (s)		14.3	18.1		20.8	
Approach LOS		B	B		C	

Intersection Summary			
HCM Average Control Delay	17.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	58.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	43.0%	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 (vph)	38	338	33	115	316	223	21	71	57	123	77	22
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.93		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5017		1770	4770		1770	1738		1770	1801	
Flt Permitted	0.95	1.00		0.95	1.00		0.69	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5017		1770	4770		1280	1738		1770	1801	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	41	367	36	125	343	242	23	77	62	134	84	24
RTOR Reduction (vph)	0	9	0	0	93	0	0	20	0	0	7	0
Lane Group Flow (vph)	41	394	0	125	492	0	23	119	0	134	101	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	4.5	14.6		11.0	21.1		10.9	10.9		11.4	27.3	
Effective Green, g (s)	4.5	14.6		11.0	21.1		10.9	10.9		11.4	27.3	
Actuated g/C Ratio	0.06	0.21		0.16	0.30		0.16	0.16		0.16	0.39	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	114	1048		279	1440		200	271		289	703	
v/s Ratio Prot	0.02	0.08		c0.07	c0.10			c0.07		c0.08	0.06	
v/s Ratio Perm							0.02					
v/c Ratio	0.36	0.38		0.45	0.34		0.12	0.44		0.46	0.14	
Uniform Delay, d1	31.3	23.7		26.7	19.0		25.4	26.7		26.5	13.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.9	0.2		1.1	0.1		0.3	1.1		1.2	0.1	
Delay (s)	33.3	24.0		27.8	19.1		25.6	27.9		27.7	13.8	
Level of Service	C	C		C	B		C	C		C	B	
Approach Delay (s)		24.8			20.7			27.5			21.5	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	22.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	69.9	Sum of lost time (s)	22.0
Intersection Capacity Utilization	46.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	72	451	600	101	106	55
Ideal Flow (vphpl)	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	0.91	0.91	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)	1770	5085	5085	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	5085	5085	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	78	490	652	110	115	60
RTOR Reduction (vph)	0	0	0	77	0	48
Lane Group Flow (vph)	78	490	652	33	115	12
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	6.3	26.8	14.5	14.5	9.7	9.7
Effective Green, g (s)	6.3	26.8	14.5	14.5	9.7	9.7
Actuated g/C Ratio	0.13	0.55	0.30	0.30	0.20	0.20
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)	230	2810	1520	473	354	317
v/s Ratio Prot	c0.04	0.10	c0.13		c0.06	
v/s Ratio Perm				0.02		0.01
v/c Ratio	0.34	0.17	0.43	0.07	0.32	0.04
Uniform Delay, d1	19.2	5.4	13.7	12.2	16.6	15.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.0	0.2	0.1	0.5	0.0
Delay (s)	20.1	5.4	13.9	12.2	17.1	15.7
Level of Service	C	A	B	B	B	B
Approach Delay (s)		7.4	13.6		16.6	
Approach LOS		A	B		B	

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	48.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	36.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	139	512	16	27	372	144	19	136	73	141	73	113
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5063		1770	4872		1770	1766		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.71	1.00		0.55	1.00	1.00
Satd. Flow (perm)	1770	5063		1770	4872		1314	1766		1028	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)	151	557	17	29	404	157	21	148	79	153	79	123
RTOR Reduction (vph)	0	2	0	0	49	0	0	14	0	0	0	91
Lane Group Flow (vph)	151	572	0	29	512	0	21	213	0	153	79	32
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	11.7	27.3		2.5	18.1		16.6	16.6		16.6	16.6	16.6
Effective Green, g (s)	11.7	27.3		2.5	18.1		16.6	16.6		16.6	16.6	16.6
Actuated g/C Ratio	0.18	0.43		0.04	0.29		0.26	0.26		0.26	0.26	0.26
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	327	2180		70	1391		344	462		269	488	414
v/s Ratio Prot	c0.09	0.11		0.02	c0.11			0.12			0.04	
v/s Ratio Perm							0.02			c0.15		0.02
v/c Ratio	0.46	0.26		0.41	0.37		0.06	0.46		0.57	0.16	0.08
Uniform Delay, d1	23.0	11.6		29.7	18.1		17.6	19.6		20.3	18.0	17.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.0	0.1		3.9	0.2		0.1	0.7		2.7	0.2	0.1
Delay (s)	24.1	11.7		33.7	18.2		17.6	20.4		23.0	18.2	17.7
Level of Service	C	B		C	B		B	C		C	B	B
Approach Delay (s)		14.2			19.0			20.1			20.1	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	63.4	Sum of lost time (s)	17.0
Intersection Capacity Utilization	55.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — 2015 background without NS extension
28: Kapolei Parkway & Kualakai Parkway
PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	291	271	271	266	402	430
Ideal Flow (vphpl)	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	0.97	0.91	0.91	0.88	0.97	0.88
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	5085	5085	2787	3433	2787
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	5085	2787	3433	2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	316	295	295	289	437	467
RTOR Reduction (vph)	0	0	0	0	0	343
Lane Group Flow (vph)	316	295	295	289	437	124
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		1	
Permitted Phases				8		1
Actuated Green, G (s)	11.5	31.1	13.6	13.6	15.5	15.5
Effective Green, g (s)	11.5	31.1	13.6	13.6	15.5	15.5
Actuated g/C Ratio	0.20	0.53	0.23	0.23	0.26	0.26
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)	674	2699	1180	647	908	737
v/s Ratio Prot	c0.09	0.06	0.06		c0.13	
v/s Ratio Perm				c0.10		0.04
v/c Ratio	0.47	0.11	0.25	0.45	0.48	0.17
Uniform Delay, d1	20.8	6.8	18.3	19.3	18.2	16.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.0	0.1	0.5	0.4	0.1
Delay (s)	21.4	6.9	18.5	19.8	18.6	16.7
Level of Service	C	A	B	B	B	B
Approach Delay (s)		14.4	19.1		17.6	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	58.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	40.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — Total 2015 without NS extension with project
7: Kapolei Parkway & Kamaaha Avenue
AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	83	498	101	108	519	140	107	241	164	161	211	83
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.97		1.00	0.94		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4956		1770	4923		1770	1750		1770	1784	
Flt Permitted	0.95	1.00		0.95	1.00		0.57	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4956		1770	4923		1056	1750		1770	1784	
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)	90	541	110	117	564	152	116	262	178	175	229	90
RTOR Reduction (vph)	0	19	0	0	29	0	0	19	0	0	12	0
Lane Group Flow (vph)	90	632	0	117	687	0	116	421	0	175	307	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	9.3	22.2		12.7	25.6		32.1	32.1		16.1	53.2	
Effective Green, g (s)	9.3	22.2		12.7	25.6		32.1	32.1		16.1	53.2	
Actuated g/C Ratio	0.09	0.21		0.12	0.24		0.31	0.31		0.15	0.51	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	157	1047		214	1199		323	534		271	903	
v/s Ratio Prot	0.05	0.13		c0.07	c0.14			c0.24		c0.10	0.17	
v/s Ratio Perm							0.11					
v/c Ratio	0.57	0.60		0.55	0.57		0.36	0.79		0.65	0.34	
Uniform Delay, d1	46.0	37.5		43.5	34.9		28.5	33.4		41.8	15.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.0	1.0		2.8	0.7		0.7	7.6		5.2	0.2	
Delay (s)	51.0	38.5		46.3	35.6		29.2	41.0		47.0	15.7	
Level of Service	D	D		D	D		C	D		D	B	
Approach Delay (s)		40.0			37.1			38.5			26.8	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	36.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	105.1	Sum of lost time (s)	22.0
Intersection Capacity Utilization	67.8%	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 (vph)	87	554	181	65	648	102	82	31	69	136	68	98
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	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	3433	1863	1583	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)	95	602	197	71	704	111	89	34	75	148	74	107
RTOR Reduction (vph)	0	0	139	0	0	82	0	0	66	0	0	84
Lane Group Flow (vph)	95	602	58	71	704	29	89	34	9	148	74	23
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	8.0	21.4	21.4	5.6	19.0	19.0	6.0	9.2	9.2	12.5	15.7	15.7
Effective Green, g (s)	8.0	21.4	21.4	5.6	19.0	19.0	6.0	9.2	9.2	12.5	15.7	15.7
Actuated g/C Ratio	0.11	0.29	0.29	0.08	0.26	0.26	0.08	0.13	0.13	0.17	0.22	0.22
Clearance Time (s)	6.0	6.0	6.0	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	3.0	3.0	3.0
Lane Grp Cap (vph)	195	1497	466	264	1329	414	283	236	200	304	402	342
v/s Ratio Prot	c0.05	0.12		0.02	c0.14		0.03	0.02		c0.08	c0.04	
v/s Ratio Perm			0.04			0.02			0.01			0.01
v/c Ratio	0.49	0.40	0.12	0.27	0.53	0.07	0.31	0.14	0.05	0.49	0.18	0.07
Uniform Delay, d1	30.4	20.5	18.8	31.6	23.0	20.2	31.4	28.2	27.9	27.2	23.3	22.7
Progression Factor	1.00	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	0.1	0.6	0.4	0.1	0.6	0.3	0.1	1.2	0.2	0.1
Delay (s)	32.3	20.7	18.9	32.2	23.4	20.3	32.1	28.5	28.0	28.4	23.5	22.8
Level of Service	C	C	B	C	C	C	C	C	C	C	C	C
Approach Delay (s)		21.5			23.7			29.9			25.5	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	23.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	72.7	Sum of lost time (s)	18.0
Intersection Capacity Utilization	46.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	141	365	16	57	632	377	12	71	19	271	129	202
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.94		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5054		1770	4800		1770	1803		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.66	1.00		0.69	1.00	1.00
Satd. Flow (perm)	1770	5054		1770	4800		1225	1803		1292	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)	153	397	17	62	687	410	13	77	21	295	140	220
RTOR Reduction (vph)	0	3	0	0	76	0	0	7	0	0	0	151
Lane Group Flow (vph)	153	411	0	62	1021	0	13	91	0	295	140	69
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	14.4	40.5		7.2	33.3		29.7	29.7		29.7	29.7	29.7
Effective Green, g (s)	14.4	40.5		7.2	33.3		29.7	29.7		29.7	29.7	29.7
Actuated g/C Ratio	0.15	0.43		0.08	0.35		0.31	0.31		0.31	0.31	0.31
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	270	2168		135	1693		385	567		406	586	498
v/s Ratio Prot	c0.09	0.08		0.04	c0.21			0.05			0.08	
v/s Ratio Perm							0.01			c0.23		0.04
v/c Ratio	0.57	0.19		0.46	0.60		0.03	0.16		0.73	0.24	0.14
Uniform Delay, d1	37.1	16.7		41.7	25.1		22.4	23.4		28.7	24.0	23.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.7	0.0		2.5	0.6		0.0	0.1		6.4	0.2	0.1
Delay (s)	39.8	16.8		44.2	25.7		22.4	23.5		35.1	24.2	23.3
Level of Service	D	B		D	C		C	C		D	C	C
Approach Delay (s)		23.0			26.7			23.4			28.8	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	26.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	94.4	Sum of lost time (s)	17.0
Intersection Capacity Utilization	64.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis Total 2015 without NS extension with project
28: Kapolei Parkway & Kualakai Parkway

AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	466	316	0	116	493	267	216	256	353	0	155	12
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	0.97	0.91		0.97	0.91	0.88	0.97	0.95	0.88		0.95	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85		0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)	3433	5085		3433	5085	2787	3433	3539	2787		3501	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (perm)	3433	5085		3433	5085	2787	3433	3539	2787		3501	
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)	507	343	0	126	536	290	235	278	384	0	168	13
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	253	0	4	0
Lane Group Flow (vph)	507	343	0	126	536	290	235	278	131	0	177	0
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		
Protected Phases	7	4		3	8		1	6		5		
Permitted Phases						8			6		2	
Actuated Green, G (s)	19.0	27.8		9.1	17.9	17.9	11.9	28.5	28.5		10.6	
Effective Green, g (s)	19.0	27.8		9.1	17.9	17.9	11.9	28.5	28.5		10.6	
Actuated g/C Ratio	0.23	0.33		0.11	0.21	0.21	0.14	0.34	0.34		0.13	
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)	782	1695		375	1091	598	490	1209	952		445	
v/s Ratio Prot	c0.15	0.07		0.04	c0.11		c0.07	0.08				
v/s Ratio Perm						0.10			0.05		c0.05	
v/c Ratio	0.65	0.20		0.34	0.49	0.48	0.48	0.23	0.14		0.40	
Uniform Delay, d1	29.2	19.9		34.4	28.8	28.7	32.9	19.6	19.0		33.5	
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	0.1		0.5	0.4	0.6	0.7	0.1	0.1		0.6	
Delay (s)	31.0	19.9		34.9	29.1	29.3	33.6	19.7	19.0		34.0	
Level of Service	C	B		C	C	C	C	B	B		C	
Approach Delay (s)		26.6			29.9			23.1			34.0	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	27.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	83.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	53.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis Total 2015 without NS extension with project
36: Roosevelt Avenue & West Entrance

AM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	3	308	691	4	2	1
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)	3	335	751	4	2	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			503			
pX, platoon unblocked	0.63				0.63	0.63
vC, conflicting volume	755				1092	751
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	317				852	310
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	782				207	460

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	3	335	751	4	2	1
Volume Left	3	0	0	0	2	0
Volume Right	0	0	0	4	0	1
cSH	782	1700	1700	1700	207	460
Volume to Capacity	0.00	0.20	0.44	0.00	0.01	0.00
Queue Length 95th (ft)	0	0	0	0	1	0
Control Delay (s)	9.6	0.0	0.0	0.0	22.6	12.9
Lane LOS	A				C	B
Approach Delay (s)	0.1		0.0		19.4	
Approach LOS					C	

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	46.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	27	310	695	34	15	13
Ideal Flow (vphpl)	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	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)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	337	755	37	16	14
RTOR Reduction (vph)	0	0	0	18	0	12
Lane Group Flow (vph)	29	337	755	19	16	2
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		6	
Permitted Phases				8		6
Actuated Green, G (s)	2.2	38.0	29.8	29.8	6.8	6.8
Effective Green, g (s)	2.2	38.0	29.8	29.8	6.8	6.8
Actuated g/C Ratio	0.04	0.67	0.52	0.52	0.12	0.12
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)	69	1246	977	831	212	190
v/s Ratio Prot	0.02	c0.18	c0.41		c0.01	
v/s Ratio Perm				0.01		0.00
v/c Ratio	0.42	0.27	0.77	0.02	0.08	0.01
Uniform Delay, d1	26.7	3.8	10.8	6.5	22.2	22.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.1	0.1	3.9	0.0	0.2	0.0
Delay (s)	30.8	3.9	14.6	6.5	22.4	22.0
Level of Service	C	A	B	A	C	C
Approach Delay (s)		6.0	14.3		22.2	
Approach LOS		A	B		C	

Intersection Summary			
HCM Average Control Delay	11.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	56.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	49.9%	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 (vph)	38	640	33	115	665	223	21	71	57	123	77	22
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.96		1.00	0.93		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5048		1770	4894		1770	1738		1770	1801	
Flt Permitted	0.95	1.00		0.95	1.00		0.69	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5048		1770	4894		1280	1738		1770	1801	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	41	696	36	125	723	242	23	77	62	134	84	24
RTOR Reduction (vph)	0	4	0	0	40	0	0	21	0	0	8	0
Lane Group Flow (vph)	41	728	0	125	925	0	23	118	0	134	100	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	4.7	23.0		11.9	30.2		11.8	11.8		12.3	29.1	
Effective Green, g (s)	4.7	23.0		11.9	30.2		11.8	11.8		12.3	29.1	
Actuated g/C Ratio	0.06	0.28		0.15	0.37		0.15	0.15		0.15	0.36	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	103	1433		260	1825		186	253		269	647	
v/s Ratio Prot	0.02	0.14		c0.07	c0.19			c0.07		c0.08	0.06	
v/s Ratio Perm							0.02					
v/c Ratio	0.40	0.51		0.48	0.51		0.12	0.47		0.50	0.16	
Uniform Delay, d1	36.8	24.3		31.7	19.6		30.1	31.7		31.5	17.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.5	0.3		1.4	0.2		0.3	1.4		1.5	0.1	
Delay (s)	39.3	24.6		33.1	19.9		30.4	33.1		33.0	17.7	
Level of Service	D	C		C	B		C	C		C	B	
Approach Delay (s)		25.3			21.4			32.7			26.2	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	81.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	53.5%	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 (vph)	72	415	338	119	524	101	420	130	314	106	113	55
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	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	3433	1863	1583	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)	78	451	367	129	570	110	457	141	341	115	123	60
RTOR Reduction (vph)	0	0	280	0	0	83	0	0	268	0	0	51
Lane Group Flow (vph)	78	451	87	129	570	27	457	141	73	115	123	9
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	7.9	19.0	19.0	9.0	20.1	20.1	17.0	17.2	17.2	11.3	11.5	11.5
Effective Green, g (s)	7.9	19.0	19.0	9.0	20.1	20.1	17.0	17.2	17.2	11.3	11.5	11.5
Actuated g/C Ratio	0.10	0.24	0.24	0.11	0.25	0.25	0.21	0.21	0.21	0.14	0.14	0.14
Clearance Time (s)	6.0	6.0	6.0	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	3.0	3.0	3.0
Lane Grp Cap (vph)	174	1200	374	384	1270	395	725	398	338	248	266	226
v/s Ratio Prot	c0.04	0.09		0.04	c0.11		c0.13	c0.08		0.06	c0.07	
v/s Ratio Perm			0.05			0.02			0.05			0.01
v/c Ratio	0.45	0.38	0.23	0.34	0.45	0.07	0.63	0.35	0.22	0.46	0.46	0.04
Uniform Delay, d1	34.2	25.8	24.9	33.0	25.5	23.1	28.9	26.9	26.1	31.8	31.7	29.7
Progression Factor	1.00	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	1.8	0.2	0.3	0.5	0.3	0.1	1.8	0.5	0.3	1.4	1.3	0.1
Delay (s)	36.1	26.0	25.2	33.5	25.8	23.1	30.7	27.5	26.4	33.2	32.9	29.8
Level of Service	D	C	C	C	C	C	C	C	C	C	C	C
Approach Delay (s)		26.5			26.6			28.6			32.4	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	27.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	80.5	Sum of lost time (s)	24.0
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	191	723	16	27	554	114	19	136	73	141	73	158
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	0.97		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5069		1770	4955		1770	1766		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.71	1.00		0.52	1.00	1.00
Satd. Flow (perm)	1770	5069		1770	4955		1314	1766		963	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)	208	786	17	29	602	124	21	148	79	153	79	172
RTOR Reduction (vph)	0	2	0	0	21	0	0	14	0	0	0	128
Lane Group Flow (vph)	208	801	0	29	705	0	21	213	0	153	79	44
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	15.3	36.6		2.5	23.8		19.1	19.1		19.1	19.1	19.1
Effective Green, g (s)	15.3	36.6		2.5	23.8		19.1	19.1		19.1	19.1	19.1
Actuated g/C Ratio	0.20	0.49		0.03	0.32		0.25	0.25		0.25	0.25	0.25
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	360	2467		59	1568		334	449		245	473	402
v/s Ratio Prot	c0.12	0.16		0.02	c0.14			0.12			0.04	
v/s Ratio Perm							0.02			c0.16		0.03
v/c Ratio	0.58	0.32		0.49	0.45		0.06	0.47		0.62	0.17	0.11
Uniform Delay, d1	27.0	11.8		35.7	20.5		21.3	23.8		24.9	21.9	21.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.2	0.1		6.3	0.2		0.1	0.8		4.9	0.2	0.1
Delay (s)	29.3	11.8		42.0	20.7		21.3	24.6		29.8	22.0	21.6
Level of Service	C	B		D	C		C	C		C	C	C
Approach Delay (s)		15.4			21.5			24.3			24.8	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	19.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	75.2	Sum of lost time (s)	17.0
Intersection Capacity Utilization	61.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — Total 2015 without NS extension with project
28: Kapolei Parkway & Kualakai Parkway

PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	378	453	9	229	269	266	357	519	461	19	491	127
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	6.0	
Lane Util. Factor	0.97	0.91		0.97	0.91	0.88	0.97	0.95	0.88	1.00	0.95	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5070		3433	5085	2787	3433	3539	2787	1770	3430	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5070		3433	5085	2787	3433	3539	2787	1770	3430	
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)	411	492	10	249	292	289	388	564	501	21	534	138
RTOR Reduction (vph)	0	2	0	0	0	0	0	0	286	0	16	0
Lane Group Flow (vph)	411	500	0	249	292	289	388	564	215	21	656	0
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		
Protected Phases	7	4		3	8		1	6		5		
Permitted Phases						8			6		2	
Actuated Green, G (s)	19.1	23.7		13.6	18.2	18.2	18.0	48.1	48.1	2.8	32.9	
Effective Green, g (s)	19.1	23.7		13.6	18.2	18.2	18.0	48.1	48.1	2.8	32.9	
Actuated g/C Ratio	0.17	0.21		0.12	0.16	0.16	0.16	0.43	0.43	0.02	0.29	
Clearance Time (s)	6.0	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	3.0	
Lane Grp Cap (vph)	584	1071		416	825	452	551	1517	1195	44	1006	
v/s Ratio Prot	c0.12	c0.10		0.07	0.06		c0.11	0.16		0.01		
v/s Ratio Perm						c0.10			0.08		c0.19	
v/c Ratio	0.70	0.47		0.60	0.35	0.64	0.70	0.37	0.18	0.48	0.65	
Uniform Delay, d1	43.9	38.7		46.7	41.8	43.9	44.6	21.8	19.8	54.0	34.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.8	0.3		2.3	0.3	3.0	4.1	0.2	0.1	7.9	1.5	
Delay (s)	47.7	39.0		49.0	42.0	46.9	48.7	21.9	19.9	61.9	36.2	
Level of Service	D	D		D	D	D	D	C	B	E	D	
Approach Delay (s)		43.0			45.8			28.4			37.0	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM Average Control Delay	37.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	112.2	Sum of lost time (s)	30.0
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis — Total 2015 without NS extension with project
35: Roosevelt Avenue & West Entrance

PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	5	768	448	6	7	6
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)	5	835	487	7	8	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			564			
pX, platoon unblocked	0.82				0.82	0.82
vC, conflicting volume	493				1333	487
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	266				1295	258
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				95	99
cM capacity (veh/h)	1059				145	637

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	5	835	487	7	8	7
Volume Left	5	0	0	0	8	0
Volume Right	0	0	0	7	0	7
cSH	1059	1700	1700	1700	145	637
Volume to Capacity	0.01	0.49	0.29	0.00	0.05	0.01
Queue Length 95th (ft)	0	0	0	0	4	1
Control Delay (s)	8.4	0.0	0.0	0.0	31.1	10.7
Lane LOS	A				D	B
Approach Delay (s)	0.1		0.0		21.7	
Approach LOS					C	

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	50.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis — Total 2015 without NS extension with project
39: Roosevelt Avenue & East Entrance
PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	115	775	454	87	128	84
Ideal Flow (vphpl)	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	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)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	125	842	493	95	139	91
RTOR Reduction (vph)	0	0	0	58	0	75
Lane Group Flow (vph)	125	842	493	37	139	16
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		6	
Permitted Phases				8		6
Actuated Green, G (s)	11.0	43.4	26.4	26.4	11.6	11.6
Effective Green, g (s)	11.0	43.4	26.4	26.4	11.6	11.6
Actuated g/C Ratio	0.16	0.65	0.39	0.39	0.17	0.17
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)	291	1207	734	624	306	274
v/s Ratio Prot	0.07	c0.45	0.26		c0.08	
v/s Ratio Perm				0.02		0.01
v/c Ratio	0.43	0.70	0.67	0.06	0.45	0.06
Uniform Delay, d1	25.2	7.6	16.7	12.6	24.9	23.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	1.8	2.4	0.0	1.1	0.1
Delay (s)	26.2	9.4	19.2	12.6	25.9	23.2
Level of Service	C	A	B	B	C	C
Approach Delay (s)		11.5	18.1		24.9	
Approach LOS		B	B		C	

Intersection Summary			
HCM Average Control Delay	15.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	67.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — Total 2015 with NS extension with project
7: Kapolei Parkway & Kamaaha Avenue
AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	83	471	101	108	491	140	107	241	164	161	211	83
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.97		1.00	0.94		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4950		1770	4916		1770	1750		1770	1784	
Flt Permitted	0.95	1.00		0.95	1.00		0.57	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4950		1770	4916		1056	1750		1770	1784	
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)	90	512	110	117	534	152	116	262	178	175	229	90
RTOR Reduction (vph)	0	21	0	0	31	0	0	19	0	0	12	0
Lane Group Flow (vph)	90	601	0	117	655	0	116	421	0	175	307	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	9.2	20.9		12.7	24.4		32.2	32.2		16.1	53.3	
Effective Green, g (s)	9.2	20.9		12.7	24.4		32.2	32.2		16.1	53.3	
Actuated g/C Ratio	0.09	0.20		0.12	0.23		0.31	0.31		0.15	0.51	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	157	996		216	1154		327	542		274	915	
v/s Ratio Prot	0.05	0.12		c0.07	c0.13			c0.24		c0.10	0.17	
v/s Ratio Perm							0.11					
v/c Ratio	0.57	0.60		0.54	0.57		0.35	0.78		0.64	0.34	
Uniform Delay, d1	45.5	37.7		42.9	35.1		27.8	32.6		41.2	14.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.0	1.0		2.8	0.6		0.7	6.9		4.8	0.2	
Delay (s)	50.4	38.8		45.6	35.7		28.5	39.5		46.0	15.1	
Level of Service	D	D		D	D		C	D		D	B	
Approach Delay (s)		40.2			37.2			37.2			26.0	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	35.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	103.9	Sum of lost time (s)	22.0
Intersection Capacity Utilization	67.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — Total 2015 with NS extension with project
10: Kapolei Parkway & Kinoiki Street — AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	87	527	181	65	620	102	82	31	69	136	68	98
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	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	3433	1863	1583	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)	95	573	197	71	674	111	89	34	75	148	74	107
RTOR Reduction (vph)	0	0	140	0	0	83	0	0	65	0	0	84
Lane Group Flow (vph)	95	573	57	71	674	28	89	34	10	148	74	23
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	7.9	20.6	20.6	5.6	18.3	18.3	6.0	9.3	9.3	12.3	15.6	15.6
Effective Green, g (s)	7.9	20.6	20.6	5.6	18.3	18.3	6.0	9.3	9.3	12.3	15.6	15.6
Actuated g/C Ratio	0.11	0.29	0.29	0.08	0.25	0.25	0.08	0.13	0.13	0.17	0.22	0.22
Clearance Time (s)	6.0	6.0	6.0	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	3.0	3.0	3.0
Lane Grp Cap (vph)	195	1459	454	268	1296	403	287	241	205	303	405	344
v/s Ratio Prot	c0.05	0.11		0.02	c0.13		0.03	0.02		c0.08	c0.04	
v/s Ratio Perm			0.04			0.02			0.01			0.01
v/c Ratio	0.49	0.39	0.12	0.26	0.52	0.07	0.31	0.14	0.05	0.49	0.18	0.07
Uniform Delay, d1	30.0	20.6	18.9	31.2	23.0	20.3	31.0	27.7	27.4	26.9	22.9	22.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.2	0.1	0.5	0.4	0.1	0.6	0.3	0.1	1.2	0.2	0.1
Delay (s)	32.0	20.7	19.1	31.7	23.4	20.4	31.6	28.0	27.5	28.1	23.1	22.4
Level of Service	C	C	B	C	C	C	C	C	C	C	C	C
Approach Delay (s)		21.6			23.7			29.4			25.1	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	23.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	71.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — Total 2015 with NS extension with project
13: Kapolei Parkway & Renton Road — AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	141	367	16	57	632	377	12	71	19	271	129	202
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.94		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5054		1770	4800		1770	1803		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.66	1.00		0.69	1.00	1.00
Satd. Flow (perm)	1770	5054		1770	4800		1225	1803		1292	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)	153	399	17	62	687	410	13	77	21	295	140	220
RTOR Reduction (vph)	0	3	0	0	76	0	0	7	0	0	0	151
Lane Group Flow (vph)	153	413	0	62	1021	0	13	91	0	295	140	69
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	14.4	40.5		7.2	33.3		29.7	29.7		29.7	29.7	29.7
Effective Green, g (s)	14.4	40.5		7.2	33.3		29.7	29.7		29.7	29.7	29.7
Actuated g/C Ratio	0.15	0.43		0.08	0.35		0.31	0.31		0.31	0.31	0.31
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	270	2168		135	1693		385	567		406	586	498
v/s Ratio Prot	c0.09	0.08		0.04	c0.21			0.05			0.08	
v/s Ratio Perm							0.01			c0.23		0.04
v/c Ratio	0.57	0.19		0.46	0.60		0.03	0.16		0.73	0.24	0.14
Uniform Delay, d1	37.1	16.8		41.7	25.1		22.4	23.4		28.7	24.0	23.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.7	0.0		2.5	0.6		0.0	0.1		6.4	0.2	0.1
Delay (s)	39.8	16.8		44.2	25.7		22.4	23.5		35.1	24.2	23.3
Level of Service	D	B		D	C		C	C		D	C	C
Approach Delay (s)		23.0			26.7			23.4			28.8	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	26.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	94.4	Sum of lost time (s)	17.0
Intersection Capacity Utilization	64.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — Total 2015 with NS extension with project
28: Kapolei Parkway & Kualakai Parkway — AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	466	289	27	163	446	267	195	308	322	50	215	62
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	6.0	
Lane Util. Factor	0.97	0.91		0.97	0.91	0.88	0.97	0.95	0.88	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5021		3433	5085	2787	3433	3539	2787	1770	3421	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5021		3433	5085	2787	3433	3539	2787	1770	3421	
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)	507	314	29	177	485	290	212	335	350	54	234	67
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	271	0	18	0
Lane Group Flow (vph)	507	335	0	177	485	290	212	335	79	54	283	0
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		
Protected Phases	7	4		3	8		1	6		5		
Permitted Phases						8			6		2	
Actuated Green, G (s)	19.5	26.8		10.6	17.9	17.9	11.6	20.0	20.0	7.0	15.4	
Effective Green, g (s)	19.5	26.8		10.6	17.9	17.9	11.6	20.0	20.0	7.0	15.4	
Actuated g/C Ratio	0.22	0.30		0.12	0.20	0.20	0.13	0.23	0.23	0.08	0.17	
Clearance Time (s)	6.0	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	3.0	
Lane Grp Cap (vph)	757	1522		412	1030	564	450	801	631	140	596	
v/s Ratio Prot	c0.15	0.07		0.05	0.10		c0.06	c0.09		0.03		
v/s Ratio Perm						c0.10			0.03		0.08	
v/c Ratio	0.67	0.22		0.43	0.47	0.51	0.47	0.42	0.13	0.39	0.47	
Uniform Delay, d1	31.5	23.0		36.1	31.1	31.4	35.6	29.2	27.2	38.7	32.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.3	0.1		0.7	0.3	0.8	0.8	0.4	0.1	1.8	0.6	
Delay (s)	33.8	23.1		36.8	31.4	32.2	36.3	29.6	27.3	40.4	33.5	
Level of Service	C	C		D	C	C	D	C	C	D	C	
Approach Delay (s)		29.4			32.7			30.3			34.5	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	31.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	88.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	55.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis — Total 2015 with NS extension with project
35: Roosevelt Avenue & West Entrance — AM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	2	370	754	2	1	1
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)	2	402	820	2	1	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			564			
pX, platoon unblocked	0.56				0.56	0.56
vC, conflicting volume	822				1226	820
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	295				1013	291
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	713				148	421

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	2	402	820	2	1	1
Volume Left	2	0	0	0	1	0
Volume Right	0	0	0	2	0	1
cSH	713	1700	1700	1700	148	421
Volume to Capacity	0.00	0.24	0.48	0.00	0.01	0.00
Queue Length 95th (ft)	0	0	0	0	1	0
Control Delay (s)	10.1	0.0	0.0	0.0	29.4	13.6
Lane LOS	B				D	B
Approach Delay (s)	0.1		0.0		21.5	
Approach LOS					C	

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	49.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	77	321	710	157	67	70
Ideal Flow (vphpl)	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	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)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	84	349	772	171	73	76
RTOR Reduction (vph)	0	0	0	78	0	67
Lane Group Flow (vph)	84	349	772	93	73	9
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		6	
Permitted Phases				8		6
Actuated Green, G (s)	7.8	56.2	42.4	42.4	9.6	9.6
Effective Green, g (s)	7.8	56.2	42.4	42.4	9.6	9.6
Actuated g/C Ratio	0.10	0.72	0.54	0.54	0.12	0.12
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)	177	1346	1015	863	218	195
v/s Ratio Prot	c0.05	0.19	c0.41		c0.04	
v/s Ratio Perm				0.06		0.01
v/c Ratio	0.47	0.26	0.76	0.11	0.33	0.05
Uniform Delay, d1	33.1	3.7	13.8	8.6	31.2	30.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.0	0.1	3.4	0.1	0.9	0.1
Delay (s)	35.1	3.8	17.2	8.6	32.1	30.2
Level of Service	D	A	B	A	C	C
Approach Delay (s)		9.9	15.6		31.1	
Approach LOS		A	B		C	

Intersection Summary			
HCM Average Control Delay	15.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	77.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	15	371	756	19	12	6
Ideal Flow (vphpl)	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	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)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	403	822	21	13	7
RTOR Reduction (vph)	0	0	0	10	0	6
Lane Group Flow (vph)	16	403	822	11	13	1
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		6	
Permitted Phases				8		6
Actuated Green, G (s)	0.9	37.7	30.8	30.8	6.6	6.6
Effective Green, g (s)	0.9	37.7	30.8	30.8	6.6	6.6
Actuated g/C Ratio	0.02	0.67	0.55	0.55	0.12	0.12
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)	28	1248	1019	866	207	186
v/s Ratio Prot	0.01	c0.22	c0.44		c0.01	
v/s Ratio Perm				0.01		0.00
v/c Ratio	0.57	0.32	0.81	0.01	0.06	0.00
Uniform Delay, d1	27.5	3.9	10.3	5.8	22.1	21.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	25.2	0.2	4.8	0.0	0.1	0.0
Delay (s)	52.7	4.1	15.1	5.8	22.2	22.0
Level of Service	D	A	B	A	C	C
Approach Delay (s)		5.9	14.9		22.1	
Approach LOS		A	B		C	

Intersection Summary			
HCM Average Control Delay	12.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	56.3	Sum of lost time (s)	18.0
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Volume (vph)	127	16	126	372	34	200
Ideal Flow (vphpl)	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	1.00	1.00	1.00
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	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	138	17	137	404	37	217
RTOR Reduction (vph)	0	14	0	250	0	0
Lane Group Flow (vph)	138	3	137	154	37	217
Turn Type		Perm		Perm	Prot	
Protected Phases	4		6		5	2
Permitted Phases		4		6		
Actuated Green, G (s)	7.3	7.3	17.1	17.1	2.4	25.5
Effective Green, g (s)	7.3	7.3	17.1	17.1	2.4	25.5
Actuated g/C Ratio	0.16	0.16	0.38	0.38	0.05	0.57
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)	288	258	711	604	95	1060
v/s Ratio Prot	c0.08		0.07		0.02	c0.12
v/s Ratio Perm		0.00		c0.10		
v/c Ratio	0.48	0.01	0.19	0.26	0.39	0.20
Uniform Delay, d1	17.0	15.7	9.2	9.5	20.5	4.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3	0.0	0.1	0.2	2.6	0.1
Delay (s)	18.3	15.7	9.4	9.7	23.1	4.8
Level of Service	B	B	A	A	C	A
Approach Delay (s)	18.0		9.6			7.5
Approach LOS	B		A			A

Intersection Summary			
HCM Average Control Delay	10.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	44.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	36.4%	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 (vph)	38	613	33	115	660	223	21	71	57	123	77	22
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		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.96		1.00	0.93		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5046		1770	4893		1770	1738		1770	1801	
Flt Permitted	0.95	1.00		0.95	1.00		0.69	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5046		1770	4893		1280	1738		1770	1801	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	41	666	36	125	717	242	23	77	62	134	84	24
RTOR Reduction (vph)	0	4	0	0	40	0	0	20	0	0	8	0
Lane Group Flow (vph)	41	698	0	125	919	0	23	119	0	134	100	0
Turn Type	Prot			Prot			Perm			Prot		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases							2					
Actuated Green, G (s)	4.7	22.6		11.8	29.7		11.8	11.8		12.2	29.0	
Effective Green, g (s)	4.7	22.6		11.8	29.7		11.8	11.8		12.2	29.0	
Actuated g/C Ratio	0.06	0.28		0.15	0.37		0.15	0.15		0.15	0.36	
Clearance Time (s)	6.0	6.0		6.0	6.0		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	
Lane Grp Cap (vph)	103	1418		260	1807		188	255		269	650	
v/s Ratio Prot	0.02	0.14		c0.07	c0.19			c0.07		c0.08	0.06	
v/s Ratio Perm							0.02					
v/c Ratio	0.40	0.49		0.48	0.51		0.12	0.46		0.50	0.15	
Uniform Delay, d1	36.5	24.1		31.5	19.7		29.8	31.4		31.3	17.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.5	0.3		1.4	0.2		0.3	1.3		1.5	0.1	
Delay (s)	39.0	24.4		32.9	19.9		30.1	32.7		32.7	17.5	
Level of Service	D	C		C	B		C	C		C	B	
Approach Delay (s)		25.2			21.4			32.4			25.9	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	80.4	Sum of lost time (s)	22.0
Intersection Capacity Utilization	53.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — Total 2015 with NS Extension with project
10: Kapolei Parkway & Kinoiki Street — PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	72	388	338	119	524	101	420	130	314	106	113	55
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	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	3433	1863	1583	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)	78	422	367	129	570	110	457	141	341	115	123	60
RTOR Reduction (vph)	0	0	281	0	0	83	0	0	268	0	0	51
Lane Group Flow (vph)	78	422	86	129	570	27	457	141	73	115	123	9
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	7.9	18.9	18.9	9.0	20.0	20.0	17.0	17.2	17.2	11.3	11.5	11.5
Effective Green, g (s)	7.9	18.9	18.9	9.0	20.0	20.0	17.0	17.2	17.2	11.3	11.5	11.5
Actuated g/C Ratio	0.10	0.24	0.24	0.11	0.25	0.25	0.21	0.21	0.21	0.14	0.14	0.14
Clearance Time (s)	6.0	6.0	6.0	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	3.0	3.0	3.0
Lane Grp Cap (vph)	174	1195	372	384	1265	394	726	399	339	249	266	226
v/s Ratio Prot	c0.04	0.08		0.04	c0.11		c0.13	c0.08		0.06	c0.07	
v/s Ratio Perm			0.05			0.02			0.05			0.01
v/c Ratio	0.45	0.35	0.23	0.34	0.45	0.07	0.63	0.35	0.22	0.46	0.46	0.04
Uniform Delay, d1	34.2	25.7	24.9	32.9	25.6	23.1	28.8	26.9	26.0	31.8	31.6	29.7
Progression Factor	1.00	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	1.8	0.2	0.3	0.5	0.3	0.1	1.7	0.5	0.3	1.4	1.3	0.1
Delay (s)	36.0	25.8	25.2	33.5	25.8	23.2	30.6	27.4	26.4	33.1	32.9	29.8
Level of Service	D	C	C	C	C	C	C	C	C	C	C	C
Approach Delay (s)		26.5			26.7			28.6			32.3	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	27.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	80.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — Total 2015 with NS Extension with project
13: Kapolei Parkway & Renton Road — PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	191	723	16	27	554	114	19	136	73	141	73	158
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		5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	0.97		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5069		1770	4955		1770	1766		1770	1863	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.71	1.00		0.52	1.00	1.00
Satd. Flow (perm)	1770	5069		1770	4955		1314	1766		963	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)	208	786	17	29	602	124	21	148	79	153	79	172
RTOR Reduction (vph)	0	2	0	0	21	0	0	14	0	0	0	128
Lane Group Flow (vph)	208	801	0	29	705	0	21	213	0	153	79	44
Turn Type	Prot			Prot			Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		6
Actuated Green, G (s)	15.3	36.6		2.5	23.8		19.1	19.1		19.1	19.1	19.1
Effective Green, g (s)	15.3	36.6		2.5	23.8		19.1	19.1		19.1	19.1	19.1
Actuated g/C Ratio	0.20	0.49		0.03	0.32		0.25	0.25		0.25	0.25	0.25
Clearance Time (s)	6.0	6.0		6.0	6.0		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)	360	2467		59	1568		334	449		245	473	402
v/s Ratio Prot	c0.12	0.16		0.02	c0.14			0.12			0.04	
v/s Ratio Perm							0.02			c0.16		0.03
v/c Ratio	0.58	0.32		0.49	0.45		0.06	0.47		0.62	0.17	0.11
Uniform Delay, d1	27.0	11.8		35.7	20.5		21.3	23.8		24.9	21.9	21.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.2	0.1		6.3	0.2		0.1	0.8		4.9	0.2	0.1
Delay (s)	29.3	11.8		42.0	20.7		21.3	24.6		29.8	22.0	21.6
Level of Service	C	B		D	C		C	C		C	C	C
Approach Delay (s)		15.4			21.5			24.3			24.8	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	19.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	75.2	Sum of lost time (s)	17.0
Intersection Capacity Utilization	61.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis — Total 2015 with NS Extension with project
28: Kapolei Parkway & Kualakai Parkway — PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	378	426	36	256	242	266	317	602	418	84	622	193
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	6.0	
Lane Util. Factor	0.97	0.91		0.97	0.91	0.88	0.97	0.95	0.88	1.00	0.95	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5026		3433	5085	2787	3433	3539	2787	1770	3413	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5026		3433	5085	2787	3433	3539	2787	1770	3413	
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)	411	463	39	278	263	289	345	654	454	91	676	210
RTOR Reduction (vph)	0	6	0	0	0	0	0	0	281	0	20	0
Lane Group Flow (vph)	411	496	0	278	263	289	345	654	173	91	866	0
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		
Protected Phases	7	4		3	8		1	6		5		
Permitted Phases						8			6		2	
Actuated Green, G (s)	20.3	24.4		14.7	18.8	18.8	17.6	45.5	45.5	10.9	38.8	
Effective Green, g (s)	20.3	24.4		14.7	18.8	18.8	17.6	45.5	45.5	10.9	38.8	
Actuated g/C Ratio	0.17	0.20		0.12	0.16	0.16	0.15	0.38	0.38	0.09	0.32	
Clearance Time (s)	6.0	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	3.0	
Lane Grp Cap (vph)	583	1026		422	800	438	506	1347	1061	161	1108	
v/s Ratio Prot	c0.12	c0.10		0.08	0.05		c0.10	0.18		0.05		
v/s Ratio Perm						c0.10			0.06		c0.25	
v/c Ratio	0.70	0.48		0.66	0.33	0.66	0.68	0.49	0.16	0.57	0.78	
Uniform Delay, d1	46.8	42.0		50.0	44.7	47.3	48.3	28.1	24.4	52.0	36.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.9	0.4		3.7	0.2	3.6	3.8	0.3	0.1	4.5	3.6	
Delay (s)	50.6	42.3		53.7	45.0	50.9	52.1	28.4	24.5	56.5	40.2	
Level of Service	D	D		D	D	D	D	C	C	E	D	
Approach Delay (s)		46.1			50.0			32.8			41.7	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM Average Control Delay	41.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	119.5	Sum of lost time (s)	30.0
Intersection Capacity Utilization	68.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis — Total 2015 with NS Extension with project
35: Roosevelt Avenue & West Entrance — PM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	3	934	517	3	5	3
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)	3	1015	562	3	5	3
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			564			
pX, platoon unblocked	0.79				0.79	0.79
vC, conflicting volume	565				1584	562
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	315				1606	311
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				94	99
cM capacity (veh/h)	982				91	575

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	3	1015	562	3	5	3
Volume Left	3	0	0	0	5	0
Volume Right	0	0	0	3	0	3
cSH	982	1700	1700	1700	91	575
Volume to Capacity	0.00	0.60	0.33	0.00	0.06	0.01
Queue Length 95th (ft)	0	0	0	0	5	0
Control Delay (s)	8.7	0.0	0.0	0.0	47.1	11.3
Lane LOS	A				E	B
Approach Delay (s)	0.0		0.0		33.7	
Approach LOS					D	

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	59.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	191	885	509	128	104	98
Ideal Flow (vphpl)	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	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)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	208	962	553	139	113	107
RTOR Reduction (vph)	0	0	0	81	0	91
Lane Group Flow (vph)	208	962	553	58	113	16
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		6	
Permitted Phases				8		6
Actuated Green, G (s)	16.0	54.5	32.5	32.5	11.5	11.5
Effective Green, g (s)	16.0	54.5	32.5	32.5	11.5	11.5
Actuated g/C Ratio	0.21	0.70	0.42	0.42	0.15	0.15
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)	363	1302	776	660	261	233
v/s Ratio Prot	0.12	c0.52	0.30		c0.06	
v/s Ratio Perm				0.04		0.01
v/c Ratio	0.57	0.74	0.71	0.09	0.43	0.07
Uniform Delay, d1	27.9	7.3	18.9	13.8	30.3	28.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.2	2.2	3.1	0.1	1.2	0.1
Delay (s)	30.1	9.6	22.0	13.8	31.4	28.8
Level of Service	C	A	C	B	C	C
Approach Delay (s)		13.2	20.3		30.1	
Approach LOS		B	C		C	

Intersection Summary			
HCM Average Control Delay	17.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	78.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	62.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	82	939	520	58	112	58
Ideal Flow (vphpl)	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	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)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	89	1021	565	63	122	63
RTOR Reduction (vph)	0	0	0	32	0	53
Lane Group Flow (vph)	89	1021	565	31	122	10
Turn Type	Prot			Perm		Perm
Protected Phases	7	4	8		6	
Permitted Phases				8		6
Actuated Green, G (s)	7.8	50.1	36.3	36.3	11.2	11.2
Effective Green, g (s)	7.8	50.1	36.3	36.3	11.2	11.2
Actuated g/C Ratio	0.11	0.68	0.50	0.50	0.15	0.15
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)	188	1273	923	784	270	242
v/s Ratio Prot	0.05	c0.55	0.30		c0.07	
v/s Ratio Perm				0.02		0.01
v/c Ratio	0.47	0.80	0.61	0.04	0.45	0.04
Uniform Delay, d1	30.8	8.1	13.4	9.5	28.3	26.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	3.7	1.2	0.0	1.2	0.1
Delay (s)	32.7	11.9	14.6	9.5	29.5	26.5
Level of Service	C	B	B	A	C	C
Approach Delay (s)		13.5	14.1		28.5	
Approach LOS		B	B		C	

Intersection Summary			
HCM Average Control Delay	15.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	73.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Volume (vph)	542	47	137	622	57	262
Ideal Flow (vphpl)	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	1.00	1.00	1.00
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	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	589	51	149	676	62	285
RTOR Reduction (vph)	0	24	0	512	0	0
Lane Group Flow (vph)	589	27	149	164	62	285
Turn Type		Perm		Perm	Prot	
Protected Phases	4		6		5	2
Permitted Phases		4		6		
Actuated Green, G (s)	30.7	30.7	17.7	17.7	6.7	30.4
Effective Green, g (s)	30.7	30.7	17.7	17.7	6.7	30.4
Actuated g/C Ratio	0.42	0.42	0.24	0.24	0.09	0.42
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)	743	665	451	383	162	775
v/s Ratio Prot	c0.33		0.08		0.04	c0.15
v/s Ratio Perm		0.02		c0.10		
v/c Ratio	0.79	0.04	0.33	0.43	0.38	0.37
Uniform Delay, d1	18.4	12.5	22.8	23.4	31.3	14.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.8	0.0	0.4	0.8	1.5	0.3
Delay (s)	24.2	12.5	23.3	24.2	32.8	15.0
Level of Service	C	B	C	C	C	B
Approach Delay (s)	23.3		24.0			18.2
Approach LOS	C		C			B

Intersection Summary			
HCM Average Control Delay	22.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	73.1	Sum of lost time (s)	18.0
Intersection Capacity Utilization	55.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Appendix C

Botanical Inventory Survey

Botanical Resurvey

of the

Debartolo Property

Ewa, O‘ahu

by

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Isle Botanica
Honolulu, Hawai‘i

Report prepared for

Hawai‘i Debartolo LLC

June 2011

INTRODUCTION

The study site (Fig. 1) is located in western O‘ahu on the Ewa Plain. The main portion (“Debartolo property,” TMK 91016108) comprises a 67-acre parcel east of Kapolei and west of Varona Village. Its southern boundary is marked by Roosevelt Road and its northern boundary by the Kapolei Parkway. In addition to this parcel, a 200-ft wide strip of land on State property, contiguous with the eastern boundary of the Debartolo property, was also studied. The area was used for decades for growing sugar cane, but cultivation ceased long ago and the land abandoned. The southern part of the study area is an abandoned quarry, with large hills of excavated material in the center of the property lying north of a large barrow pit. Most of the rest of the site, including the State land to the east, is covered with non-native grasslands with or without shrubs and scattered trees.

METHODOLOGY

Before the fieldwork was carried out, a review of the literature was undertaken by the principal investigator. The current status of the endangered species previously reported from the surrounding area was checked using the official database of threatened and endangered plant species (USFWS 2005). This list is identical to the State of Hawai‘i list of threatened and endangered species. In addition, information about threatened and endangered plant species found in the area was extracted from the Hawai‘i Natural Heritage Program database (Anon. 2005) of Federally Listed Plant Species (see Fig. 2). Several botanical surveys have been carried out in the area, the most relevant of which were by Nagata (1996), Char and Associates (1997a, 2003, and 2004), and Whistler (2007). An endangered plant species, ko‘oloa‘ula (*Abutilon menziesii*), was found in the area by Nagata in 1996, and a mitigation plan for the species was prepared and carried out by the State (DLNR 2003).

After the literature review, a botanical field survey was conducted on the study area and the adjacent State property by the principal investigator on 25 June 2011. A “walk-through survey” was employed, and all plant species encountered were recorded, along with an indication of their frequency. Particular care was taken in looking for the federally listed endangered plant species ko‘oloa‘ula (*Abutilon menziesii*). The species encountered were incorporated into a checklist of all plants found at the study site (see Appendix I). Notes were also taken on vegetation types present, indicating the dominance and frequency of the plant species found there. These notes were written up into the vegetation description below. All the species encountered during the fieldwork were familiar to the principal investigator and were identified in the field.

The objectives of the current field study were to provide a general description of the vegetation types present at the site (particularly any sensitive types of vegetation that may harbor rare plant species), to make a checklist of all native and naturalized vascular plants encountered, to search for threatened and endangered species; and to determine whether any threatened or endangered plant species or sensitive types of vegetation (plant communities) present would be adversely affected by the proposed action.

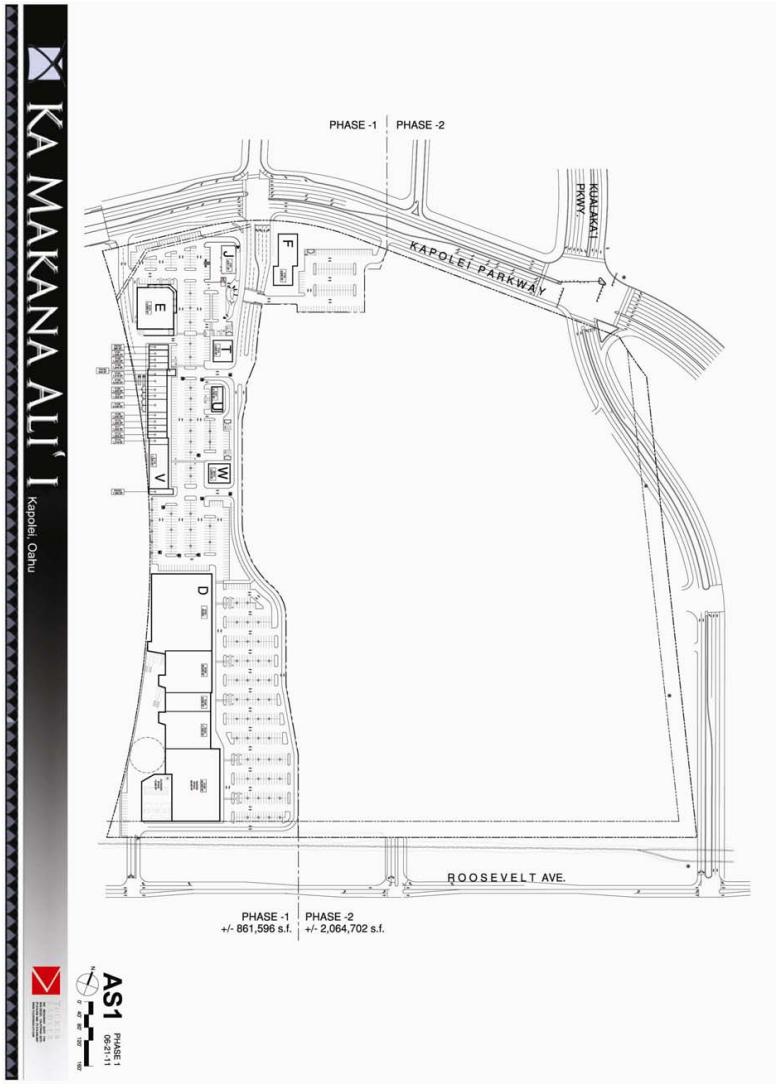

Fig. 1. The Debartolo study site.

Ewa Beach project area

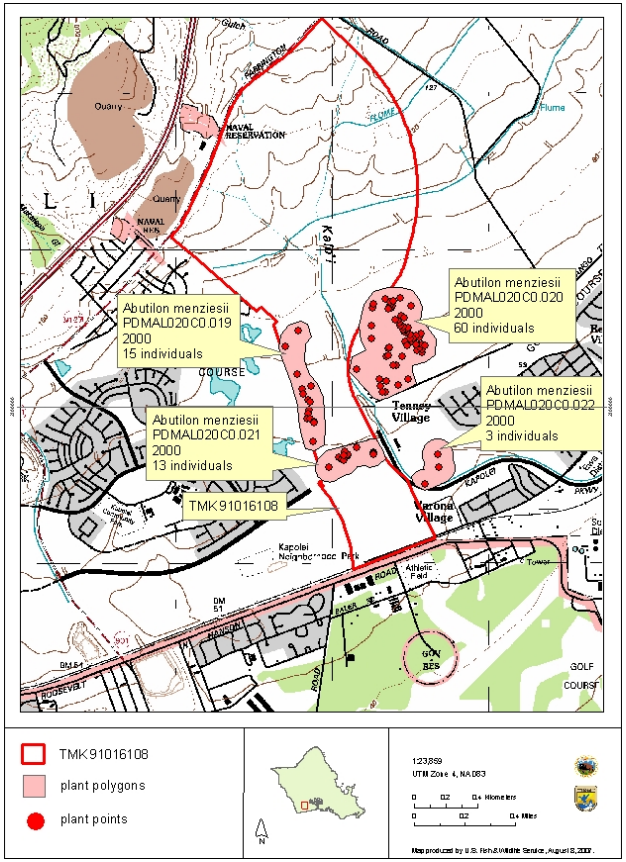

Fig. 2. Hawai'i Natural Heritage Program database map of Federally Listed Plant Species in the vicinity of the Debartolo property study site (marked as TMK 91016018).

PREVIOUS LITERATURE

The study site is located in an area used for decades for cultivating sugar cane, but when this industry ceased operations in the area, the land was earmarked for development. A botanical survey was carried in 1996 on an area of approximately 1300 acres for the East Kapolei Master Plan, which includes the present study site (Nagata 1996). No native plant communities were found in the area, and 99 plant species were recorded. Among the 99 were five native species. Four of these are common and widespread, but a population of 38 individuals of the federally listed endangered plant koʻoloaʻula (*Abutilon menziesii*), clustered in four groups, was found and mapped. None of these individuals were recorded on the present study site, but some were very close to it. Since the land had been so heavily disturbed for so long, the USFWS determined that the populations were "secondary in origin."

Char and Associates (1997a) did a follow-up survey on the koʻoloaʻula populations in late 1996 after a heavy rainy period and recorded 88 individuals that they grouped into three colonies (lumping two of Nagata's groups into one, but not finding his northern-most population). They recommended a mitigation plan be initiated. This plan was eventually carried out (DLNR 2003). Seedlings and cuttings were propagated and some were outplanted to establish new wild populations in appropriate habitat near Kaʻena Point and in the Koko Crater botanical garden.

Char and Associates (1997b) did another botanical survey in 1996 the area for the proposed North-South Road Corridor. This area is north of and nearly contiguous with the present study site. They recorded 80 plant species present in this proposed corridor, five of them native or possibly native: ʻuhaloa (*Waltheria indica*), popolo (*Solanum americanum*), ʻilima (*Sida fallax*), maʻo (*Abutilon incanum*), and koʻoloaʻula (*Abutilon menziesii*). These are the same five native species recorded by Nagata (1996). The first four are common indigenous species, and the latter one a federally listed endangered plant species. Like Nagata, they found no native vegetation.

Another botanical survey was carried out in the area for the site of the proposed University of Hawaiʻi West Oʻahu campus north of the present study site (Char and Associates 2003). During that survey of the 500-acre parcel, 95 plant species were encountered. This included six native species: the same five listed above by both Char and Associates (1997b) and Nagata (1996), as well as the indigenous paʻu-o-Hiʻiaka (*Jacquemontia ovalifolia*), which is a common littoral plant in Hawaiʻi. No native vegetation was found, which was to be expected in this heavily disturbed area.

Char and Associates (2004) did another survey in the area for the "Kapolei Parkway Extension from North-South Road to OR&L Right of Way," which lies just east of the present study site. The western border of this site is contiguous with the eastern boundary of the Debartolo property, and hence its western-most 200 feet comprise the same area as the 200-ft wide corridor on State land that was studied during the present survey. The number of plant species found during this survey was not cited, but the same six native species encountered on the surveys listed above were recorded here. Char and Associates also found five new locations for koʻoloaʻula, but only one to a few individuals were found at each (Fig. 2 notes only 3 individuals total).

The most recent survey of the present study site was done several years ago by the present author (Whistler 2007). In that survey, which included a 500-ft wide State-owned corridor on the east side, 58 plant species were found, only four of them native. Three of the native species were common indigenous species, but a single individual of the endangered *Abutilon menziesii* (koʻoloaʻula) was also found in the adjacent 500 ft wide corridor.

THE VEGETATION

Two types of vegetation can be recognized at the study site: (1) Managed Land Vegetation; and (2) Buffel Grass Grassland. Both of these are classified as "disturbed vegetation," with only a few native species present. The latter type is not homogeneous, since it may be with or without kiawe trees or other species of shrubs, but the subtypes are united by the matrix of Buffel grass that they share. The vegetation types are described below. These are the same as those recognized in the previous botanical survey of the study site (Whistler 2007).

(1) Managed Land Vegetation

This comprises the vegetation on areas that are under periodic or frequent management, such as roadsides and unpaved roads (Fig. 3). The major portion of the Managed Land Vegetation at the site comprises the areas that have been used as a quarry on the southern half of the Debartolo property. This includes a large barrow pit and piles of excavated soil (Fig. 4) that cover most of the southern portion of the site. Much of the area, particularly the northern portion of the site and the adjacent State property, was probably once cultivated with sugar cane, but there is no sign of this cultivation or the sugar cane at the present time. The dominant plant species in this type of vegetation, especially along roadsides, include *Atriplex semibaccata* (Australian saltbush), swollen fingergrass (*Chloris barbata*), weedy heliotrope (*Heliotropium procumbens*), *Sida ciliaris* (no common name), and Dahlberg daisy (*Dyssodia tenuiloba*), and lesser amounts of other weedy species.

(2) Buffel Grass Grassland

This is a heterogeneous assemblage of subtypes united by the dominance of Buffel grass (*Cenchrus ciliaris*) as the ground cover. It was described as "Fallowed Fields Mixed Herb Associations" by Nagata (1996), and "mixed grass shrubland" by Char and Associates (1997b), and is the category recognized in the most recent botanical survey of the site (Whistler 2007). No other herbaceous species approaches the dominance of Buffel grass in this vegetation. In some places it is almost entirely this species, but in others it is mixed with lesser amounts of alien weedy species, particularly partridge pea (*Chamaecrista nictitans*), golden crown-beard (*Verbesina encelioides*), Guinea grass (*Panicum maximum*), fuzzy rattlepod (*Crotalaria incana*), and wild bushbean (*Macroptilium atropurpureum*), and the common native ʻuhaloa (*Waltheria indica*). In other places, scattered individuals of the trees koa haole (*Leucaena leucocephala*), kiawe (*Prosopis pallida*), and ʻopiuma (*Pithecellobium dulce*) are present (Fig. 5). The State property to the east of the Debartolo property is also covered with a dense matrix of Buffel grass, mixed with lesser amounts of other herbaceous species. A single shrub of the endangered koʻoloaʻula was found here during the 2007 survey, but it was not seen during the present survey and in any case was not within the 200 ft wide zone studied this time.

THE FLORA

Sixty-seven plant species were recorded at the study site (see Appendix 1) during the present survey. This included 19 species not found during the previous survey (Whistler 2007), but ten species found during that earlier survey were not found this time. Only six of the 77 species found during the two surveys are native, five of them indigenous, one endemic. Indigenous plants are species native to a region or place, but are also found elsewhere. Endemic plants are species restricted to a single region or area, i.e., in the case of Hawai‘i, they are found only in Hawai‘i. In biodiversity terms, the endemic status is the more important of the two categories, since if a species belonging to it is endangered or threatened in Hawai‘i, it would likewise be classified globally. Indigenous species, however, can be rare in Hawai‘i, but may be common elsewhere in the Pacific. Over 90% of the native plants in Hawai‘i are endemic, one of the highest rates in the world. The majority of the 67 species encountered during the survey are naturalized or weedy “alien” plants that were accidentally or intentionally introduced to Hawai‘i, but which have now become established in the islands and can spread on their own.

All five of the indigenous species found during the two surveys are common or occasional species. Two of them, ‘uhaloa (*Waltheria indica*) and ‘ilima (*Sida fallax*), are widespread species common in disturbed habitats in Hawai‘i. The third, *Jacquemontia ovalifolia* (pa‘u-o-Hi‘i‘aka), is found in the Caribbean in addition to Hawai‘i. The fourth, hoary abutilon (*Abutilon incanum*), is occasional, but is only questionably native in Hawai‘i. The fifth, alena (*Boerhavia repens*), was not found during the present survey, but is common in Hawai‘i. The endemic species, ko‘oloa‘ula (*Abutilon menziesii*), is a federally listed endangered species, but it was not found on the site during the present survey.

The previous survey was conducted during a dry summer (August 2007) in an exceptional drought year. Although the present survey was also conducted during the dry season, this year so far has 50% above the average rainfall, and the last two months (May and June) have had four times the normal rainfall for this period. This has resulted in an unusually verdant lowland condition for this time of year. This probably accounts for the number of new species recorded for the site (19).

DISCUSSION

The study was conducted in June 2011. Two types of vegetation can be recognized at the site: Managed Land Vegetation and Buffel Grass Grassland. Both of these are heavily disturbed. The latter is heterogeneous, with subtypes most notably recognized by the presence or absence of trees or shrubs in the matrix of Buffel grass. No native vegetation is present due to the decades of sugar cane cultivation. Likewise, no wetlands were found, since the area is so dry and the soil unsuitable for this kind of vegetation.

Sixty-seven plant species were found during the survey, four of them indigenous: ‘ilima (*Sida fallax*), ‘uhaloa (*Waltheria indica*), pa‘u-o-Hi‘i‘aka (*Jacquemontia ovalifolia*), and ma‘o (*Abutilon incanum*). The first three are common in Hawai‘i, often in disturbed places, the latter is occasional (and is questionably native). Only two other indigenous species have been reported from the area during previous surveys, popolo (*Solanum americanum*) and alena (*Boerhavia repens*). Both are widespread and common indigenous plants in Hawai‘i. Ten other species found during the previous survey (Whistler 2007) were not found during the present one, but all except one of these are weedy alien species that were listed as “uncommon” in the 2007 report.

One endangered species was found in the area during previous surveys, ko‘oloa‘ula (*Abutilon menziesii*). Ko‘oloa‘ula is a much-branched shrub belonging to the mallow family Malvaceae. It is now rare in the lowlands of Hawai‘i, and was listed as Endangered in 1986 (Federal Register 1986). Prior to 1996, only a few plants had been found on O‘ahu, but in that year a population of 38 individuals was discovered in abandoned sugar cane fields (Nagata 1996). A later survey after a period of heavy rain recorded 88 individuals (Char and Associates 1997a). A single individual was found during the 2007 survey about 270 feet east of the western boundary of the State property, and is apparently the same individual recorded by Char and Associates (2003) at “location no. 5.” If it still exists, it was not seen during the present survey, and in any case, it was east of the present study area.

The present survey was carried out in the dry season, but this has been a very wet year and it is unlikely that more species would be found during a wet season survey. Any additional species would most likely be alien weeds in any case.

CONCLUSIONS

Two botanical factors can complicate proposed construction in Hawai‘i. One is the presence of sensitive types of vegetation, the other is the presence of endangered plant species. Sensitive vegetation includes wetlands and native forest. No wetlands or native forests are found in the area, since the topography is not suitable (no basins) and the area is so highly disturbed. Only four native species turned up in the survey, all of them indigenous and none are rare in Hawai‘i. The only plant that could cause any problem is the federally listed ko‘oloa‘ula, but it was not found in the study area during the present survey, nor in any previous survey.

Consequently, there are no botanical reasons why development of the parcel cannot take place. This includes the main parcel and the 200 ft wide strip of State land. All of the proposed development is on very disturbed land.

LITERATURE CITED

Anon. 2005 (Revised). Hawai‘i Natural Heritage Program Database. Hawai‘i Natural Heritage Program, Honolulu.

Char and Associates. 1997a. Summary of findings: ko‘oloa‘ua on East Kapolei project site, ‘Ewa District, Island of O‘ahu. Report prepared for Parsons Brinckerhoff. 6 pp.

Char and Associates. 1997b. Botanical resources study, North-South Road corridor (H-1 Freeway to Kapolei Parkway), ‘Ewa District, Island of O‘ahu. Report prepared for Parsons Brinckerhoff. 13 pp.

Char and Associates. 2003. Botanical Survey, University of Hawai‘i West O‘ahu, East Kapolei, ‘Ewa District, O‘ahu. Report prepared for Parsons Brinckerhoff. 17 pp.

Char and Associates. 2004. Botanical resources assessment study, Kapolei Parkway extension from North-South Road to OR&L right-of-way, Kapolei, O‘ahu. Report prepared for Parsons Brinckerhoff. 13 pp.

DLNR Division of Forestry and Wildlife Natural Area Reserve System. 2001. Interim management report for *Abutilon menziesii* April 24, 2001.

DLNR Division of Forestry and Wildlife Natural Area Reserve System. 2003. Final management report for *Abutilon menziesii* October 31, 2003.

Federal Register. 1986. 51 FR 34412; September 26, 1986.

Imada, C. 2007. Pers. comm.

Nagata, K. 1996. East Kapolei Master Plan biological survey. Report prepared for PBR Hawai‘i. 19 pp.

Porter, J. R. 1972. Hawaiian names for vascular plants. University of Hawai‘i College of Tropical Agriculture Experimental Station Paper 1:1–64.

St. John, H. 1973. List and summary of the flowering plants in the Hawaiian Islands. Pacific Tropical Botanical Garden Memoir 1: 1–519.

U.S. Fish and Wildlife Service (USFWS). 2005. Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 (Tuesday, November 1, 2005).

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. Manual of the flowering plants of Hawai‘i. University of Hawai‘i Press and Bishop Museum Press, Honolulu. 2 vols.

Whistler. 2007. Botanical survey of the Debartolo and adjacent State property, Ewa, O‘ahu. Report prepared for Belt Collins Hawai‘i Ltd. 11 pp.

APPENDIX 1. PLANT SPECIES CHECKLIST

The following is a checklist of the vascular plants inventoried during the field study at the Debartolo and adjacent State properties during the 2011 survey. The plants are divided into two groups, Monocots, and Dicots. Within these groups, the species are presented taxonomically by family, with each family and each species in the family in alphabetical order. The taxonomy and nomenclature follow Wagner *et al*. (1999). In most cases, common English and/or Hawaiian names listed here have been taken from St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used.
   E = endemic (found only in Hawai‘i).
   I = indigenous (native to Hawai‘i as well as other geographic areas).
   P = Polynesian introduction (introduced to Hawai‘i by Polynesians before the advent of the Europeans).
   X = Introduced or alien (not native, introduced to Hawai‘i, either accidentally or intentionally, after the advent of the Europeans).
4. Relative frequency (abundant, locally abundant, common, locally common, occasional, uncommon, rare).

* Indicates new species not recorded during the 2007 survey.

Species	Common Names	Status	Abundance
MONOCOTS			
POACEAE (Grass Family)			
Cenchrus ciliaris L.	Buffel grass	X	abundant
**Cenchrus echinatus* L.	sandbur	X	uncommon
Chloris barbata (L.) Sw.	swollen fingergrass	X	common
Cynodon dactylon (L.) Pers.	Bermuda grass	X	locally common
**Dactyloctenium aegyptium* (L.) Willd.	beach wiregrass	X	uncommon
**Digitaria* cf. *violascens* Link	violet crabgrass	X	rare
Eragrostis cf. *cilianensis* (All.) Link	stink grass	X	
Panicum maximum Jacq.	Guinea grass	X	occasional
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X	uncommon
**Setaria verticillata* (L.) P. Beauv.	bristly foxtail	X	locally common
DICOTS			
AMARANTHACEAE (Amaranth Family)			
**Achyranthes aspera* L.	----------	X	uncommon
**Amaranthus pungens* Kunth	khaki weed	X	uncommon
Amaranthus spinosus L.	spiny amaranth	X	occasional
**Amaranthus viridis* L.	slender amaranth	X	rare
ANACARDIACEAE (Mango Family)			
Schinus terebinthifolius Raddi	Christmas berry	X	not found 2011
AIZOACEAE (Carpetweed Family)			
Tetragonia tetragonioides (Pall.) Kuntze	New Zealand spinach	X	uncommon
ASTERACEAE (Sunflower Family)			
**Bidens pilosa* L.	beggar’s-tick	X	uncommon
Conyza bonariensis (L.) Cronq.	hairy horseweed	X	occasional

Species	Common Names	Status	Abundance
ASTERACEAE (cont'd.)			
Dyssodia tenuiloba A.P. de Candolle	Dahlberg daisy	X	locally common
**Emilia fosbergii* Nicolson	red pualele, emilia	X	uncommon
**Lactuca serriola* L.	prickly lettuce	X	occasional
Pluchea carolinensis (Jacq.) G. Don	pluchea	X	common
Pluchea x*fosbergii* Cooperr. & Galang	hybrid pluchea	X	not found 2011
Pluchea indica (L.) Less.	Indian pluchea	X	not found 2011
Sonchus oleraceus L.	sow thistle	X	occasional
Tridax procumbens L.	coat buttons	X	occasional
Verbesina encelioides (Cav.) Benth. & Hook.	golden crownbeard	X	common
**Xanthium strumarium* L.	cocklebur	X	uncommon
BIGNONIACEAE (Bignonia Family)			
Spathodea campanulata P. Beauv.	African tulip tree	X	uncommon
BORAGINACEAE (Heliotrope Family)			
Cordia dichotoma Forst. f.	sebestan	X	occasional
Heliotropium procumbens Mill.	weedy heliotrope	X	locally common
BRASSICACEAE (Mustard Family)			
**Lepidium virginicum* L.	wild peppergrass	X	uncommon
CHENOPODIACEAE (Goosefoot Family)			
Atriplex semibaccata R. Br.	Australian saltbush	X	common
Atriplex subrecta Verd.	----------	X	not found 2011
Salsola kali L.	Russian thistle	X	not found 2011
CONVOLVULACEAE (Morning-Glory Family)			
Ipomoea obscura (L.) Ker-Gawl.	bindweed	X	occasional
**Ipomoea triloba* L.	pink bindweed	X	uncommon
**Jacquemontia ovalifolia* (Choisy) H. Hall.	pa'u-o-Hi'i'aka	I	rare
Merremia aegyptia (L.) Urb.	hairy merremia	X	occasional
CUCURBITACEAE (Gourd Family)			
Coccinea grandis (L.) Voigt	ivy gourd	X	rare
Cucumis dipsaceus Ehrenb. ex Spach	wild cucumber	X	occasional
Momordica charantia L.	wild bittermelon	X	uncommon
EUPHORBIACEAE (Spurge Family)			
Chamaesyce hirta (L.) Millsp.	garden spurge	X	common
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X	common
**Chamaesyce prostrata* (Aiton) Small	prostrate spurge	X	occasional
Ricinus communis L.	castor bean	X	occasional
FABACEAE (Pea Family)			
Acacia confusa Merr.	Formosan koa	X	not found 2011
Acacia farnesiana (L.) Willd.	klu	X	rare
Chamaecrista nictitans (L.) Moench	partridge pea, lau-ki	X	locally common

Species	Common Names	Status	Abundance
FABACEAE (cont'd.)			
Crotalaria incana L.	fuzzy rattlepod	X	common
**Crotalaria pallida* Aiton	smooth rattlepod	X	uncommon
Desmanthus pernambucanus (L.) Thellung	virgate mimosa	X	common
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	X	occasional
Indigofera spicata Forssk.	creeping indigo	X	locally common
Indigofera suffruticosa Mill.	indigo, 'iniko	X	occasional
Leucaena leucocephala (Lam.) de Wit	koa haole	X	common
Macroptilium atropurpureum (DC) Urb.	wild bushbean	X	locally common
Medicago polymorpha L.	bur clover	X	not found 2011
Pithecellobium dulce (Roxb.) Benth.	'opiuma, Manila tamarind	X	locally common
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe, mesquite	X	occasional
Samanea saman (Jacq.) Merr.	monkeypod	X	not found 2011
LAMIACEAE (Mint Family)			
Leonotis nepetifolia (L.) R. Br.	orange lion's-ear	X	occasional
MALVACEAE (Mallow Family)			
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X	uncommon
Abutilon incanum (Link) Sweet	ma'o, hoary abutilon	I?	uncommon
Abutilon menziesii Seem.	ko'oloa 'ula	E	not found 2011
**Malvastrum coromandelianum* (L.) Garcke	false mallow	X	occasional
Sida ciliaris L.	----------	X	locally common
Sida fallax Walp.	'ilima	I	occasional
Sida rhombifolia L.	Cuba jute	X	uncommon
Sida spinosa L.	prickly sida	X	locally common
NYCTAGINACEAE (Four-o'-Clock Family)			
Boerhavia repens R. Br.	alena, nena	I	not found 2011
PASSIFLORACEAE (Passionflower Family)			
Passiflora foetida L.	love-in-a-mist	X	uncommon
SOLANACEAE (Nightshade Family)			
Datura stramonium L.	Jimson weed	X	uncommon
**Lycopersicon pimpinellifolium* (Jusl.) Mill.	currant tomato	X	common
Nicotiana glauca R. C. Graham	tree tobacco	X	occasional
STERCULIACEAE (Cacao Family)			
Waltheria indica L.	'uhaloa	I	common
VERBENACEAE (Verbena Family)			
**Stachytarpheta jamaicensis* (L.) Vahl	Jamaica vervain, oi, owi	X	occasional

Fig. 3. Managed Land Vegetation at the study site.

Fig. 4. View from a hill showing quarrying deposits and Buffel Grass Grassland.

Fig. 5. Buffel Grass Grassland with scattered trees.

Appendix D

Faunal and Avifaunal Resource Inventory

Avian and Terrestrial Surveys Conducted for the Ka Makana Ali‘i Project, TMK: 9-1-016: parcel 142 East Kapolei, ‘Ewa District, Island of O‘ahu

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June, 2011

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Introduction

Hawaii Debartolo LLC, is proposing develop Ka Makana Ali‘i, a regional mixed-use center on a 67-acre property in East Kapolei, in the district of `Ewa within the City and County of Honolulu. The subject property is owned by the Department of Hawaiian Homelands (DHHL) and leased to Hawaii Debartolo LLC. The subject property is identified as Tax Map Key 9-1-016: parcel 142 (Figure 1). The proposed regional mixed-use center will include approximately 1.5 million square feet of mixed-use retail, office, and hotel development

This report describes the methods used and the results of, avian and mammalian surveys conducted on the subject property as part of the environmental disclosure process associated with the proposed project.

The primary purpose of the surveys was to determine if there are any avian or mammalian species currently listed, or proposed for listing under either federal or State of Hawai‘i endangered species statutes within or adjacent to the study area.

The federal and State of Hawai‘i listed species status follows species identified in the following referenced documents, (Department of Land and Natural Resources (DLNR) 1998; U. S. Fish & Wildlife Service (USFWS) 2005a, 2005b, 2011). Fieldwork was conducted on June 22, 2011.

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text.

Site Description

The 67-acre site is fallow land bordered to the north by Kapolei Parkway, to the south by Renton Road and to the east and west by as yet undeveloped lands (Figure 1 & 2). There is a large borrow pit located adjacent to Renton Road, and several large piles of fill have been deposited on the site (Figure 3). Currently the site is being used by dirt bikers, and off road vehicles as an unofficial motocross site. There are numerous unpaved dirt roads crisscrossing the site.

Vegetation of the site is best characterized as buffel grass/Kiawe grassland (Figure 2). Numerous ruderal species typically associated with disturbed areas in the ‘Ewa plains are prominent along the unpaved roads and along the HECO right-of way running the length of the eastern border of the site.

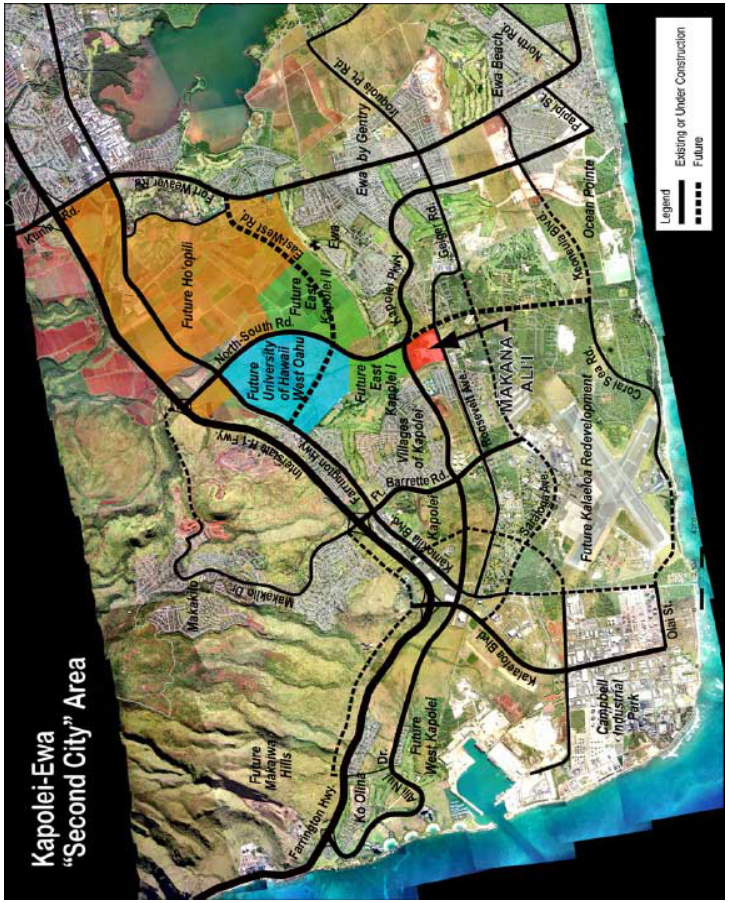

Figure 1 Ka Makana Ali‘i Project – Highlighted in red

Figure 2 - Ka Makana Ali'i Site looking north from the top of a mound of fill

Figure 3 – Borrow pit on southern end of site

Methods

The avian phylogenetic order and nomenclature used in this report follows the *AOU Check-List of North American Birds* (American Ornithologists' Union, 1998), and the 42nd through the 51st supplements to the Check-List (American Ornithologists' Union 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chesser *et al*., 2009, 2010). Mammal scientific names follow (Tomich, 1986). Place names follow (Pukui *et al.*, 1974). Place names follow *Place Names of Hawaii* (Pukui *et al.,* 1974).

Avian Survey

Six avian count stations were evenly within the project site. A single 8-minute avian point count was made at each count station. Field observations were made with the aid of Leica 10 X 42 binoculars and by listening for vocalizations. The count and subsequent search of the remainder of the site was conducted between 6:30 am and 9:00 am. Additionally I surveyed the HECO utility easement corridor, which borders the eastern side of the site. Time not spent counting the point count stations was used to search the rest of the site for species and habitats not detected during the point counts. Weather conditions were ideal, with no rain, unlimited visibility and winds of between 1 and 5 kilometers an hour.

Mammalian Survey

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of O'ahu are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the project area.

Results

Avian Survey

A total of 346 individual birds of 17 species, representing 12 separate families, were recorded during station counts. All species detected are considered to be alien to the Hawaiian Islands (Table 1). No other avian species were detected during the time I spent on the site.

No avian species detected during the course of this survey are protected or proposed for protection under either the federal or State of Hawai'i endangered species statutes.

Avian diversity and densities were in keeping with the highly disturbed nature of the habitat present on the site, and the site's location in East Kapolei. Four species, Red Avadavat (*Amandava amandava*), Red-vented Bulbul (*Pycnonotus cafer*), Common Waxbill (*Estrilda astrild*), and Nutmeg Mannikin (*Lonchura punctulata)* accounted for 57 percent of

all birds recorded during station counts. The most commonly recorded species was Red Avadavat, which accounted for slightly more than 22.5 percent of the total number of individual birds recorded. An average of 58 individual birds was recorded per station count – this is a relatively high number.

Table 1 – Avian Species Detected Within the Ka Makana Aliʻi Site

Common Name	*Scientific Name*	*ST*	*RA*
	GALLIFORMES		
	PHASIANIDAE – Pheasants & Partridges		
	Phasianinae – Pheasants & Allies		
Gray Francolin	*Francolinus pondicerianus*	A	1.50
Black Francolin	*Francolinus francolinus*	A	0.33
	PELECANIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	0.50
	COLUMBIFORMES		
	COLUMBIDAE – Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	1.33
Zebra Dove	*Geopelia striata*	A	4.67
	PASSERIFORMES		
	PYCNONOTIDAE – Bulbuls		
Red-vented Bulbul	*Pycnonotus cafer*	A	7.83
	ZOSTEROPIDAE – White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	1.33
	TIMALIIDAE - Babblers		
Red-billed Leiothrix	*Leiothrix lutea*	A	0.33
	STURNIDAE – Starlings		
Common Myna	*Acridotheres tristis*	A	4.17
	EMBERIZIDAE – Emberizids		
Red-crested Cardinal	*Paroaria coronata*	A	3.00
	CARDINALIDAE – Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	1.83
	FRINGILLIDAE – Fringilline and Carduleline Finches & Allies		
	Carduelinae – Carduline Finches		
House Finch	*Carpodacus mexicanus*	A	3.67
	PASSERIDAE - Old World Sparrows		
House Sparrow	*Passer domesticus*		
	ESTRILDIDAE – Estrildid Finches		
	Estrildinae – Estrildine Finches		
Common Waxbill	*Estrilda astrild*	A	4.67
Red Avadavat	*Amandava amandava*	A	13.00
Nutmeg Mannikin	*Lonchura punctulata*	A	6.00
Chestnut Munia	*Lonchura atricapilla*	A	2.50

Key to table 2

ST Status

A Alien – Introduced to the Hawaiian Islands by humans

RA Relative Abundance - Number of birds detected divided by the number of count stations (6)

Mammalian Survey

Three terrestrial mammalian species were detected on site during the course of this survey, Tracks, scat and sign of dog (*Canis f. familiaris*), small Indian mongoose (*Herpestes a. auropunctatus*), and cat (*Felis catus*) were encountered at numerous locations within the site.

No mammalian species currently protected or proposed for protection under either the federal or State of Hawaiʻi endangered species programs were detected during the course of this survey, nor were any expected (DLNR, 1998; USFWS; 2005a, 2005b, 2011).

Discussion

Avian Resources

The findings of the avian survey are consistent with the results of several other faunal surveys conducted in the ʻEwa Plains over the past seven years (David, 2004, 2005a, 2005b, 2007a, 2007b, 2008; David and Guinther, 2005, 2006, 2007). During the course of this survey 17 avian species detected, all of these are alien to the Hawaiian Islands.

Although not detected during this survey it is probable that two migratory shorebird species use loafing and foraging resources on this site during the fall and winter months. The two, Pacific Golden-Plover Pacific (*Pluvialis fulva*) and Ruddy Turnstone (*Arenaria interpres*) are indigenous migratory shorebird species that nest in the high Arctic during the late spring and summer months, returning to Hawaiʻi and the Tropical Pacific to spend the fall and winter months each year. They usually leave Hawaiʻi for their trip back to the Arctic in late April or the very early part of May.

Although no seabirds were detected during the course of this survey, several seabird species potentially overfly the site on occasion. The primary cause of mortality in resident seabirds is thought to be predation by alien mammalian species at the nesting colonies (USFWS 1983; Simons and Hodges 1998; Ainley *et al.,* 2001). Collision with man-made structures is considered to be the second most significant cause of mortality in locally nesting seabird species in Hawaiʻi. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals

(Hadley 1961; Telfer 1979; Sincock 1981; Reed *et al.*, 1985; Telfer *et al.*, 1987; Cooper and Day, 1998; Podolsky *et al.* 1998; Ainley *et al.,* 2001; Hue *et al.,* 2001; Day *et al* 2003).

There are no known nesting colonies of any of the resident seabird species present on O'ahu on, or within close proximity of the project site.

Mammalian Resources

The findings of the mammalian survey are consistent with the results of several other faunal surveys conducted in the 'Ewa Plains over the past seven years (David, 2004, 2005a, 2005b, 2007a, 2007b, 2008; David and Guinther, 2005, 2006, 2007).

Although no rodents were detected during the course of this survey, it is likely that the four established alien *muridae* fund on O'ahu, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), European house mouse (*Mus musculus domesticus*) and possibly Polynesian rats (*Rattus exulans hawaiiensis*) use various resources found within the general project area on a seasonal basis. All of these introduced rodents are deleterious to native ecosystems and the native faunal species dependant on them.

No Hawaiian hoary bats were detected during the course of this survey. Given the paucity of documented records of this species on O'ahu and the complete lack of suitable roosting vegetation on the site the chance that any use resources on the subject property are extremely low (USFWS, 1998; David, 2011).

Potential Impacts to Protected Species

Seabirds

The principal potential impact that construction and operation of the proposed development poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with the project during the nesting season. The two main areas that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, 1) during construction if it is deemed expedient, or necessary to conduct nighttime construction activities, 2) following build-out, the potential use of streetlights or other exterior lighting during the seabird nesting season.

Recommendations

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

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

Critical Habitat

There is no federally delineated Critical Habitat present on or adjacent to the property. Thus the development and operation of proposed development will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under State law.

Glossary

Alien – Introduced to Hawai'i by humans
Endangered – Listed and protected under the Endangered Species Act of 1973, as amended (ESA) as an endangered species
Endemic – Native to the Hawaiian Islands and unique to Hawai'i
Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally
Muridae – Rodents, including rats, mice and voles, one of the most diverse family of mammals
Nocturnal – Night-time, after dark
'Ōpe'ape'a – Endemic endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*)
Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young
Phylogenetic – The evolutionary order that organisms are arranged by
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Sign – Biological term referring tracks, scat, rubbing, odor, marks, nests, and other signs created by animals by which their presence may be detected
Threatened – Listed and protected under the ESA as a threatened species

DHHL – Department of Hawaiian Homelands
DLNR – Hawai'i State Department of Land & Natural Resources
DOFAW – Division of Forestry and Wildlife
ESA – Endangered Species Act of 1973, as amended
HECO – Hawaiian Electric Company
USFWS – United State Fish & Wildlife Service

Literature Cited

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

American Ornithologist's Union. 1998. *Check-list of North American Birds*. 7th edition. AOU. Washington D.C. 829pp.

_____. 2000. Forty-second supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 117:847-858.

Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2002. Forty-third supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 119:897-906.

_____. 2003 Forty-fourth supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 120:923-931.

_____. 2004 Forty-fifth supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 121:985-995.

_____. 2005 Forty-sixth supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 122:1031-1031.

_____. 2006 Forty-seventh supplement to the American Ornithologist's Union *Check-list of North American Birds*. Auk 123:926-936.

Banks, R. C., C. R. Terry Chesser, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2007 Forty-eighth supplement to the American Ornithologist Union *Check-list of North American Birds*. Auk 124:1109-1115.

Banks, R. C., C. R. Terry Chesser, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2008 Forty-ninth supplement to the American Ornithologist Union *Check-list of North American Birds*. Auk 125:758-768.

Chesser, R. T., R. C. Banks, F. K. Barker, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz, and K. Winker. 2009. Fiftieth supplement to the American Ornithologist Union *Check-list of North American Birds*. Auk 126:1-10.

_____. 2010. Fifty-first supplement to the American Ornithologist Union *Check-list of North American Birds*. Auk 127:726-744.

Cooper, B. A and R. H. Day. 1998. Summer Behavior and Mortality of Dark-rumped Petrels and Newells' Shearwaters at Power Lines on Kauai. Colonial Waterbirds, 21 (1): 11-19.

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

David, R. E. 2004. An Avian Assessment of the Proposed Kalo'i Gulch Drainageway Improvements at One'ula Beach Park Project. Prepared for: Planning Solutions, Inc. & Haseko (Ewa), Inc.

David, R. E. 2005a. A Survey of Avian and Terrestrial Mammalian Species for the Kamokila Boulevard Extension Project, 'Ewa District, O'ahu, Hawai'i. Prepared for: Kimura International, and the State of Hawai'i Department of Transportation, Highways Division (HDOT).

David, R. E. 2005b. A Survey of Avian and Terrestrial Mammalian Species for the Proposed Interstate H-1 Addition and Modification of Highway Accesses, Pālailai Interchange and Makakilo Interchange Project, 'Ewa District, O'ahu, Hawai'i. Prepared for: Engineering Concepts, Inc. & The State of Hawai'i, Department of Transportation, Highways Division.

David, R. E. 2007a. A Survey of Avian and Mammalian Resources for the Ho'opili Development Project, 'Ewa District, O'ahu, Hawai'i. - Main Parcels. Prepared for: PBR Hawaii, and D. R. Horton – Schuler Division.

David, R. E. 2007b. A Survey of Avian and Mammalian Resources for the Castle and Cooke, Waiawa Master Planned Community, 'Ewa District, O'ahu, Hawai'i. Prepared for: Wilson Okamoto Corporation, and catle & Cooke Hawaii.

David, R. E. 2008. A Biological Assessment Conducted on the Proposed Honua Power Project Site, 'Ewa District, O'ahu, Hawai'i. Prepared for: Planning Solutions, Inc. and Honua Power, LLC.

David, R. E. 2010. Unpublished field notes – O'ahu 1980 - 2011.

David, R. E., and E. Guinther. 2005. A Survey of Botanical, Avian and Mammalian Resources, Hawaiian Electric Generating Station and Transmission Additions Project Site, Campbell Industrial Park, 'Ewa District, O'ahu, Hawai'i. Prepared for: Planning Solutions, Inc. & Hawaiian Electric Company.

David, R., and E. B. Guinther 2006. A Survey of Botanical, Avian, and Mammalian Resources, Kapolei Harborside Center, 'Ewa District, O'ahu, Hawai'i. Prepared for: Group 70 International, and The Estate of James Campbell.

David, R. E., and E. B. Guinther 2007. A Survey of Botanical, Avian, and Mammalian Resources, Imperium Renewable Bio-Diesel Production Plant, 'Ewa District, O'ahu, Hawai'i. Prepared for: Belt Collins Hawaii, and Imperium Renewables Inc.

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

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

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

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

Pukui , M. K., S. H. Elbert, and E. T. Mookini 1976. *Place Names of Hawaii*. University of Hawaii Press. Honolulu, Hawai'i. 289 pp.

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

Simons, T. R., and C. N. Hodges. 1998. Dark-rumped Petrel (*Pterodroma phaeopygia*). *In* A. Poole and F. Gill (editors). The Birds of North America, No. 345. The Academy of Natural Sciences, Philadelphia, PA. and the American Ornithologists Union, Washington, D.C.

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

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

Telfer, T. C. , J. L. Sincock, G. V. Byrd, and J. R. Reed. 1987. Attraction of Hawaiian seabirds to lights: Conservation efforts and effects of moon phase. Wildlife Society Bulletin 15:406-413.

Tomich, P.Q. 1986. *Mammals in Hawaii*. Bishop Museum Press. Honolulu, Hawaii. 37 pp.

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

_____. Recovery Plan for the Hawaiian Hoary Bat. U.S. Fish & Wildlife Service, Portland, Oregon.

_____. 2005a. Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 (Tuesday, November 1, 2005).

_____. 2005b. 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species That Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions. Federal Register, 70 No. 90 (Wednesday, May 11, 2005): 24870-24934.

_____. 2011. USFWS Threatened and Endangered Species System (TESS), online at http://ecos.fws.gov/tess_public/StartTESS.do

Appendix E

Noise Impact Analysis

ACOUSTIC STUDY FOR THE KA MAKANA ALI`I PROJECT KAPOLEI, HAWAII

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CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Ka Makana Ali`i Project in Kapolei were evaluated for their potential impacts and their relationship to the current FHA/HUD noise standard of 65 DNL. The traffic noise level increases along the roadways in the project environs (see FIGURE 1) were calculated. Low to moderate increases in traffic noise are predicted to occur as a result of project traffic following project build-out by CY 2015. Increases in traffic noise due to non-project traffic are typically greater than increases due to project traffic.

Kapolei Parkway, Kualakai Parkway, Renton Road, and Roosevelt Avenue are the dominant traffic noise corridors in the project environs. Existing traffic noise levels probably exceed 65 DNL at existing residences which front Kapolei Parkway, Renton Road, and Roosevelt Avenue. Existing traffic noise levels along Roosevelt Avenue are approximately 65 DNL at 136 feet setback distance from the centerline of that roadway. By 2015, traffic noise levels along Roosevelt Avenue are predicted to increase by 0.9 DNL units without the project and by an additional 0.2 to 0.3 DNL units with the project.

Along Kualakai Parkway north of the project, traffic noise levels are expected to be approximately 65 DNL at 333 feet distance from the centerline in CY 2015, with increases of 2.9 DNL and 2.7 DNL associated with non-project and project traffic, respectively. Along Kapolei Parkway, traffic noise levels are expected to increase by 1.2 to 2.0 DNL by CY 2015 as a result of non-project traffic, and by 0.4 to 1.5 DNL by CY 2015 as a result of project traffic. Future traffic noise levels will continue to exceed 65 DNL at existing residences which front Kapolei Parkway, Renton Road, and Roosevelt Avenue. The proposed hotel on the project site should be outside the 65 DNL traffic noise contour, and has adequate setback from Kapolei Parkway's centerline.

The proposed project will be a contributor to increased traffic noise levels along the existing major roadways which will service the project. The future traffic noise contributions from project traffic should be less than the contributions from non-project traffic. Traffic noise mitigation measures should not be required for buildings on the project site since the planned buildings have adequate setback distances from Kapolei Parkway and the Kualakai Parkway Extension.

The planned hotel included with the project is located outside (or beyond) the 60 DNL aircraft noise contour associated with Honolulu International Airport and Kalaeloa Airport aircraft operations. Through 2025, the planned hotel should not be exposed to aircraft noise levels which are considered to be incompatible for hotel uses by the State Department of Transportation, Airports Division.

Unavoidable, but temporary, noise impacts may occur during construction of the proposed project, particularly during the excavation and site preparation activities on the project site. Because construction activities are predicted to be audible within the project site and at adjoining properties, the quality of the acoustic environment may be

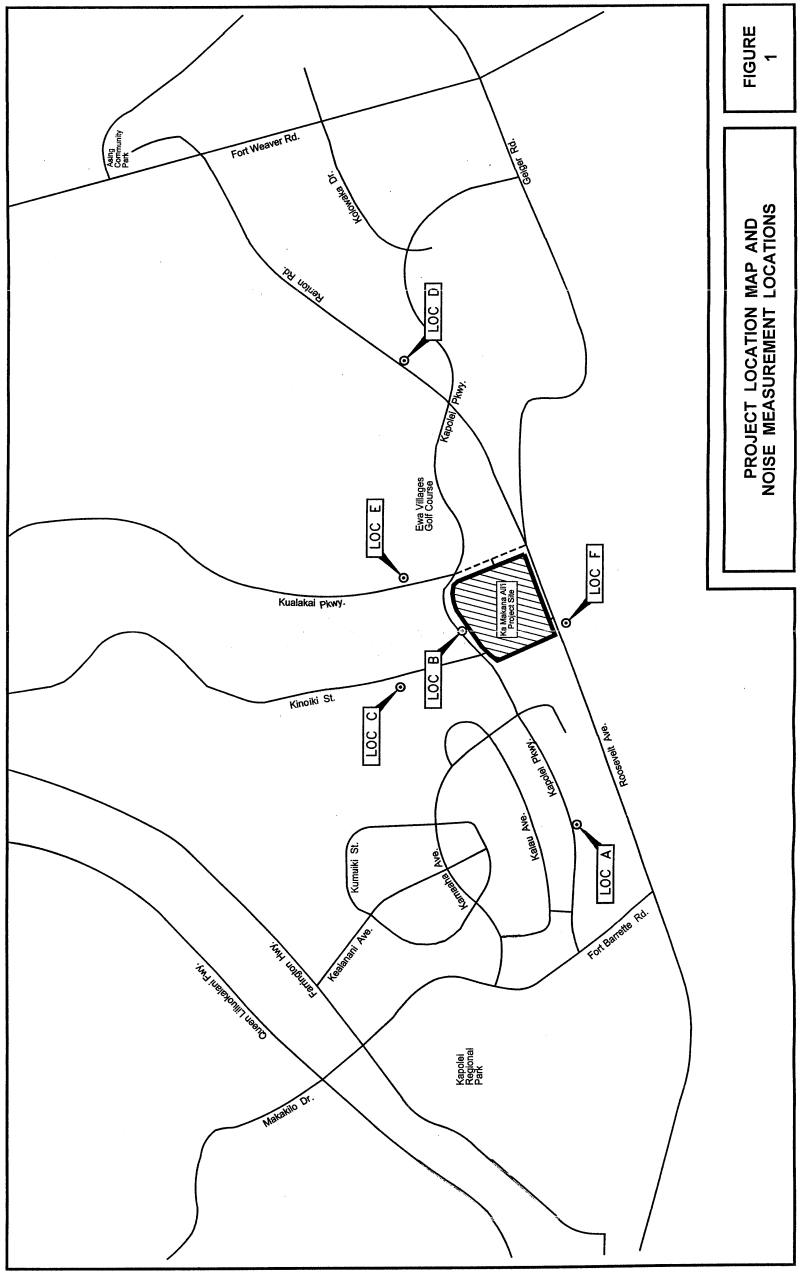


FIGURE 1

PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS

degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases, but the use of quiet equipment and the use of the State Department of Health curfew periods are recommended as standard mitigation measures.

CHAPTER II. PURPOSE

The primary objective of this study was to describe the existing and future traffic noise environment in the environs of the proposed Makana Ali`i Project in Kapolei on the island of Oahu. Traffic forecasts for 2015 were used. Traffic noise level increases and impacts associated with the proposed development were to be determined along the public roadways which are expected to service the project traffic. A specific objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases.

The proposed location of the project's Hotel was compared to previously developed aircraft noise contours for Honolulu International Airport and Kalaeloa Airport. The projected aircraft noise levels at the proposed Hotel site were compared to Hawaii State Department of Transportation recommendations for acceptable aircraft noise levels at resort developments.

Impacts from short term construction noise at the project site were also included as noise study objectives. Recommendations for minimizing potential construction noise impacts were also to be provided as required.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies (such as FHA/HUD) to assess environmental noise is the Day-Night Average Sound Level (Ldn or DNL). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the DNL descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL descriptor. A more complete list of noise descriptors is provided in APPENDIX B to this report.

TABLE 1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the DNL descriptor system are shown in FIGURE 2. As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the roadway is a high speed freeway.

For purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 DNL or less is considered acceptable for residences. This standard is applied nationally (Reference 2), including Hawaii. Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, and as recommended in Reference 3, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 DNL are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 DNL.

On the island of Oahu, the State Department of Health (DOH) regulates noise from construction activities, through the issuance of permits for allowing excessive noise during limited time periods. State DOH noise regulations are expressed in maximum allowable property line noise limits rather than DNL (see Reference 4). Al-

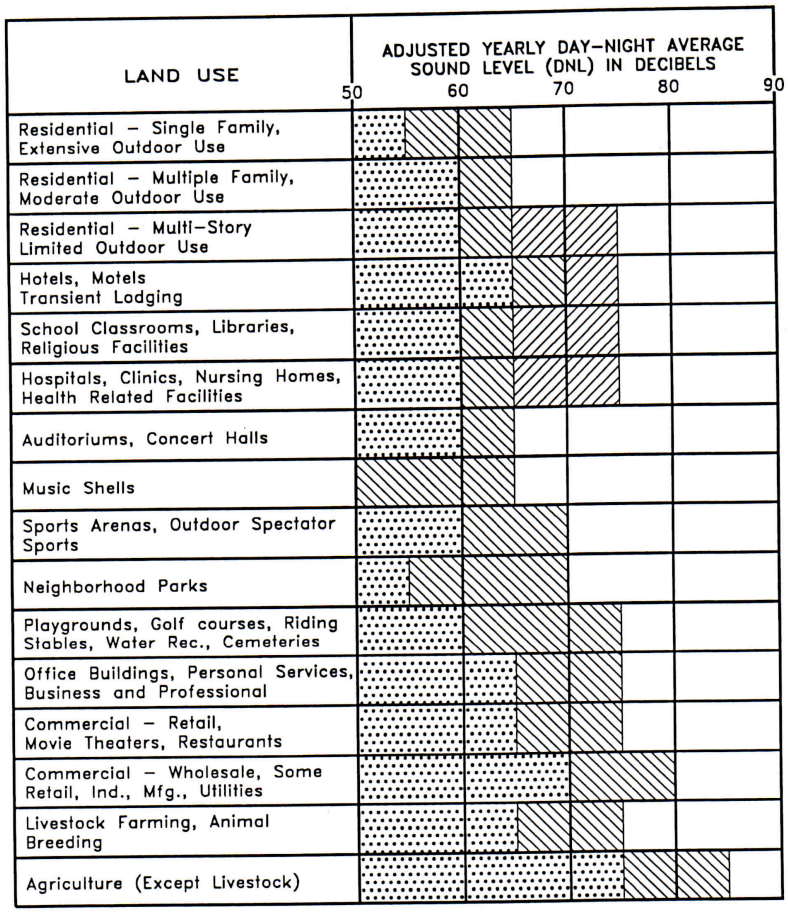
TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY–NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL (1) STANDARD
Minimal Exposure	Not Exceeding 55 DNL	Not Exceeding 55 Leq	Unconditionally Acceptable
Moderate Exposure	Above 55 DNL But Not Above 65 DNL	Above 55 Leq But Not Above 65 Leq	Acceptable(2)
Significant Exposure	Above 65 DNL But Not Above 75 DNL	Above 65 Leq But Not Above 75 Leq	Normally Unacceptable
Severe Exposure	Above 75 DNL	Above 75 Leq	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the Leq instead of the Ldn descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 Leq.



LAND USE COMPATIBILITY WITH YEARLY AVERAGE DAY-NIGHT AVERAGE SOUND LEVEL (DNL) AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED.
(Source: American National Standards Institute S12.9-1998/Part 5)

FIGURE 2

though they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for residential, commercial, and industrial lands equate to approximately 55, 60, and 76 DNL, respectively.

For aircraft noise, the State Department of Transportation, Airports Division (HDOTA), has recommended that 60 DNL be used as the common level for determining land use compatibility in respect to noise sensitive uses (such as hotels) near its airports. In order to further reduce risks of adverse noise impacts from airport noise in the State of Hawaii, Reference 5 requires that disclosure of the airport noise levels be provided prior to real property transactions concerning properties located within Air Installation Compatibility Use Zones (AICUZ) or located within airport noise maps developed under Federal Aviation Regulation (FAR) Part 150 - Airport Noise Compatibility Planning (14 CFR Part 150).

It should be noted that the noise compatibility guidelines and relationships to the DNL noise descriptor may not be applicable to impulsive noise sources such as pile drivers. The use of penalty factors (such as adding 10 dB to measured sound levels or the use of C-Weighting filters) have been proposed. However, the relationships between levels of impulsive noise sources and land use compatibility have not been as firmly established as have the relationships for non-impulsive sources. The State DOH limits for impulsive sounds which exceed 120 impulses in any 20 minute period are 10 dB above the limits for non-impulsive sounds. If impulsive sounds do not exceed 120 impulses in any 20 minute time period, there are no regulatory limits on their sound levels under the State DOH regulations.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic noise levels were measured at six locations (A through F) in the project environs to provide a basis for developing the project's traffic noise contributions along the roadways which will service the proposed development. The locations of the measurement sites are shown in FIGURE 1. Traffic noise measurements were performed during the month of May 2011. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in TABLE 2.

Traffic noise calculations for the existing conditions as well as noise predictions for 2015 were performed using the Federal Highway Administration (FHWA) Traffic Noise Model (Reference 6). Traffic data entered into the noise prediction model were: roadway and receiver locations; hourly traffic volumes, average vehicle speeds; estimates of traffic mix; and propagation loss factors for various ground covers. The traffic data and forecasts for the project (Reference 7), plus the spot traffic counts obtained during the noise measurement periods were the primary sources of data inputs to the model. APPENDIX C summarizes the AM and PM peak hour traffic volumes for CY 2010 and 2015, which were used to model existing and future traffic noise along the streets in the project environs. Hawaii State Department of Transportation counts on Kapolei Parkway (Reference 8) and Renton Road (Reference 9) were also used to develop the relationship between the 24-hour DNL and the AM or PM peak hour Leq traffic noise levels. For existing and future traffic on Kapolei Parkway, Kamaaha Avenue, Kinoiki Street, and Kualakai Parkway, it was assumed that the average noise levels, or Leq(h), during the AM peak hour were 2 dB greater than the 24-hour DNL along these roadways in the project environs. For existing and future traffic on Renton Road west of Kapolei Parkway and Roosevelt Avenue, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were 2 dB less than the 24-hour DNL along these roadways in the project environs. For existing and future traffic on Renton Road east of Kapolei Parkway, it was assumed that the average noise levels, or Leq(h), during the AM peak hour were 1 dB greater than the 24-hour DNL along this roadway in the project environs. These assumptions were based on computations of both the hourly Leq and the 24-hour DNL of traffic noise along Kapolei Parkway (see FIGURE 3) and Renton Road (see FIGURE 4).

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors without the benefit of shielding from buildings. Traffic noise levels were also calculated for future conditions with and without the proposed project. The forecasted changes in traffic noise levels over existing levels were calculated with and without the project, and noise impact risks evaluated. The relative contributions of non-project and project traffic to the total noise levels were also calculated, and an evaluation of possible traffic noise impacts was made.

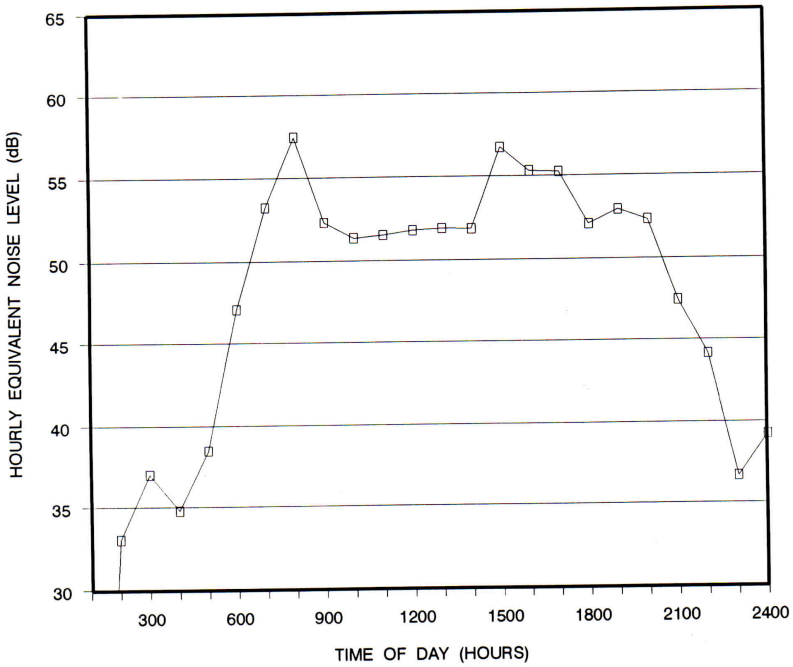
TABLE 2

TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A. 99 FT from the center of Kapolei Parkway (5/25/11)	0557 TO 0657	39	247	0	14	59.3	59.3
B. 84 FT from the center line of Kapolei Pkwy. (5/25/11)	0703 TO 0803	38	925	11	22	64.4	64.3
C. 46 FT from the center of Kinoiki Street (5/25/11)	0812 TO 0912	38	82	1	0	54.9	54.9
D. 60 FT from the center of Renton Road (5/25/11)	0921 TO 1021	40	292	3	11	61.8	61.8
E. 99 FT from the center of Kualakai Parkway (5/25/11)	1033 TO 1133	45	319	8	13	65.0	65.0
F. 96 FT from the center of Roosevelt Avenue (5/25/11)	1151 TO 1251	42	704	4	20	62.4	62.4

FIGURE 3

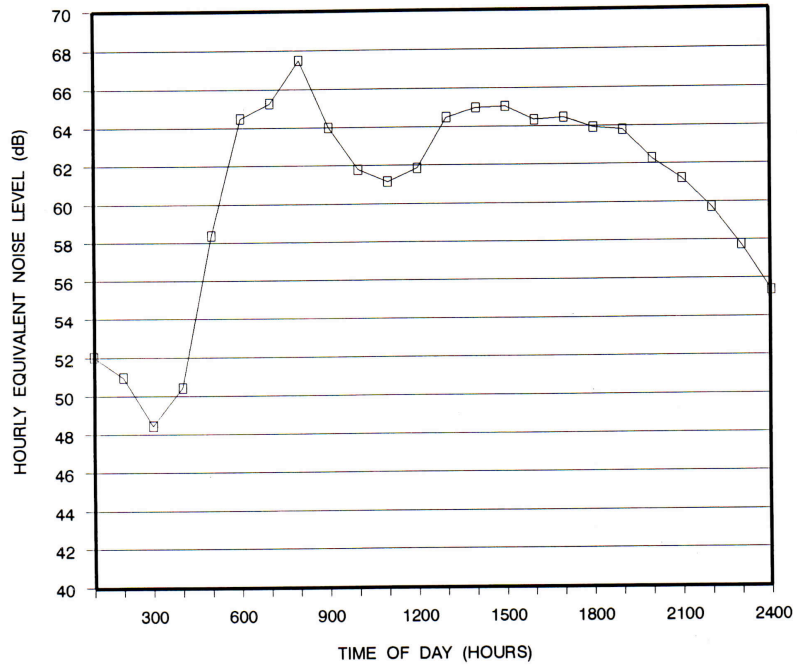
HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAPOLEI PARKWAY 0.2 MILES EAST OF KAMAAHA AVENUE (AUGUST 18, 2009)



□ 100 FT from Roadway Centerline (53.2 DNL)

FIGURE 4

HOURLY VARIATIONS OF TRAFFIC NOISE AT 60 FT SETBACK DISTANCE FROM THE CENTERLINE OF RENTON ROAD BETWEEN ALAIKI STREET AND KAPOLEI PARKWAY (FEBRUARY 4, 2009)



□ 60 FT from Roadway Centerline (66.9 DNL)

Because of the proposed hotel located within the project's boundaries, the results of a previous aircraft noise study for the Kalaeloa Airport environs were used to determine if the proposed hotel was located outside the 60 DNL airport noise contour associated with aircraft operations in the study area. The locations of the forecasted aircraft noise contours for years 2004 and 2025 developed in Reference 10 were compared with the proposed hotel's location on the project site.

Calculations of average exterior and interior noise levels from construction activities were performed for typical naturally ventilated and air conditioned buildings. Predicted noise levels were compared with existing background ambient noise levels, and the potential for noise impacts was assessed.

V. EXISTING ACOUSTICAL ENVIRONMENT

The existing background ambient noise levels within the project area are controlled by motor vehicle traffic along Kapolei Parkway, Kualakai Parkway, Renton Road, and Roosevelt Avenue. Jet, propeller, and helicopter aircraft are some of the other noise events which are intermittently audible.

Existing traffic noise level measurements were obtained at Locations A through F where shown in FIGURE 1. The results of the traffic noise measurements are summarized in TABLE 2. All of the measurement sites were located at street level. As shown in TABLE 2, correlation between measured and predicted traffic noise levels was considered acceptable for predicting both existing and future traffic noise levels in the project environs.

APPENDIX C contains the existing traffic volumes on the roadways in the project environs during 2010. Calculations of existing traffic noise levels during the applicable AM or PM peak traffic hour using the traffic volumes contained in APPENDIX C are presented in TABLE 3. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for later comparison with forecasted traffic noise levels with and without the project. It should be noted that, for the wider roadways (Kapolei Parkway and Kualakai Parkway), traffic noise levels were calculated at 75 feet instead of the 50 feet distance indicated in the column heading of TABLE 3 (as well as in TABLE 5).

The existing setback distances from the roadways' centerlines to their associated 65 and 70 DNL contours were also calculated as shown in TABLE 4. The contour line setback distances do not take into account noise shielding effects from existing buildings or the additive contributions of traffic noise from intersecting street sections. Based on the results of TABLE 4, it was concluded that the existing 65 DNL traffic noise contour is located at approximately 136 feet from the centerline of Roosevelt Avenue, 120 feet from the centerline of Kualakai Parkway, 51 to 75 feet from the centerline of Renton Road, 58 to 74 feet from the centerline of Kapolei Parkway, and less than 50 feet from the centerlines of Kamaaha Avenue and Kinoiki Street.

Existing traffic noise levels at residences makai of Roosevelt Avenue, along Renton Road, and at the second floor living units along Kapolei Parkway are probably greater than 65 DNL due to the relatively high traffic noise levels along those roadways. The ground floor living units along Kapolei Parkway probably experience traffic noise levels less than 65 DNL due to the sound attenuation provided by the existing walls along the Kapolei Parkway Rights-of-Way. The existing traffic noise levels at other residences in the project environs along Kamaaha Avenue and Kinoiki Street are in the "Moderate Exposure, Acceptable" category, and are typically less than 65 DNL.

The project site is currently located outside the 60 DNL aircraft noise contour associated with operations at both Kalealoa and Honolulu International Airport. As

TABLE 3

EXISTING (CY 2010) TRAFFIC VOLUMES AND NOISE LEVELS ALONG ROADWAYS IN PROJECT AREA (AM OR PM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	****** VOLUMES (VPH) ******** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Kapolei Parkway West of Kamaaha Ave. (AM)	39	798	763	4	31	66.0 (1)	63.9	59.8
Kapolei Pkwy. Between Kamaaha & Kinoiki St. (AM)	39	984	941	5	38	66.9 (1)	64.8	60.8
Kapolei Pkwy. Between Kinoiki & Kualakai Pkwy. (AM)	38	1,031	986	5	40	65.9 (1)	63.2	56.6
Kapolei Pkwy. Between Kualakai & Renton Rd. (AM)	38	762	729	4	29	64.6 (1)	61.9	55.3
Kapolei Pkwy. South of Renton Rd. (AM)	38	1,177	1,126	6	45	66.7 (1)	63.9	57.3
Kamaaha Ave. North of Kapolei Pkwy. (AM)	38	874	864	10	0	65.0	58.9	51.5
Kamaaha Ave. South of Kapolei Pkwy. (AM)	38	887	876	11	0	65.0	58.9	51.6
Kinoiki St. North of Kapolei Pkwy. (AM)	38	270	267	3	0	59.4	52.4	47.4
Kinoiki St. South of Kapolei Pkwy. (AM)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kualakai Pkwy. North of Kapolei Pkwy. (PM)	45	723	679	17	27	70.1(1)	68.0	64.2
Kualakai Pkwy. South of Kapolei Pkwy. (PM)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kualakai Pkwy. North of Roosevelt Ave. (PM)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Renton Rd. West of Kapolei Pkwy. (PM)	40	326	311	3	12	63.1	59.5	56.0
Renton Rd. East of Kapolei Pkwy. (AM)	40	1,040	993	10	37	68.1	64.5	61.0
Roosevelt Ave. West of Project Entrance Rd. (PM)	42	1,243	1,203	6	34	68.2	64.6	60.7
Roosevelt Ave. Between Entrance & Kualakai (PM)	42	1,243	1,203	6	34	68.2	64.6	60.7
Roosevelt Ave. East of Kualakai Pkwy. (PM)	42	1,243	1,203	6	34	68.2	64.6	60.7

NOTE:
(1) Traffic noise level calculated at 75 feet instead of 50 feet from roadway centerline.

TABLE 4

EXISTING AND CY 2015 DISTANCES TO 65 AND 70 DNL CONTOURS

STREET SECTION	65 DNL SETBACK (FT) EXISTING	65 DNL SETBACK (FT) CY 2015	70 DNL SETBACK (FT) EXISTING	70 DNL SETBACK (FT) CY 2015
Kapolei Parkway West of Kamaaha Ave. (AM)	65	90	< 40	< 50
Kapolei Pkwy. Between Kamaaha & Kinoiki St. (AM)	74	107	< 40	< 55
Kapolei Pkwy. Between Kinoiki & Kualakai Pkwy. (AM)	67	82	< 40	< 50
Kapolei Pkwy. Between Kualakai & Renton Rd. (AM)	58	84	< 40	< 50
Kapolei Pkwy. South of Renton Rd. (AM)	73	85	< 50	< 55
Kamaaha Ave. North of Kapolei Pkwy. (AM)	40	41	23	23
Kamaaha Ave. South of Kapolei Pkwy. (AM)	40	41	23	23
Kinoiki St. North of Kapolei Pkwy. (AM)	24	33	14	20
Kinoiki St. South of Kapolei Pkwy. (AM)	N/A	48	N/A	29
Kualakai Pkwy. North of Kapolei Pkwy. (PM)	120	333	76	134
Kualakai Pkwy. South of Kapolei Pkwy. (PM)	N/A	144	N/A	66
Kualakai Pkwy. North of Roosevelt Ave. (PM)	N/A	67	N/A	34
Renton Rd. West of Kapolei Pkwy. (PM)	51	52	19	20
Renton Rd. East of Kapolei Pkwy. (AM)	75	95	29	32
Roosevelt Ave. West of Project Entrance Rd. (PM)	136	160	52	64
Roosevelt Ave. Between Entrance & Kualakai (PM)	136	162	52	65
Roosevelt Ave. East of Kualakai Pkwy. (PM)	136	162	52	64

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLES 3 and 5 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for ground level receptors.

such, the location of a noise sensitive land use such as a hotel on the project site is considered acceptable by the land use compatibility guidelines of the State Department of Transportation, Airports Division.

CHAPTER VI. FUTURE NOISE ENVIRONMENT

Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 7 for CY 2015 with and without the proposed project. The future projections of project plus non-project traffic noise levels on the roadways which would service the project are shown in TABLE 5 for the applicable AM or PM peak traffic hour, under the Build Alternative. The changes in setback distances to the 65 and 70 DNL contours along the streets in the project environs are shown in TABLE 4. TABLE 6 presents the predicted changes in traffic noise levels along the various roadway sections resulting from non-project and project traffic. The largest increase (5.6 DNL) in future traffic noise levels is expected to occur along Kualakai Parkway north of Kapolei Parkway, with approximately half of the total increase associated with non-project traffic. The total increases in future traffic noise along the other street sections are expected to be less than 4 DNL units, with non-project traffic typically contributing 50 percent or greater proportion of the increases.

Kualakai Parkway is expected to become the dominant traffic noise corridor in the project area, and Kapolei Parkway is expected to become the second most dominant traffic noise corridor in the project environs. Roosevelt Avenue and Renton Road are expected to experience smaller increases in future traffic noise levels, and are expected to become less dominant traffic noise contributors in the project envrions.

Future traffic noise levels at the first row and second floors of existing residences which front Kapolei Parkway, at the first row of residences fronting Renton Road, and at the first row of existing residences on the makai side of Roosevelt Avenue are expected to remain above 65 DNL. The proposed hotel on the project site should be outside the 65 DNL traffic noise contour along Kapolei Parkway. Future traffic noise levels at existing residences along Kinoiki Street and Kamaaha Avenue are expected to continue to be less than 65 DNL. Where existing residences are located along Kapolei Parkway, future traffic noise level increases are predicted to range from 1.3 to 1.5 DNL due to non-project traffic and to range from 0.8 to 1.3 DNL due to project traffic. Along Renton Road and Roosevelt Avenue where residents are located, future traffic noise level increases due to non-project traffic are predicted to range from 0.4 to 0.9 DNL, and are predicted to range from 0.2 to 0.3 DNL due to project traffic.

The project site is currently located outside the 60 DNL aircraft noise contour associated with projected year 2025 operations at both Kalealoa and Honolulu International Airport. FIGURE 5, which was extracted from Reference 10, depicts the northern extent of the 60 DNL contour. Because the 60 DNL contour does not go beyond Roosevelt Avenue, and because the project site is located north of Roosevelt Avenue, noise sensitive land uses on the project site should remain outside the 60 DNL airport noise contour associated with projected year 2025 operations at both Kalealoa and Honolulu International Airport. As such, the location of a noise sensitive land use such as a hotel on the project site is considered acceptable by the land use compatibility guidelines of the State Department of Transportation, Airports Division.

TABLE 5

FUTURE (CY 2015) TRAFFIC VOLUMES AND NOISE LEVELS ALONG ROADWAYS IN PROJECT AREA (AM OR PM PEAK HOUR, BUILD)

LOCATION	SPEED (MPH)	TOTAL VPH	****** VOLUMES (VPH) ******** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Kapolei Parkway West of Kamaaha Ave. (PM)	39	1,387	1,327	7	53	68.3 (1)	66.2	62.2
Kapolei Pkwy. Between Kamaaha & Kinoiki St. (PM)	39	1,794	1,716	9	69	69.5 (1)	67.4	63.3
Kapolei Pkwy. Between Kinoiki & Kualakai Pkwy. (PM)	38	1,568	1,500	8	60	67.9 (1)	65.1	58.5
Kapolei Pkwy. Between Kualakai & Renton Rd. (PM)	38	1,681	1,608	8	65	68.1 (1)	65.4	58.8
Kapolei Pkwy. South of Renton Rd. (AM)	38	1,723	1,648	9	66	68.2 (1)	65.5	58.9
Kamaaha Ave. North of Kapolei Pkwy. (AM)	38	919	908	11	0	65.2	59.1	51.7
Kamaaha Ave. South of Kapolei Pkwy. (AM)	38	932	921	11	0	65.2	59.1	51.8
Kinoiki St. North of Kapolei Pkwy. (PM)	38	577	570	7	0	62.8	55.7	50.7
Kinoiki St. South of Kapolei Pkwy. (PM)	35	1,434	1,417	17	0	66.5	59.4	54.3
Kualakai Pkwy. North of Kapolei Pkwy. (PM)	45	2,603	2,442	62	99	75.7 (1)	73.6	69.8
Kualakai Pkwy. South of Kapolei Pkwy. (PM)	35	1,632	1,531	39	62	71.1 (1)	69.0	65.2
Kualakai Pkwy. North of Roosevelt Ave. (PM)	35	521	488	13	20	66.2 (1)	64.1	60.2
Renton Rd. West of Kapolei Pkwy. (PM)	40	344	329	3	12	63.2	59.6	56.2
Renton Rd. East of Kapolei Pkwy. (AM)	40	1,191	1,136	12	43	68.7	65.1	61.6
Roosevelt Ave. West of Project Entrance Rd. (PM)	42	1,597	1,546	8	43	69.3	65.7	61.7
Roosevelt Ave. Between Entrance & Kualakai (PM)	42	1,638	1,586	8	44	69.4	65.8	61.8
Roosevelt Ave. East of Kualakai Pkwy. (PM)	42	1,608	1,557	8	43	69.3	65.7	61.8

NOTE:
(1) Traffic noise level calculated at 75 feet instead of 50 feet from roadway centerline.

TABLE 6

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2015) (IN LEQ OR DNL)

STREET SECTION	NOISE LEVEL INCREASE DUE TO: NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Kapolei Parkway West of Kamaaha Ave. (AM)	1.5	0.8
Kapolei Pkwy. Between Kamaaha & Kinoiki St. (AM)	1.3	1.3
Kapolei Pkwy. Between Kinoiki & Kualakai Pkwy. (AM)	1.4	0.5
Kapolei Pkwy. Between Kualakai & Renton Rd. (AM)	2.0	1.5
Kapolei Pkwy. South of Renton Rd. (AM)	1.2	0.4
Kamaaha Ave. North of Kapolei Pkwy. (AM)	0.2	0.0
Kamaaha Ave. South of Kapolei Pkwy. (AM)	0.2	0.0
Kinoiki St. North of Kapolei Pkwy. (AM)	1.9	1.4
Kinoiki St. South of Kapolei Pkwy. (AM)	N/A	ALL (1)
Kualakai Pkwy. North of Kapolei Pkwy. (PM)	2.9	2.7
Kualakai Pkwy. South of Kapolei Pkwy. (PM)	N/A	ALL (1)
Kualakai Pkwy. North of Roosevelt Ave. (PM)	N/A	ALL (1)
Renton Rd. West of Kapolei Pkwy. (PM)	0.1	0.0
Renton Rd. East of Kapolei Pkwy. (AM)	0.4	0.2
Roosevelt Ave. West of Project Entrance Rd. (PM)	0.9	0.2
Roosevelt Ave. Between Entrance & Kualakai (PM)	0.9	0.3
Roosevelt Ave. East of Kualakai Pkwy. (PM)	0.9	0.2

Note:
(1) All of future traffic noise increases on new roadways are associated with project traffic.

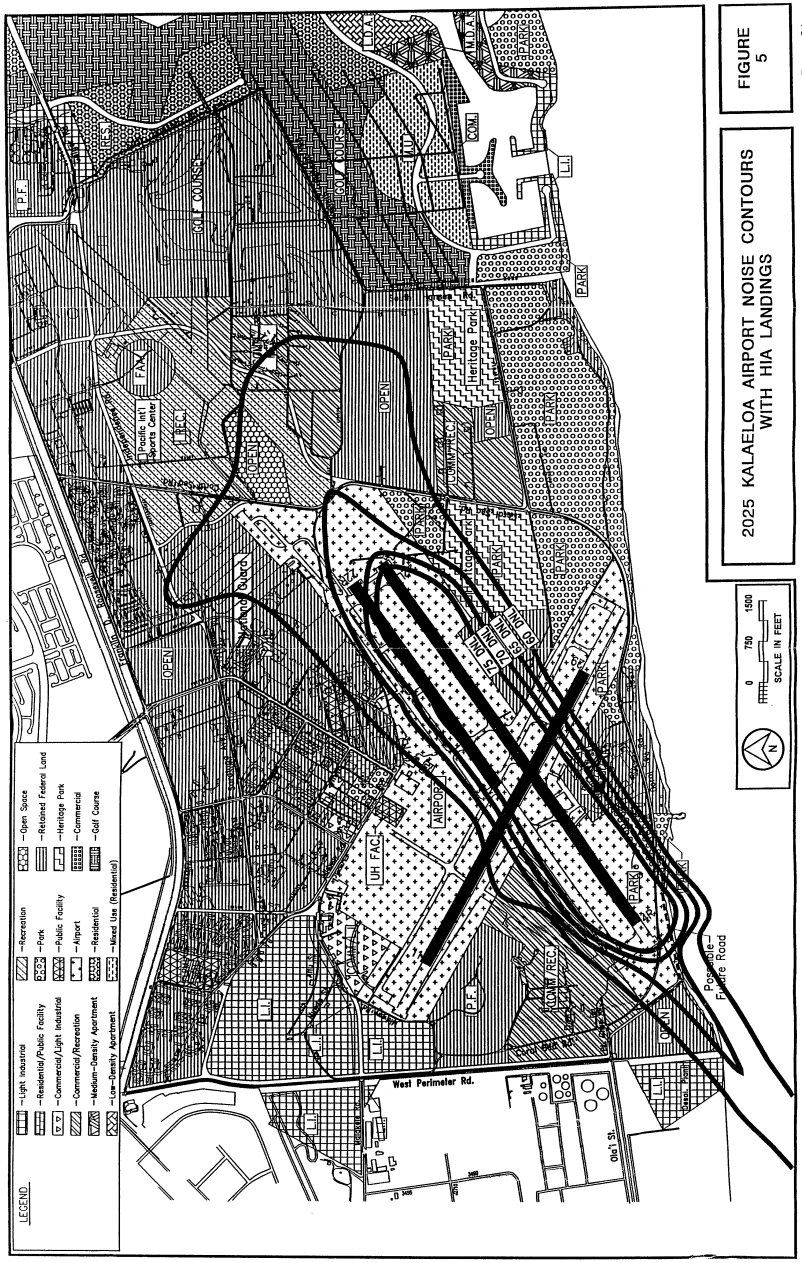


FIGURE 5

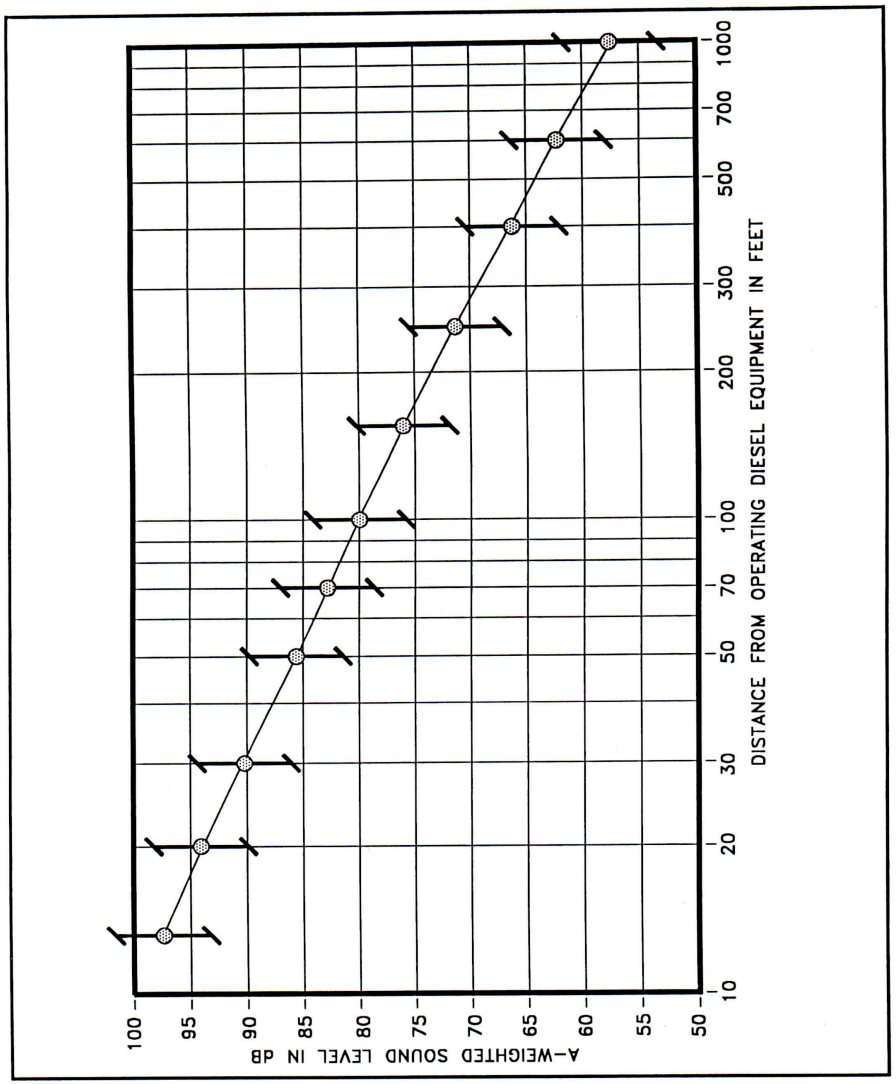
2025 KALAELOA AIRPORT NOISE CONTOURS WITH HIA LANDINGS

CHAPTER VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE MITIGATION MEASURES

Traffic Noise. Closure and air conditioning of residences is an effective traffic noise mitigation measure, particularly at second floor living areas which are difficult to shield with sound attenuating walls. Except for those noise sensitive structures which are air conditioned or which are shielded by sound attenuating walls, existing traffic noise levels could result in adverse noise impacts at residences which front Kapolei Parkway, Roosevelt Avenue, and Renton Road. By 2015, with or without the proposed project, traffic noise levels at these same residences are predicted to increase, with most of the increases associated with non-project traffic. Traffic noise mitigation measures are typically implemented by individual homeowners and/or developers of noise sensitive properties located along roadways, and these mitigation measures typically involve closure and air conditioning and/or the addition of sound attenuating walls. Along public roadways, traffic noise mitigation measures are also considered for implementation in conjunction with roadway improvement projects, with mitigation measures typically involving sound attenuating walls which can be constructed within the public Rights-of-Way. Because motor vehicle traffic noise usually originates from multiple sources and from multiple contributors to total traffic along public roadways, its mitigation has historically been the responsibility of individual homeowners, developers who locate noise sensitive properties along roadways, or government agencies who are involved in roadway improvement projects.

General Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of exterior noise from construction activity (excluding pile driving activity) at various distances from the job site are shown in FIGURE 6. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in FIGURE 6, while the intermittent noise levels of vibratory pile drivers are at the upper end of the noise level ranges depicted in the figure.

FIGURE 6 is useful for predicting exterior noise levels at short distances (within 100 feet) from the work when visual line of sight exists between the construction equipment and the receptor. Direct line-of-sight distances from the construction equipment to existing residential buildings will range from 350 feet to 2,600 feet, with corresponding average noise levels of 68 to 27 dBA (plus or minus 5 dBA). For receptors along a cross-street, the construction noise level vs. distance curve of FIGURE 6 should be reduced by approximately 8 dBA when the work is occurring at the intersection with the cross street, and should be reduced by 15 dBA when work is occurring at least 100 feet from the intersection (and the visual line-of-sight is blocked



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 6

by intervening buildings). Typical levels of construction noise inside naturally ventilated and air conditioned structures are approximately 10 and 20 dB less, respectively, than the levels shown in FIGURE 6.

The existing residences along Nanahu Street and located west of the project site are predicted to experience the highest noise levels during construction activities. The highest noise levels are expected to occur during the earthwork and site preparation phase of construction. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work, and due to the administrative controls available for regulation of construction noise. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 feet distance), and due to the exterior nature of the work (sheet pile driving, grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site.

Peak airborne noise levels from pile diving may be as much as 15 dBA greater than noise levels shown in FIGURE 6 for non-impulsive (steady) construction noise sources. Although the pile driving can produce more intense noise levels, each pulse is of short individual duration (less than one second). Therefore, its impact on speech communication is not as severe as that of steady source of the same noise level.

Severe noise impacts are not expected to occur inside air conditioned structures which are beyond 350 feet of the project construction site. Inside naturally ventilated structures, interior noise levels (with windows or doors opened) are estimated to range between 54 to 64 dBA at 350 feet distance from the construction site. Closure of all doors and windows facing the construction site would generally reduce interior noise levels by an additional 5 to 10 dBA.

The incorporation of State Department of Health construction noise permit procedures (in Reference 4) is another noise mitigation measure which is normally applied to construction activities. FIGURE 7 depicts the normally permitted hours of construction. Noisy construction activities are not allowed on Sundays and holidays, during the early morning, and during the late evening and nighttime periods under the DOH permit procedures.

Potential Noise Impacts Associated with New Fire Station. A new fire station is expected to be constructed across Kapolei Parkway from the project site, and the average sound level from sirens is predicted to be in the order of 86 dBA in the vicinity of the planned hotel on the project site. Because the hotel is expected to service business travelers, is expected to be air conditioned, and can therefore utilize sound attenuation measures (increased setbacks or the use of sound attenuation glazing), adverse noise impacts should be avoidable.

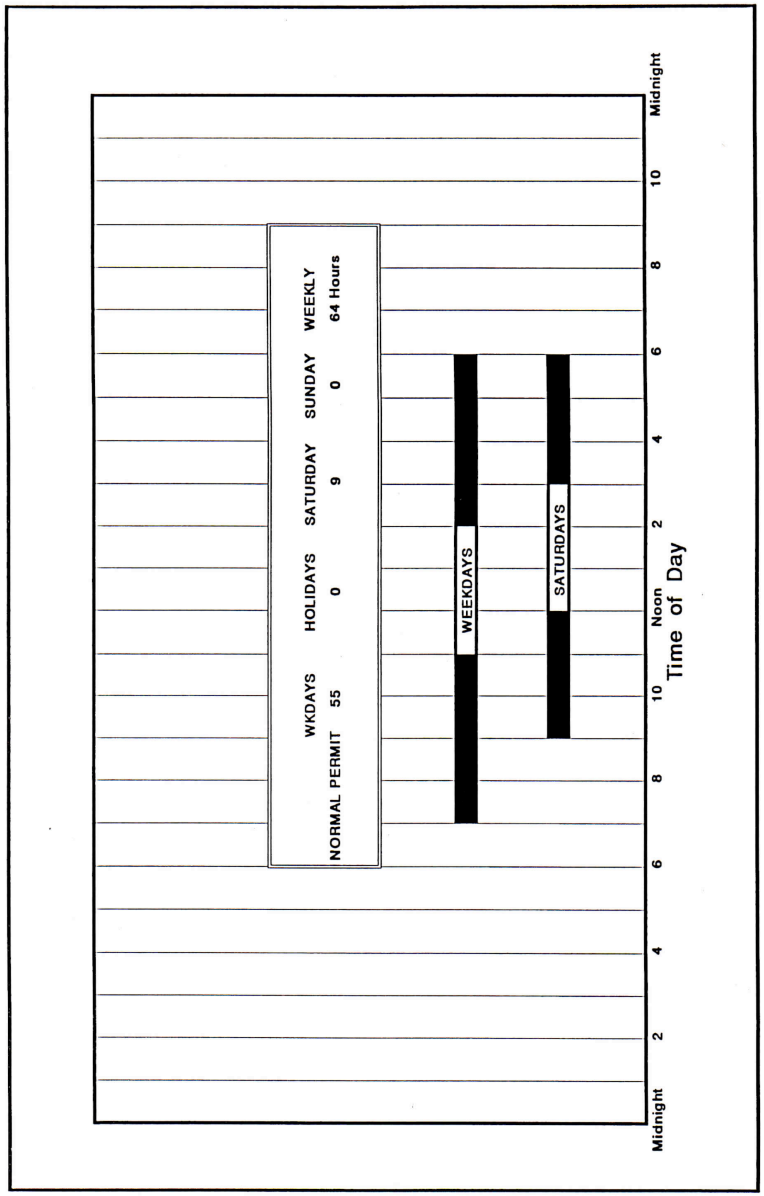


FIGURE 7

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 FR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; As Amended March 29, 1984.

(3) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety;" Environmental Protection Agency (EPA 550/9-74-004); March 1974.

(4) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

(5) "Mandatory Seller Disclosures in Real Estate Transactions;" Chapter 508D, Hawaii Revised Statutes; July 1, 1996.

(6) "FHWA Traffic Noise Model User's Guide;" FHWA-PD-96-009, Federal Highway Administration; Washington, D.C.; January 1998 and Version 2.5 Upgrade (April 14, 2004).

(7) Existing (2010) and Future (2015) Traffic Turning Movements for Makana Ali`i Project; PB Americas, Inc; May 2011.

(8) 24-Hour Traffic Counts, Kapolei Parkway 0.2 Miles East of Kamaaha Avenue; State Department of Transportation; August 18, 2009.

(9) 24-Hour Traffic Counts, Renton Road Between Alaiki Street and Kapolei Parkway; State Department of Transportation; February 4, 2009.

(10) "Acoustic Working Paper for the Kalaeloa Community Development Plan; Kalaeloa Airport; Kapolei, Oahu; Y. Ebisu & Associates; August 2005.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the Time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level[4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average Value Over (Non-Time Domain) Set of Observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level Exceeded x% of the Total Set of (Non-Time Domain) Observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x Value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX C

SUMMARY OF BASE YEAR AND YEAR 2015 TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2010 ***** AM VPH	PM VPH	CY 2015 (NO BUILD) AM VPH	PM VPH	CY 2015 (BUILD) AM VPH	PM VPH
Kapolei Pkwy.; W. of Kamaaha (EB)	346	235	501	409	655	684
Kapolei Pkwy.; W. of Kamaaha (WB)	452	196	627	359	681	703
Two-Way	798	431	1,128	768	1,336	1,387
Kapolei Pkwy.; Kamaaha to Kinoiki (EB)	464	332	642	521	796	796
Kapolei Pkwy.; Kamaaha to Kinoiki (WB)	520	458	716	655	770	999
Two-Way	984	790	1,357	1,175	1,565	1,794
Kapolei Pkwy.; Kinoiki to Kualakai Pkwy. (EB)	456	362	702	560	757	824
Kapolei Pkwy.; Kinoiki to Kualakai Pkwy. (WB)	575	454	640	827	803	744
Two-Way	1,031	816	1,342	1,386	1,560	1,568
Kapolei Pkwy.; Kualakai Pkwy. to Renton (EB)	288	416	472	670	535	933
Kapolei Pkwy.; Kualakai Pkwy. to Renton (WB)	474	289	725	521	861	748
Two-Way	762	705	1,197	1,191	1,396	1,681
Kapolei Pkwy.; S. of Renton (NB)	733	348	957	543	1,066	725
Kapolei Pkwy.; S. of Renton (SB)	444	498	606	726	657	937
Two-Way	1,177	846	1,563	1,269	1,723	1,662
Kamaaha Ave.; N. of Kapolei Pkwy. (NB)	441	316	464	332	464	332
Kamaaha Ave.; N. of Kapolei Pkwy. (SB)	433	211	455	222	455	222
Two-Way	874	527	919	554	919	554
Kamaaha Ave.; S. of Kapolei Pkwy. (NB)	487	142	512	149	512	149
Kamaaha Ave.; S. of Kapolei Pkwy. (SB)	400	213	420	225	420	225
Two-Way	887	355	932	374	932	374
Kinoiki St.; N. of Kapolei Pkwy. (NB)	154	80	189	173	220	303
Kinoiki St.; N. of Kapolei Pkwy. (SB)	116	105	234	161	302	274
Two-Way	270	185	423	334	522	577
Kinoiki St.; S. of Kapolei Pkwy. (NB)	N/A	N/A	N/A	N/A	182	864
Kinoiki St.; S. of Kapolei Pkwy. (SB)	N/A	N/A	N/A	N/A	314	570
Two-Way	N/A	N/A	N/A	N/A	496	1,434
Kualakai Pkwy.; N. of Kapolei Pkwy. (NB)	380	252	713	557	948	1,266
Kualakai Pkwy.; N. of Kapolei Pkwy. (SB)	307	471	524	832	825	1,337
Two-Way	687	723	1,237	1,389	1,773	2,603

APPENDIX C (CONTINUED)

SUMMARY OF BASE YEAR AND YEAR 2015 TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2010 *****		CY 2015 (NO BUILD)		CY 2015 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Kualakai Pkwy.; S. of Kapolei Pkwy. (NB)	N/A	N/A	N/A	N/A	327	852
Kualakai Pkwy.; S. of Kapolei Pkwy. (SB)	N/A	N/A	N/A	N/A	545	780
Two-Way	N/A	N/A	N/A	N/A	872	1,632
Kualakai Pkwy.; N. of Roosevelt (NB)	N/A	N/A	N/A	N/A	234	319
Kualakai Pkwy.; N. of Roosevelt (SB)	N/A	N/A	N/A	N/A	142	202
Two-Way	N/A	N/A	N/A	N/A	376	521
Renton Rd.; W. of Kapolei Pkwy. (EB)	97	216	102	228	102	228
Renton Rd.; W. of Kapolei Pkwy. (WB)	192	110	202	116	202	116
Two-Way	289	326	304	344	304	344
Renton Rd.; E. of Kapolei Pkwy. (EB)	524	362	577	419	589	471
Renton Rd.; E. of Kapolei Pkwy. (WB)	516	276	575	327	602	372
Two-Way	1,040	638	1,152	746	1,191	843
Roosevelt Ave.; W. of Project Entrance (EB)	293	788	308	828	385	1,019
Roosevelt Ave.; W. of Project Entrance (WB)	657	455	478	691	761	578
Two-Way	950	1,243	786	1,519	1,146	1,597
Roosevelt Ave.; Proj. Entr. to Kualakai (EB)	293	788	308	828	386	1,046
Roosevelt Ave.; Proj. Entr. to Kualakai (WB)	657	455	478	691	777	593
Two-Way	950	1,243	786	1,519	1,162	1,638
Roosevelt Ave.; E. of Kualakai Pkwy. (EB)	293	788	308	828	388	971
Roosevelt Ave.; E. of Kualakai Pkwy. (WB)	657	455	478	691	867	637
Two-Way	950	1,243	786	1,519	1,255	1,608

Appendix F

Air Quality Impact Analysis

AIR QUALITY STUDY

FOR THE PROPOSED

KA MAKANA ALII PROJECT

EAST KAPOLEI, OAHU, HAWAII

Prepared for:

Hawaii DeBartolo LLC

June 2011

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7 Estimated Indirect Air Pollution Emissions from Ka Makana Alii Project Electrical Demand

8 Estimated Indirect Air Pollution Emissions from Ka Makana Alii Project Solid Waste Disposal Demand

1.0 SUMMARY

Hawaii DeBartolo LLC is proposing to develop the Ka Makana Alii Project at East Kapolei, Oahu. The proposed project will consist of retail, hotel and office space on approximately 67 acres of land leased from the Department of Hawaiian Home Lands. The project is expected to be completed and fully occupied by 2015. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities and suggests mitigative measures to reduce any potential air quality impacts where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are generally comparable to the national standards although the state standards for carbon monoxide are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the Kapolei area is very much affected by its leeward and coastal situation. Winds are predominantly trade winds from the east northeast except for occasional periods when kona storms may generate strong winds from the south or when the trade winds are weak and landbreeze-seabreeze circulations may develop. Wind speeds typically vary between about 5 and 15 miles per hour providing relatively good ventilation much of the time. Temperatures in the leeward Oahu area are generally very moderate

with average daily temperatures ranging from about 65°F to 84°F. The extreme minimum temperature recorded at the nearby (former) Ewa Plantation is 47°F, while the extreme maximum temperature is 93°F. This area of Oahu is one of the drier locations in the state with rainfall often highly variable from one year to the next. Monthly rainfall has been measured to vary from as little as a trace to as much as 15 inches. Average annual rainfall amounts to about 21 inches with summer months being the driest.

The present air quality of the project area appears to be reasonably good based on nearby air quality monitoring data. Air quality data from the nearest monitoring stations operated by the Hawaii Department of Health suggest that all national air quality standards are currently being met. It is possible, however, that occasional exceedances of the more stringent state standards for carbon monoxide may occur near congested roadway intersections.

If the proposed project is given the necessary approvals to proceed, it may be inevitable that some short- and/or long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved

roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, motor vehicles coming to and from the proposed development will result in a long-term increase in air pollution emissions in the project area. To assess the impact of emissions from these vehicles, a computer modeling study was undertaken to estimate current ambient concentrations of carbon monoxide at intersections in the project vicinity and to predict future levels both with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour carbon monoxide concentrations are within both the state and the national ambient air quality standards. In the year 2015 without the project, carbon monoxide concentrations were predicted to generally increase somewhat in the project area, but worst-case concentrations should remain well within air quality standards. With the project in the year 2015, project-related traffic would result in higher carbon monoxide concentrations compared to the without-project case at some locations, but worst-case concentrations should remain well within air quality standards. With the project and with the North-South Road (Kualakai Parkway) extension to Roosevelt Avenue, worst-case carbon monoxide concentrations were estimated

to remain about the same or increase only slightly at some locations compared to without the roadway extension. Implementing mitigation measures for traffic-related air quality impacts is probably unnecessary and unwarranted.

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Quantitative estimates of these potential impacts were not made, but based on the estimated demand levels and emission rates involved, any impacts will likely be negligible. Nevertheless, incorporating energy conservation design features and promoting conservation and recycling programs within the proposed development could serve to further reduce any associated impacts.

2.0 INTRODUCTION

Hawaii DeBartolo LLC is proposing to develop the Ka Makana Alii Project on approximately 67 acres of vacant lands leased from the Department of Hawaiian Home Lands. The project site is situated between Kapolei Parkway and Roosevelt Avenue in East Kapolei immediately makai of the Department of Hawaiian Home Lands offices (see Figure 1 for project location). The development will include: a major department store, a family entertainment complex, a mixed-use village with specialty retail and restaurants, two hotels, low-rise office buildings, and a neighborhood commercial center with specialty market, drugstore and convenience shops and services. Construction of the project is expected to occur in two phases commencing during 2013. Full build out is anticipated by 2015.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate potential project impacts are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS

are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit. On the other hand, the current Hawaii AAQS for sulfur dioxide are probably less stringent than the national standards. During the early part of 2010, the national primary annual and 24-hour standards for sulfur dioxide were revoked in favor of a new national 1-hour standard which is considered to be more stringent than the Hawaii short-term standards. The Hawaii AAQS for sulfur dioxide have not yet been updated to bring them in line with the national standards.

In 1993, the state revised its particulate standards to follow those set by the federal government. During 1997, the federal

government again revised its standards for particulate, but the new standards were challenged in federal court. A Supreme Court ruling was issued during February 2001, and as a result, the new standards for particulate were finally implemented during 2005. To date, the Hawaii Department of Health has not updated the state particulate standards.

In September 2001, the state vacated the state 1-hour standard for ozone and an 8-hour standard was adopted that was the same as the national standard. During 2008, the national standard for ozone was again revised and made more stringent. The Hawaii standard for ozone has not yet been amended to follow the national standard.

During the latter part of 2008, EPA revised the standard for lead making the standard more stringent. So far, the Hawaii Department of Health has not revised the corresponding state standard for lead.

During early 2010, a national 1-hour primary standard for nitrogen dioxide was implemented. To date, Hawaii has not promulgated a 1-hour standard for nitrogen dioxide, but the Hawaii annual standard for this pollutant is more stringent than the national annual standard.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affects the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. On the island of Oahu, the Koolau and Waianae Mountain Ranges are oriented almost perpendicular to the trade winds, which accounts for much of the variation in the local climatology of the island. The site of the proposed project is located on the broad Ewa Plain leeward of the Koolau Mountains.

Wind frequency data for Honolulu International Airport (HIA), which is located about 8 miles to the east of the project site, are given in Table 2. These data can be expected to be reasonably representative of the project area. Wind frequency for HIA show that the annual prevailing wind direction for this area of Oahu is east northeast. On an annual basis, 34.7 percent of the time the wind is from this direction, and more than 70 percent of the time the wind is in the northeast quadrant. Winds from the south are infrequent occurring only a few days during the year and mostly in winter in association with kona storms. Wind speeds average about 10 knots (12 mph) and mostly vary between about 5 and 15 knots (6 and 17 mph).

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depend to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project's near coastal, leeward location results in a relatively moderate temperature profile compared to other locations around Oahu and the state. Based on more than 50 years of data collected at the former nearby Ewa Plantation, average annual daily minimum and maximum temperatures in the project area are 65°F and 84°F, respectively [1]. The extreme minimum temperature on record is 47°F, and the extreme maximum is 93°F.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is oftentimes measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Kapolei area, stability class 5 or 6 is generally the highest stability class that occurs, developing during clear, calm

nighttime or early morning hours when temperature inversions form due to radiational cooling. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3000 feet (1000 meters).

Rainfall can have a beneficial affect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The Ewa Plain is one of the driest areas on Oahu due to its leeward and near sea level location. Average annual rainfall amounts to about 21 inches but may vary from about 10 inches during a dry year to more than 40 inches during a wet year [1]. Most of the rainfall usually occurs

during the winter months. Monthly rainfall may vary from as little as a trace to as much as 15 inches or more.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from motor vehicles, industrial sources, agricultural operations and to a lesser extent by natural sources. Table 3 presents an air pollutant emission summary for the island of Oahu for calendar year 1993. This is the most recent information available. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the particulate emissions on Oahu originate from area sources, such as the mineral products industry and agriculture. Sulfur oxides are emitted almost exclusively by point sources, such as power plants and refineries. Nitrogen oxides emissions emanate predominantly from industrial point sources, although area sources (mostly motor vehicle traffic) also contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources. Based on previous emission inventories that have been reported for Oahu, emissions of particulate and nitrogen oxides may have increased during the past several years, while emissions of sulfur oxides, carbon monoxide and hydrocarbons probably have declined.

The H-1 Freeway, which passes near the project area to the north, is a major arterial roadway that presently carries moderate to heavy levels of vehicle traffic during peak traffic hours. Emissions from motor vehicles using this roadway, primarily

nitrogen oxides and carbon monoxide, will tend to be carried away from the project site by the prevailing winds.

Several sources of industrial air pollution are located in the Campbell Industrial Park, which is located about 4 miles to the southwest of the project site at Barbers Point. Industries currently operating there include the Chevron and BHP refineries, H-Power, Kalaeloa Partners, Applied Energy Services, Hawaiian Cement and others. Hawaiian Electric Company's Kahe Generating Station is located a few miles to the northwest at Kahe Point. These industries emit large amounts of sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide and other air pollutants. Prevailing winds from the east or northeast will carry these emissions away from the site most of the time.

Until recently, air pollution in the project area originating from agricultural sources could mainly be attributed to sugar cane operations near the project site. Emissions from both the mill and the canefield operations in the area have now been eliminated with the closure of the Oahu Sugar Company and much of the former sugarcane lands are currently being used as pasture-land or for diversified agriculture. Long-range uses for the land have not yet been fully determined.

Natural sources of air pollution emissions that also could affect the project area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and perhaps distant volcanoes on the island of Hawaii.

The State Department of Health operates a network of air quality monitoring stations at various locations on Oahu. Each station, however, typically does not monitor the full complement of air quality parameters. Table 4 shows annual summaries of air quality measurements that were made nearest to the project area for several of the regulated air pollutants for the period 2005 through 2009. These are the most recent data that are currently available.

During the 2005-2009 period, sulfur dioxide was monitored by the State Department of Health at an air quality station located at Kapolei. Concentrations monitored were consistently low compared to the standards. Annual second-highest 3-hour concentrations (which are most relevant to the air quality standards) ranged from 0.004 to 0.011 parts per million (ppm), while the annual second-highest 24-hour concentrations were consistently at 0.003 ppm. Annual average concentrations were only about 0.001 to 0.002 ppm. There were no exceedances of the state/national 3-hour or 24-hour AAQS for sulfur dioxide during the 5-year period. Data pertaining to the new 1-hour standard have not yet been reported.

Particulate matter less than 10 microns in diameter (PM-10) is also measured at the Kapolei monitoring station. Annual second-highest 24-hour PM-10 concentrations ranged from 36 to 58 $\mu g/m^3$ between 2005 and 2009. Average annual concentrations ranged from 15 to 18 $\mu g/m^3$. All values reported were within the state and national AAQS.

Particulate matter less than 2.5 microns in diameter (PM-2.5) measured at the Kapolei monitoring station had annual 98th percentile 24-hour concentrations ranging from 7 to 21 $\mu g/m^3$ between 2005 and 2009. Average annual concentrations ranged from 4 to 6 $\mu g/m^3$. All values reported were within the state and national AAQS.

Carbon monoxide measurements were also made at the Kapolei monitoring station. The annual second-highest 1-hour concentrations ranged from 0.9 to 2.6 ppm. The annual second-highest 8-hour concentrations ranged from 0.7 to 1.2 ppm. These values are well within the standards, and no exceedances of the state or national 1-hour or 8-hour AAQS were reported.

Nitrogen dioxide is also monitored by the Department of Health at the Kapolei monitoring station. Annual average concentrations of this pollutant ranged from 0.004 to 0.005 ppm, safely inside the state and national AAQS.

The nearest available ozone measurements were obtained at Sand Island (about 11 miles east of the project area). The fourth-highest 8-hour concentrations (which are most relevant to the standard) for the period 2005 through 2009 ranged between 0.033 and 0.048 ppm, well inside the state and federal standards. The 8-hour standard for ozone did not exist prior to 2002. Prior to 2002, the now obsolete state 1-hour standard was typically exceeded several times each year.

Although not shown in the table, the nearest and most recent measurements of ambient lead concentrations that have been reported were made at the downtown Honolulu monitoring station between 1996 and 1997. Average quarterly concentrations were near or below the detection limit, and no exceedances of the state AAQS were recorded. Monitoring for this parameter was discontinued during 1997.

Based on the data and discussion presented above, it appears likely that the State of Hawaii AAQS for sulfur dioxide, nitrogen dioxide, particulate matter, ozone and lead are currently being met in the project area. While carbon monoxide measurements at the Kapolei monitoring station suggest that concentrations are within the state and national standards, local "hot spots" may exist near traffic-congested intersections. The potential for this within the specific project area is examined later in this report.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting

construction workers, and from the disruption of normal traffic flow caused by lane closures of adjacent roadways.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions at the project site would likely be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in

motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions. Monitoring dust at the project property line could be considered to quantify and document the effectiveness of dust control measures.

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

Project construction activities will also likely obstruct the normal flow of traffic at times to such an extent that overall vehicular emissions in the project area will temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from construction areas during periods of low traffic volume. Thus, most potential short-

term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation required further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, and these began to take effect during the past decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. It is estimated that carbon monoxide emissions, for example, will go down by an average of about 20 to 30 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new development.

For this project, four scenarios were selected for the carbon monoxide modeling study: (1) year 2010 with present conditions, (2) year 2015 without the project, (3) year 2015 with the project, and year 2015 with the project and with the North-South Road (Kualakai Parkway) extension. To begin the modeling study of the four scenarios, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, several of the key intersections identified in the traffic study were also selected for air quality analysis. These included the following intersections:

- Kapolei Parkway at Kamaaha Avenue
- Kapolei Parkway at Kinoiki Street
- Kapolei Parkway at Kualakai Parkway
- Kapolei Parkway at Renton Road

- Kualakai Parkway at East Entrance
- Kualakai Parkway at Roosevelt Avenue
- Roosevelt Avenue at South Entrance

The traffic impact report for the project [4] describes the projected future traffic conditions and laneage configurations of these intersections in detail. In performing the air quality impact analysis, it was assumed that all recommended traffic mitigation measures would be implemented.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the four scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report evaluated morning and afternoon peak traffic periods. These same periods were evaluated in the air quality impact assessment.

The EPA computer model MOBILE6.2 [5] was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE6.2 is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the present vehicle mix in the project area was estimated to be 35.4% light-duty gasoline-

powered automobiles, 51.7% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.6% heavy-duty diesel-powered trucks and buses, and 0.5% motorcycles. For the future scenarios studied, the vehicle mix was estimated to change slightly with fewer light-duty gasoline-powered automobiles and more light-duty gasoline-powered trucks and vans.

Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE6.2 generally have an inverse relationship to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE6.2, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [6] currently recommend that the computer model CAL3QHC [7] be used to assess carbon monoxide concentrations at roadway intersections, or in areas where its use has previously been established, CALINE4 [8] may be used. Until a few years ago, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was thought the model has become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular emissions near roadway intersections. It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Although CAL3QHC is intended primarily for use in assessing atmospheric dispersion near signalized roadway intersections, it can also be used to evaluate unsignalized intersections. This is accomplished by manually estimating queue lengths and then applying the same techniques used by the model for signalized intersections. Currently, one of the study intersections is unsignalized, Kapolei Parkway at Kinoiki Street. For the future scenarios (with or without the project), in accordance with the traffic report, this intersection was assumed to become signalized. For the future with-project scenario, the intersections of Kualakai Parkway at Roosevelt Avenue and Roosevelt Avenue at the South Entrance were assumed to be unsignalized.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, saturation capacity estimates, intersection laneage and signal timings (where applicable). All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOBILE6.2 based on assumed free-flow vehicle speeds corresponding to the posted speed limits (25 to 35 mph depending on location).

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all three scenarios. This implies that pedestrian sidewalks either already exist or are assumed to exist in the future. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning cases, while atmospheric stability category 4 was assumed for the afternoon cases. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within suburban areas for these periods. A surface roughness length of 100 cm and a mixing height of 1000 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at low levels. Thus, background contributions of carbon monoxide from sources or

roadways not directly considered in the analysis were accounted for by adding a background concentration of 1.0 ppm to all predicted concentrations for 2010. Although increased traffic is expected to occur within the project area during the next several years with or without the project, background carbon monoxide concentrations may not change significantly since individual emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 1.0 ppm was assumed to persist for the future scenarios studied.

Predicted Worst-Case 1-Hour Concentrations

Table 5 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for four scenarios: year 2010 with existing traffic, year 2015 without the project, year 2015 with the project and year 2015 with the project and with the North-South Road extension. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (2010) case was 4.9 ppm. This was projected to occur during the morning peak traffic hour near the intersection of Kapolei Parkway and Kamaaha Avenue. Concentrations at other locations and times studied were 3.9 ppm or lower. All predicted worst-case 1-hour concentrations for the 2010 scenario were within both the national AAQS of 35 ppm and the state standard of 9 ppm.

In the year 2015 without the proposed project, the highest worst-case 1-hour concentration was again predicted to occur during the morning at the intersection of Kapolei Parkway and Kamaaha Avenue. A value of 4.5 ppm was predicted to occur at this location and time. Peak-hour worst-case values at the other locations and times studied for the 2015 without project scenario ranged between 2.2 and 4.0 ppm. Compared to the existing case, concentrations generally increased somewhat, but all projected worst-case concentrations for this scenario remained well within the state and national standards.

In the year 2015 with the proposed project, the predicted highest worst-case 1-hour concentration occurred during the morning at the intersection of Kapolei Parkway and Kualakai Parkway with a value of 4.7 ppm. Other concentrations for this scenario ranged between 2.6 and 4.6 ppm. Although the predicted concentrations increased at most of the locations studied compared to the without project scenario, the values remained well within the state and federal standards.

In the year 2015 with the proposed project and with the extension of the North-South Road (Kualakai Parkway) to Roosevelt Avenue, worst-case 1-hour concentrations changed only slightly with a slightly higher concentration of 5.0 ppm occurring during the morning at the intersection of Kapolei Parkway and Kualakai Parkway. All predicted worst-case 1-hour concentrations remained well within the standards.

Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological conditions are more variable (and hence more favorable for dispersion) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.7 unless a locally derived persistence factor is available. Recent monitoring data for locations on Oahu reported by the Department of Health [11] suggest that this factor may range between about 0.2 and 0.6 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentrations.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 6. For the 2010 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the four locations studied ranged from 1.4 ppm at the Kapolei Parkway/Kinoiki Street intersection to 2.4 ppm at the Kapolei Parkway/Kamaaha Avenue intersection. The estimated worst-case concentrations for the existing case were within both the state standard of 4.4 ppm and the national limit of 9 ppm.

For the year 2015 without project scenario, worst-case concentrations ranged between 1.6 and 2.2 ppm, with the highest concentration occurring at Kapolei Parkway and Kamaaha Avenue. All predicted concentrations were within the standards.

For the 2015 with project scenario, worst-case concentrations were predicted to increase somewhat at compared to the without project case. Predicted worst-case concentrations ranged from 2.0 to 2.4 ppm with the highest concentration occurring at the intersection of Kapolei Parkway and Kualakai Parkway. All predicted 8-hour concentrations for this scenario were within both the national and the state AAQS.

In the year 2015 with the project and with the North-South Road extension to Roosevelt Avenue, predicted worst-case 8-hour concentrations remained the same or changed only slightly. All predicted concentrations for this scenario were well within the national and the state AAQS.

Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values

given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

7.2 Electrical Demand

The proposed project also will cause indirect air pollution emissions from power generating facilities as a consequence of electrical power usage. The annual electrical demand of the project is estimated to reach approximately 41 million kilowatt-hours [12]. Electrical power for the project will most probably be provided mainly by oil-fired generating facilities located on Oahu, but some of the project power could also come from sources burning other fuels, such as H-Power and the AES coal-fired power plant at Campbell Industrial Park, or from renewable energy resources that are currently being developed. In order to meet the electrical power needs of the proposed project, power generating facilities may be required to burn more fuel and hence more air pollution may be emitted at these facilities. Given in Table 7 are estimates of the indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at Oahu's power plants. These values can be compared to the island-wide emission estimates for 1993 given in Table 3. The estimated indirect emissions from project electrical demand amount to less than 1 percent of the present air pollution emissions occurring on Oahu.

7.3 Solid Waste Disposal

Solid waste generated by the proposed development when fully completed and occupied is not expected to exceed about 13 tons

per day [13]. Most project refuse will likely be hauled away and burned at the H-Power facility at Campbell Industrial Park to generate electricity. Burning of the waste to generate electricity will result in emissions of particulate, carbon monoxide and other contaminants, but these will be offset to some extent by reducing the amount of fuel oil that would be required to generate electricity for the project. Table 8 gives emission estimates assuming all project solid waste is burned at H-Power. These values can be compared to the island-wide emission estimates for 1993 given in Table 3. The estimated potential indirect emissions from project solid waste disposal demand amount to less than 0.1 percent of the present air pollution emissions occurring on Oahu.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The major potential short-term air quality impact of the project will occur from the emission of fugitive dust during construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Paving of parking areas and establishment of landscaping

early in the construction schedule will also help to control dust. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After construction of the proposed project is completed and it is fully occupied, carbon monoxide concentrations in the project area will likely increase due to emissions from project-related motor vehicle traffic, but worst-case concentrations should remain within both the state and the national ambient air quality standards. Implementing any air quality mitigation measures for long-term traffic-related impacts is probably unnecessary and unwarranted.

Any long-term impacts on air quality due to indirect emissions from supplying the project with electricity and from the disposal of waste materials generated by the project will likely be negligible based on the magnitudes of the estimated emissions compared to the current island-wide emissions. To further moderate any impacts, any related air pollution could likely be

reduced somewhat by the promotion of energy conservation and recycling programs within the proposed development.

REFERENCES

1. "Climatic Summary of the United States, Supplement for 1951 through 1960, Hawaii and Pacific", U.S. Department of Commerce, Weather Bureau, Washington, D.C., 1965.

2. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1995.

3. State of Hawaii. Hawaii Administrative Rules, Chapter 11-60, Air Pollution Control.

4. PB Americas, Inc., Traffic Impact Assessment Report for Ka Makana Alii, Draft, May 2011.

5. User's Guide to MOBILE6.0, Mobile Source Emission Factor Model, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Assessment and Standards Division, Ann Arbor, Michigan, January 2002.

6. Guideline on Air Quality Models (Revised), Including Supplements A and B, EPA-450/2-78-027R, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1986.

7. User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, U.S. Environmental Protection Agency, November 1992.

8. CALINE4 - A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways, FHWA/CA/TL-84/15, California State Department of Transportation, November 1984 with June 1989 Revisions.

9. "Persistence Factors for Mobile Source (Roadway) Carbon Monoxide Modeling", C. David Cooper, Journal of the Air & Waste Management Association, Volume 39, Number 5, May 1989.

10. Guideline for Modeling Carbon Monoxide from Roadway Intersections, U.S. Environmental Protection Agency, EPA-454/R-92-005, November 1992.

11. Annual Summaries, Hawaii Air Quality Data, 2005-2009, State of Hawaii Department of Health.

12. Personal communication via email, Lee Sichter, to Barry Neal, B.D. Neal & Associates, May 3, 2011, "Ka Makana Alii Preliminary Energy Consumption Budget".

13. Personal communication via email, Lee Sichter, to Barry Neal, B.D. Neal & Associates, May 3, 2011, "Ka Makana Alii Solid Waste Generation".

Figure 1 - Project Location Map

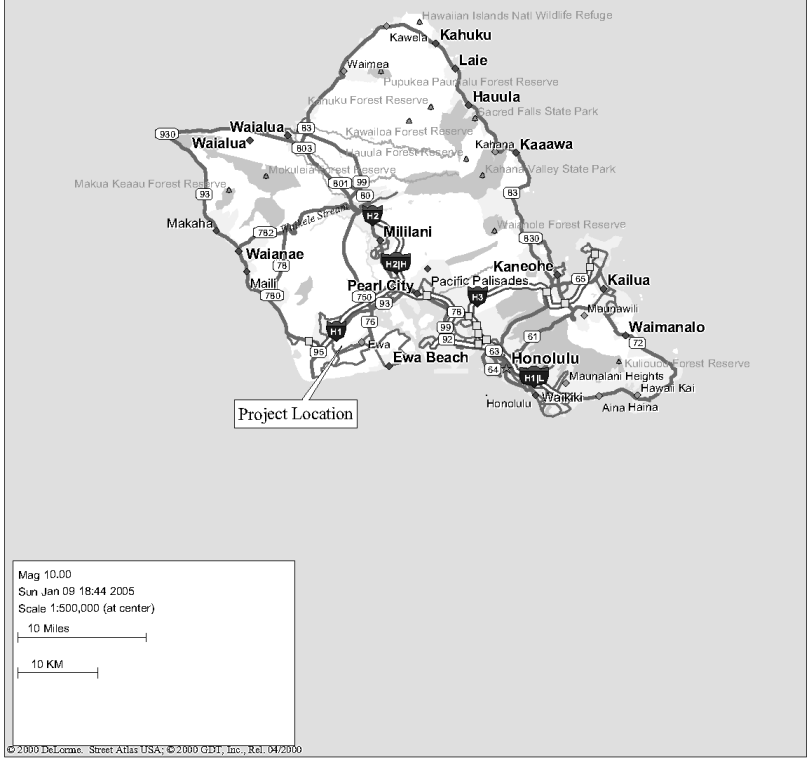

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	$\mu g/m^3$	Annual	-	-	50
		24 Hours	150[a]	150[a]	150[b]
Particulate Matter (<2.5 microns)	$\mu g/m^3$	Annual	15[c]	15[c]	-
		24 Hours	35[d]	35[d]	-
Sulfur Dioxide	ppm	Annual	-	-	0.03
		24 Hours	-	-	0.14[b]
		3 Hours	-	0.5[b]	0.5[b]
		1 Hour	0.075[e]	-	-
Nitrogen Dioxide	ppm	Annual	0.053	0.053	0.04
		1 Hour	0.100[f]	-	-
Carbon Monoxide	ppm	8 Hours	9[b]	-	4.4[b]
		1 Hour	35[b]	-	9[b]
Ozone	ppm	8 Hours	0.075[g]	0.075[g]	0.08[g]
Lead	$\mu g/m^3$	3 Months	0.15[h]	0.15[h]	-
		Quarter	1.5[i]	1.5[i]	1.5[i]
Hydrogen Sulfide	ppm	1 Hour	-	-	35[b]

[a] Not to be exceeded more than once per year on average over three years.
[b] Not to be exceeded more than once per year.
[c] Three-year average of the weighted annual arithmetic mean.
[d] 98th percentile value of the 24-hour concentrations averaged over three years.
[e] Three-year average of annual fourth-highest daily 1-hour maximum.
[f] 98th percentile value of the daily 1-hour maximum averaged over three years.
[g] Three-year average of annual fourth-highest daily 8-hour maximum.
[h] Rolling 3-month average.
[i] Quarterly average.

Table 2

ANNUAL WIND FREQUENCY FOR HONOLULU INTERNATIONAL AIRPORT (%)

Wind Direction	Wind Speed (knots)									Total
	0-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	>40	
N	0.5	2.5	1.3	0.5	0.0	0.0	0.0	0.0	0.0	4.8
NNE	0.3	1.2	1.6	1.5	0.2	0.0	0.0	0.0	0.0	4.7
NE	0.3	2.1	6.1	11.0	3.2	0.3	0.0	0.0	0.0	23.0
ENE	0.2	2.5	10.9	16.6	4.1	0.3	0.0	0.0	0.0	34.7
E	0.1	1.0	2.5	2.8	0.5	0.0	0.0	0.0	0.0	7.0
ESE	0.0	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	1.1
SE	0.0	0.3	0.8	1.0	0.1	0.0	0.0	0.0	0.0	2.2
SSE	0.1	0.4	1.2	0.7	0.1	0.0	0.0	0.0	0.0	2.4
S	0.1	0.5	1.4	0.6	0.1	0.0	0.0	0.0	0.0	2.7
SSW	0.0	0.3	0.8	0.3	0.0	0.0	0.0	0.0	0.0	1.5
SW	0.0	0.2	0.8	0.4	0.0	0.0	0.0	0.0	0.0	1.5
WSW	0.0	0.3	0.5	0.4	0.0	0.0	0.0	0.0	0.0	1.2
W	0.1	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.1
WNW	0.2	1.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	2.0
NW	0.4	2.3	0.8	0.1	0.0	0.0	0.0	0.0	0.0	3.8
NNW	0.5	2.3	0.8	0.2	0.0	0.0	0.0	0.0	0.0	3.8
Calm	2.5									2.5
Total	5.4	18.3	30.6	36.5	8.5	0.7	0.0	0.0	0.0	100.0

Source: Climatography of the United States No. 90 (1965-1974), Airport Climatological Summary, Honolulu International Airport, Honolulu, Hawaii, U.S. Department of Commerce, National Climatic Center, Asheville, NC, August 1978.

Table 3

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF OAHU, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	25,891	49,374	75,265
Sulfur Oxides	39,230	nil	39,230
Nitrogen Oxides	92,436	31,141	123,577
Carbon Monoxide	28,757	121,802	150,559
Hydrocarbons	4,160	421	4,581

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 4

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST KA MAKANA ALII PROJECT

Parameter / Location	2005	2006	2007	2008	2009
Sulfur Dioxide / Kapolei					
3-Hour Averaging Period:					
Highest Concentration (ppm)	0.025	0.005	0.010	0.009	0.010
2nd Highest Concentration (ppm)	0.011	0.004	0.008	0.009	0.007
No. of State AAQS Exceedances	0	0	0	0	0
24-Hour Averaging Period:					
Highest Concentration (ppm)	0.008	0.003	0.003	0.005	0.003
2nd Highest Concentration (ppm)	0.003	0.003	0.003	0.003	0.003
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration (ppm)	0.001	0.002	0.002	0.001	0.001
Particulate (PM-10) / Kapolei					
24-Hour Averaging Period:					
Highest Concentration ($\mu g/m^3$)	53(a)	59	75(a)	61	37
2nd Highest Concentration ($\mu g/m^3$)	36	58	57	44	36
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	15	16	17	18	16
Particulate (PM-2.5) / Kapolei					
24-Hour Averaging Period:					
Highest Concentration ($\mu g/m^3$)	55(a)	34(a)	20	35	25
98th percentile Concentration ($\mu g/m^3$)	11	7	8	21	13
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	4	4	4	5	6
Carbon Monoxide / Kapolei					
1-Hour Averaging Period:					
Highest Concentration (ppm)	1.5	1.4	3.8	2.2	3.7
2nd Highest Concentration (ppm)	1.4	1.4	0.9	1.7	2.6
No. of State AAQS Exceedances	0	0	0	0	0
8-Hour Averaging Period:					
Highest Concentration (ppm)	0.9	1.0	0.8	0.7	1.2
2nd Highest Concentration (ppm)	0.9	1.0	0.7	0.7	1.2
No. of State AAQS Exceedances	0	0	0	0	0
Nitrogen Dioxide / Kapolei					
Annual Average Concentration (ppm)	0.005	0.005	0.005	0.004	0.004
Ozone / Sand Island					
8-Hour Averaging Period:					
Highest Concentration (ppm)	0.047	0.042	0.035	0.048	0.049
4th Highest Concentration (ppm)	0.046	0.042	0.033	0.043	0.048
No. of State AAQS Exceedances	0	0	0	0	0

(a) Data flagged due to fireworks.

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2005 - 2009"

Table 5

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KA MAKANA ALII PROJECT (parts per million)

Roadway Intersection	Year/Scenario							
	2010/Present		2015/Without Project		2015/With Project[a]		2015/With Project[b]	
	AM	PM	AM	PM	AM	PM	AM	PM
Kapolei Parkway at Kamaaha Ave	4.9	2.5	4.5	3.1	4.6	3.3	4.6	3.2
Kapolei Parkway at Kinoiki Street	2.7	1.7	3.3	2.2	3.9	3.5	3.9	3.5
Kapolei Parkway at Kualakai Parkway	3.1	2.0	3.4	2.7	4.7	4.4	5.0	4.7
Kapolei Parkway at Renton Road	3.9	2.5	4.0	2.8	4.4	2.9	4.4	2.9
Kualakai Parkway at East Entrance	-	-	-	-	-	-	2.3	2.5
Kualakai Parkway at Roosevelt Ave	-	-	-	-	-	-	3.4	2.6
Roosevelt Ave at South Entrance	-	-	-	-	2.8	2.6	2.8	2.4

Hawaii State AAQS: 9
National AAQS: 35

[a]Without North-South Road extension
[b]With North-South Road extension

Table 6

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KA MAKANA ALII PROJECT (parts per million)

Roadway Intersection	Year/Scenario			
	2010/Present	2015/Without Project	2015/With Project[a]	2015/With Project[b]
Kapolei Parkway at Kamaaha Ave	2.4	2.2	2.3	2.3
Kapolei Parkway at Kinoiki Street	1.4	1.6	2.0	2.0
Kapolei Parkway at Kualakai Parkway	1.6	1.7	2.4	2.5
Kapolei Parkway at Renton Road	2.0	2.0	2.2	2.2
Kualakai Parkway at East Entrance	-	-	-	1.2
Kualakai Parkway at Roosevelt Ave	-	-	-	1.7
Roosevelt Ave at South Entrance	-	-	1.4	1.4

Hawaii State AAQS: 4.4
National AAQS: 9

[a]Without North-South Road extension
[b]With North-South Road extension

Table 7

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM KA MAKANA ALII PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	1
Sulfur Dioxide	14
Carbon Monoxide	1
Volatile Organics	<1
Nitrogen Oxides	6

[a]Based on U.S. EPA emission factors for utility boilers [2]. Assumes electrical demand of 41 million kilowatt-hrs per year and low-sulfur oil used to generate power.

Table 8

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM KA MAKANA ALII PROJECT SOLID WASTE DISPOSAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	<1
Sulfur Dioxide	1
Carbon Monoxide	5
Nitrogen Oxides	12
Lead	<1

[a]Assumes solid waste disposal demand of 13 tons per day and that solid waste is burned in a refuse-derived fuel-fired power plant equipped with spray dryer and fabric filter. Emission rates based on U.S. EPA emission factors for refuse-derived fuel-fired combustors [2].

Appendix G

Archaeological Assessment

Pacific Legacy

Historic Preservation

ARCHAEOLOGICAL ASSESSMENT
OF THE PROPOSED
KA MAKANA ALI‘I
MIXED-USE COMPLEX
KAPOLEI, HONOULIULI AHUPUA‘A
‘EWA DISTRICT, O‘AHU ISLAND
[TMK (1) 9-1-016:142]

Pacific Legacy: Exploring the past, informing the present, enriching the future.

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[TMK (1) 9-1-016:142]

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ABSTRACT

As part of the Environmental Impact Statement process, Hawai‘i DeBartolo, LLC, has requested an Archaeological Assessment for the for the proposed Ka Makana Ali‘i mixed-use complex and *mauka* half of Keoneula Road, which is slated for a parcel in central ‘Ewa Plain, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu [TMK (1) 9-1-016:142]. This assessment is based upon archival research as well as archaeological testing.

The results of archival research indicate that this general area of ‘Ewa Plain has a long and rich cultural and legendary history. However, little is mentioned of the subject property in which the Ka Makana Ali‘i is to be built.

It was predicted that this area had the potential to contain sinkholes containing cultural or paleontological remains. However, no such remains were found either on the surface or in the 62 backhoe test trenches and 6 test scrapes that were performed across the project area. Test excavations revealed that nearly the entire project area is overlain with 0.45 meters to more than 3.7 meters of sediment relating to modern construction and/or plantation agriculture. Test trench depths ranged from ca. 20 inches (ca. 0.5 meters) to ca. 12 feet, 2 inches (ca. 3.7 meters), with 54 of the 62 trenches revealing the karst layer. The stratigraphy encountered was thoroughly recorded in soil profiles, photographs, and soil analyses to provide a better understanding of the project area’s substrate and its potential to contain archaeological deposits.

Given the lack of finding any archaeological resources or even finding evidence of the karst topography within the project area, we conclude that no further archaeological work is necessary within this area.

In the event that buried sinkholes are encountered during construction excavations, they should be archaeologically investigated to determine if they contain potentially significant archaeological deposits, including human burials.

If at any time during construction potentially significant archaeological remains are encountered, work in the immediate vicinity should halt and the State Historic Preservation Division should be contacted (808-692-8015).

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Frontispiece: Proposed Ka Makana Ali‘i Location (courtesy of Hawai‘i DeBartolo LLC).

1.0 INTRODUCTION

Pacific Legacy Inc., under contract to Hawai‘i DeBartolo, LLC, conducted an archaeological assessment for the proposed Ka Makana Ali‘i and *mauka* half of Keoneula Road in East Kapolei, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu, Hawai‘i [TMK (1) 9-1-016:142] (Figures 1 and 2). The purpose of this assessment is to determine if any archaeological or human remains will be impacted by the proposed development of the mixed-use complex. The Archaeological Assessment consisted of archival research, archaeological survey, and backhoe testing.

This archaeological assessment is one of the supporting studies for the Environmental Impact Statement (EIS) being conducted by Hawai‘i DeBartolo, LLC. The purpose of this assessment is to determine if any significant or potentially significant historical or archaeological resources are present and if they would be impacted by proposed project. If potentially significant resources are present within the project area, impacts to these resources will need to be addressed and mitigation measures for potential adverse effects to these resources will be recommended.

The assessment of what resources are present in the project area was accomplished by conducting archival research, reviewing previous archaeological investigations, conducting a surface survey, and subsurface testing with a backhoe. The main source for previous archaeological investigations was the State Historic Preservation Division (SHPD) library at Kapolei, which houses a relatively complete collection of archaeological reports, as well as the Office of Environmental Quality Control (OEQC) website (http://video.doh.hawaii.gov), which carries most of the Environmental Impact Assessments and Statements for the state of Hawai‘i. Surface survey and subsurface testing was conducted by Pacific Legacy archaeologist, Kimberley Mooney, B.A. The principal investigator of the overall project was Paul L. Cleghorn, Ph.D.

Figure 1. Location of project area (courtesy of National Geographic).

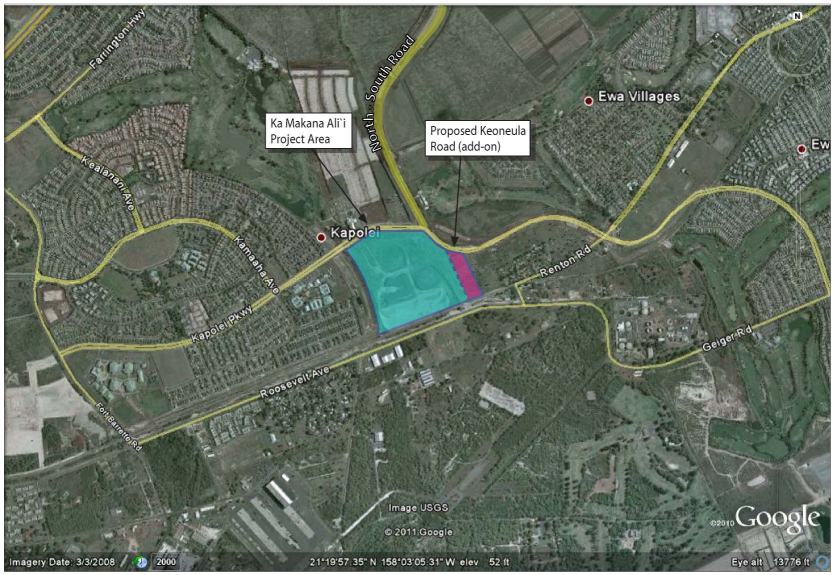

Figure 2. Location of project area (courtesy of Google Earth).

2.0 PROJECT AREA DESCRIPTIONS

2.1 ENVIRONMENTAL SETTING

A number of reports have been written on the geological formations and environmental conditions of the ʻEwa Plain (Allen 1990; Cline 1955; Foote et al. 1972; MacDonald and Abbott 1970; Stearns 1946, 1978; Stearns and Vaksvik 1935; Zeigler 2002), which address broad characteristics of the ʻEwa Plain.

2.1.1 Geology, Hydrology, and Sediments

Based on terrain and availability of water, the ʻEwa Plain can be separated into three main geographical regions that are described by Tuggle and Tomonori-Tuggle (1997:9) as: "lowland limestone exposure, the upland alluvial terrain, and a locale of floodplain and alluvial fans." Fresh water on the barren coral plain has often been reported as being insufficient to support a permanent or substantial Hawaiian settlement during pre-Contact years. However, Tuggle and Tomonari-Tuggle (1997:18-21) summarize various research projects on the availability of water in ʻEwa Plain asserting that there may have been permanent Hawaiian settlements in a number of locales, if not generally across the entire area. Water sources were identified in several locations on the plain, including: sink holes that reach the water-table, wetlands, sheet runoff, spring and creek water from gulches, natural limestone water traps, Honouliuli Stream, and other water features in Honouliuli Ahupuaʻa (Malden 1825). The proposed Ka Makana Aliʻi project area is located on the lowland limestone just southwest of Kaloʻi Gulch at roughly 50-60 ft above mean sea level (AMSL).

Generally, the ʻEwa Plain is an expansive limestone shelf that begins 3-5 miles (5 to 8 km) south of the Waianae Mountain range to the southern coast of Oʻahu, stretching from the western coast of Koʻolina east to Pearl Harbor. This elevated coralline reef was formed during an interglacial period approximately from 120,000 to 38,000 years ago, when sea levels in Hawaiʻi were some 6-8m above the present sea level, which has been termed the Waimānalo Sea Stand. During this period, coral reefs developed upwards with the gradually rising sea levels. During the next period of glaciation, sea levels dropped leaving exposed coral reefs that were then eroded by marine level fluctuation, wave/sediment abrasion, as well as weathering by rain, run-off, and wind after sea levels dropped to their present level. Further, rain water naturally absorbs carbon dioxide in the air to form a weak carbonic acid, which dissolves portions of the limestone with prolonged exposure, subsequently forming karst topography. Hallmark features of karst topography are caverns and sinkholes, which are formed as acids build up and dissolve soluble portions and natural voids in the limestone. Several miles east of the project area is an escarpment approximately 15 meters high, often referred to as "fossil cliffs" and/or "fossil bluffs," where the alluvial clay layer has been eroded away, exposing Pleistocene limestone that is laden with fossils.

Sinkholes of the ʻEwa Plain are typically bell-shaped in cross-section with openings commonly 3.28 feet (1 m) in diameter with base diameters increasing to 6.56 to 9.84 feet (2–3 m) (MacDonald and Abbott 1970; Stearns 1946, 1978; Stearns and Vaksvik 1935; Zeigler 2002:96-97).

These sinkholes became important resources for avian populations prior to human settlement in Hawaiʻi. Later, sinkholes became significant resource locales, temporary shelters, agricultural features, as well as burial locations for early Hawaiian populations on the ʻEwa Plain (Barrera 1975; Davis 1995; Lewis 1970; Miller 1993; Sinoto 1976, 1978a, 1978b, 1979). Sinkholes containing archaeological and/or paleontological remains encapsulated under alluvial soils or construction fills can be encountered anywhere within the ʻEwa Plain.

The ʻEwa Plain gently slopes *mauka* or towards the mountains, due to the deposition of alluvial clays and silts that are derived from weathered basalt from upslope. The alluvial substrate forms a wedge that lies atop the limestone bench, itself positioned above the basalt foundation (Geolabs-Hawaiʻi 1987; Stearns and Vaksvik 1935). This limestone shelf contains artesian basal aquifers that are the source of potable water found in springs and wells in several locations across the plains; two of the most prominent locations, Honouliuli Gulch "Watering Place" and Waihuna in Kaloʻi Gulch, are within two miles of the project area (Malden 1825; Sterling and Summers 1978; Mooney and Cleghorn 2008c).

Soils in the project area are currently described as Honouliuli clay with 0-2% slopes (HxA) and Mamala stony silty clay loam with 0 to 12 percent slopes (MnC) according to the Department of Agriculture Natural Resources Conservation Service (USDA/NRCS 2011; Figure 3; Table 1). The soil types roughly bisect the project area (*mauka-makai*), where the *mauka* portion is Honouliuli clay and the *makai* portion is Mamala stony silty clay. This is greatly due to agricultural practices of the early 1800's, where natural forests of the Waianae Range were extensively harvested, causing severe erosion of the mountain sides. Erosion was further advanced unintentionally by the over-grazing of livestock in the uplands and then intentionally by the intensive plowing of these soils to encourage fertile sediment deposition onto the lower plains for farming (Lewis 1970; Tuggle and Tomonari-Tuggle 1997; Wolforth and Wulzen 1998). Hence, the deposition of sediments onto the ʻEwa Plain was unnaturally increased from the early 1800s to the present time.

Also worthy of note, are the three volcanic cones lying on the northern margin of the ʻEwa Plain: Puʻu Pālailai, Puʻu Kapolei, and Puʻu Makakilo. Puʻu Pālailai, which lies ca. 2.5 miles (4 km) west of the project area, is one of only three known volcanic glass quarries on Oʻahu (Manhoff and Uyehara 1976:46; Wolforth and Wulzen 1998). As volcanic glass was a choice material for stone tool manufacture, Puʻu Pālailai would have been an important locality in pre-contact times.

2.1.2 Climate

Honouliuli, the largest *ahupuaʻa* of Oʻahu, is situated on the leeward side of Oʻahu. ʻEwa Plain covers the lower half of the *ahupuaʻa* . This is one of the driest regions of Oʻahu, having an average of 18 inches of annual rainfall (Juvik and Juvik 1998). The proposed Ka Makana Aliʻi Center is situated on the northern border of Kalaeloa (former NAS Barbers Point), whose temperatures range between 72°F (40°C) in January to 78.5°F (43°C) in August, with a variance of 13°F (7°C) throughout the day (Orr 2008:3-1). The hottest days of the year typically fall between August and September (Armstrong 1973).

2.1.3 Vegetation

Generally, the most common types of plants in the ʻEwa Plain are xeric and hardy exotics, with the exception of relatively undisturbed coastal marshlands. Previous to human settlement in the area, Cuddihy and Stone (1990) claim that the region would have been more like a savannah: a plain of grasses with sparse groves trees and shrubs. Pre-contact plant species would have included, but not limited to: *wiliwili* (*Erythrina sandwicensis*), *lama* (*Diospyros ferrea*), *pili* grass (*Heteropogon contortus*), *ʻaʻaliʻi* (*Dodonea ericarpa*), scrub *ʻōhiʻa* (*Metrosideros collina*), and possibly sandalwood or *ʻiliʻahi* (*Santalum* sp.). Ground cover may have included cayenne vervain (*Stachytarpheta urticaefolia*), *ʻilima ku kula* (Sida cordifola), morning glory (*Ipomoea indica*), *koʻokoʻolau* (*Bidens pilosa*) according to Moore and Kennedy (2002:3).

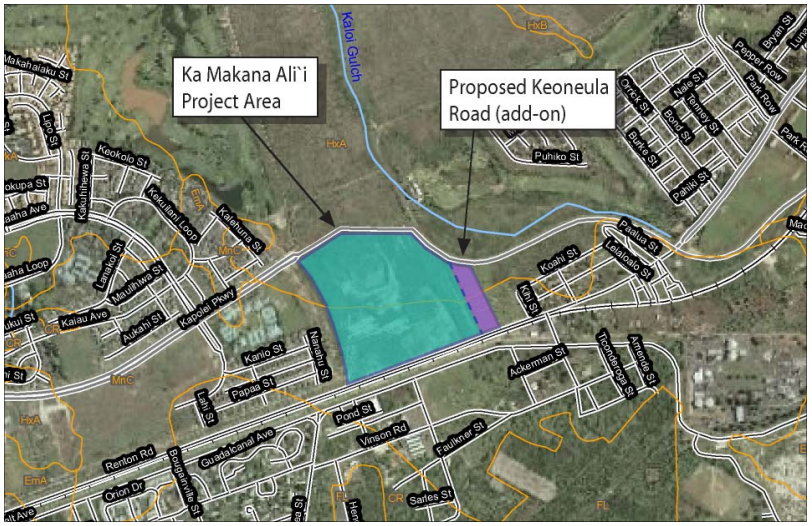

Figure 3. Ka Makana Aliʻi soil map (courtesy of NRCS/USDA Soil Survey 2011).

Table 1. Ka Makana Aliʻi Project Area– Custom Soil Report (USDA/NRCS Soil Survey 2011)

Map Unit Symbol	Map Unit Name	Acres in Project Area	Percent of Project Area
HxA	Honouliuli clay, 0 to 2 percent slopes	38	56.8%
MnC	Mamala stony silty clay loam, 0 to 12 percent slopes	29	43.2%
	Totals for Area of Interest	67	100.0%

2.2 Current State of Project Area

An archaeological survey and backhoe testing was performed by Kimberly M. Mooney, B.A., under the general guidance of Paul L. Cleghorn, Ph.D., from 11 July to 22 July 2011 on the 70-plus acres of land slated for the Ka Makana Aliʻi mixed-use complex and the proposed Keoneula Road. The pedestrian survey yielded no new archaeological sites visible on the ground surface. Rather, the project area appeared to have evidence of multiple ground disturbing activities from the time of sugarcane cultivation until recent years. Ground disturbing activities include extremely deep and vast excavations resulting in a ca. 1,345 foot by 390 foot borrow pit at the south end of the property. Further, a number of soil stockpiles cover much of the interior of the lot (Figure 4). The remaining areas have evidence of recent construction and rubbish dumping, major modifications for unofficial off-road vehicle riding (i.e. built up berms, jumps, and trails), as well as dense feral growth of grasses, weeds, shrubs, and trees. However, during a site visit 7 July 2001 with Kupuna Eaton and Makua Kalani to reintroduce them to the project area, both informants were able to spot *ʻilima*, *ʻuha loa*, and *mauna loa*, which are used in traditional medicine and crafts.

Figure 4. Current state of Ka Makana Aliʻi project area and proposed Keoneula Road corridor (courtesy of Google Earth).

3.0 TRADITIONAL AND MYTHOLOGICAL ACCOUNTS

A number of oral traditions have been recorded that help describe the physical, mystical, and cultural landscapes of Honouliuli Ahupuaʻa. Although Ka Makana Aliʻi is located in an area that has diminutive mythological significance, it is situated amidst several areas within Honouliuli Ahupuaʻa that are well known in Hawaiian legends and history.

3.1 THE NAMING OF ʻEWA AND HONOULIULI

Honouliuli is the westernmost *ahupuaʻa* of ʻEwa District, or *moku*, which stretches from Red Hill on the west edge of Kona District to Pili O Kahe just north of Koʻolina and Waimanalo (Figure 5). Sterling and Summers (1978) state that the Gods Kane and Kaneloa gave ʻEwa District its name, which translates as, "the stone that strayed," since the stone used to determine district boundaries had landed a great distance away from where it was thrown (Sterling and Summers 1978: 1). Pukui et al. (1974:28) maintain that ʻEwa literally translates as 'crooked' and comes from the same story of Kane and Kaneloa determining ʻEwa's *moku* boundaries at the landing place of their divinely thrown stone.

The name, Honouliuli, applies to the entire *ahupuaʻa* as well as a village within the *ahupuaʻa*, which is located less than two miles northeast of Ka Makana Aliʻi. Noted as the largest *ahupuaʻa* on the island of Oʻahu, Honouliuli stretches from the West Loch of Pearl Harbor to what is now called Koʻolina to the west and north all the way to Wahiawa. Honouliuli is literally translated as 'dark bay' by Pukui et al. (1974:50). Yet, Thrum (1923) and Westervelt (1963) offer a different origin for the name Honouliuli, which comes from the "Legend of Lepeamoa." According to this legend, Honouliuli is the name of Lepeamoa's grandfather and Chiefess Kapalama's husband who gave his name "to a land district west of Honolulu" (Thrum 1923: 170).

3.2 MYTHOLOGICAL TALES OF ʻEWA AND HONOULIULI

Honouliuli Ahupuaʻa is the setting for a number of legendary accounts concerning the activities of Gods, Goddesses, demi-gods, and head Oʻahu chiefs or *mōʻī* , as well as supernatural beings such as *moʻo,* mystical creatures, and wandering spirits. Compilations of Honouliuli's mythology have been created by Sterling and Summers (1978), Hammatt and Folk (1981), Kelly (1991), Charvet-Pond and Davis (1992), Maly (1992), Tuggle and Tomonori-Tuggle (1997), Mitchell and Hammatt (2004), and O'Hare et al. (2006).

Some tales paint the plains of ʻEwa as a mystical and somewhat foreboding place, where gods and goddesses frequent. For example, Sterling and Summers (1978) report a story from a January 13, 1900 *Ka Loea Kālaiʻāina* newspaper article, "The Old Women Who Turned to Stone" which reads:

> If a traveler should go by the government road to Waianae, after leaving the village of gold, Honouliuli, he will first come to the plain of Puu-ainako and when that is passed, Ke-one-ae. Then there is a straight climb up to Puu-o-Kapolei and there look seaward from the government road to a small hill. That is Puu-o-Kapolei…You go down some small inclines, then to a plain. This plain is Pukaua (sic.) and on the mauka side of the road, you will see a large rock standing on the plain. This stone has a legend that made this plain noted…There were two supernatural old women or rather peculiar women with strange powers and Puukaua (sic.) belonged to them. While they were down fishing at Kualakai in the evening, they caught these things[:] aama crabs, pipipi shell fish and whatever they could get with their hands. As they were returning home to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run, running, leaping, falling[,] sprawling, rising up and running on, without a thought to the aama crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, "Let us hide lest people see us," and so they hid. Their bodies turned to stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women…(*Ka Loea Kālaiʻāina,* 13 January 1900 as cited in Sterling and Summers 1978: 39).

Another version of this tale is offered in an article found in the *Ka Hōkū o Hawaiʻi*, February 15, 1927 (translated by Maly 1997: 19), where the women were *moʻo* and changed into lizard form as they crossed the goddess Hiʻiaka on her journey to the ʻEwa coast, for they feared she would kill them. The *moʻo* hid near the trail and Hiʻiaka greeted them and passed without harm (Maly 1997 as cited by O'Hare et al. 2006: 20). This story not only illustrates the enchantment of ʻEwa Plain in lore, but also the wealth (in one form or another) of nearby Honouliuli Village, deemed the "village of gold," which is upheld by early maps of the region where it is depicted as the largest permanent settlement of the ʻEwa District in pre-plantation times. Additionally, it accounts significant foot traffic from Honouliuli Village to Waianae in pre-Contact times.

The legend of Namakaokapaoo originates in Honouliuli Village area. This is a story of a young 2 ½ foot tall boy, named Namakaokapaoo, who killed his stepfather and threw his head five miles away before conquering Oʻahu's king and his warriors, and subsequently replaced the king with his mother as ruler (Beckwith 1970). Honouliuli Village is also the place that Ka ihu o Palaʻai, the sister of mythological figure, Maikoha, fell in love and settled (Sterling and Summers 1978:53).

Pearl Harbor, just east of Honouliuli Village, is the source of many legends. Sterling and Summers (1978) offer several stories about the shark goddess, Kaʻahupahau (translated as Cloak-well-cared-for), her origin having several interpretations. In one interpretation, Kaʻahupahau was thought to have been a miscarriage by her mother and left in the waters of Pearl Harbor, but still alive, she transformed into a shark. In another version, Kaʻahupahau and her brother were born as human, but were later transformed into sharks by a shark god. The two remained in Pearl Harbor, where they were fed *ʻawa* by their human relatives. In return, Kaʻahupahau protected her human kin from other sharks. Another major figure in Pearl Harbor mythology is Papio, the beautiful surfing chiefess, who had several conflicts with the

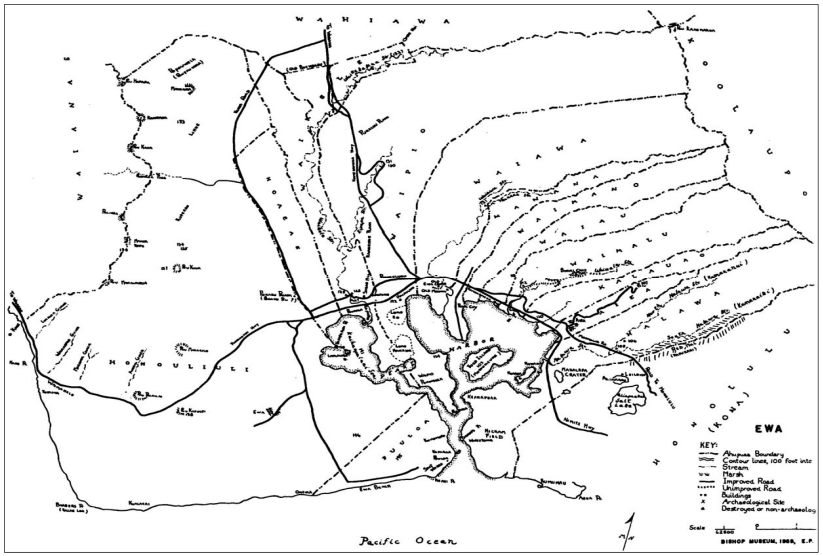

Figure 5. Ahupuaʻa of ʻEwa District (from Sterling and Summers 1978).

shark goddess, Kaʻahupahau, and is often said to have eventually been devoured by her (Sterling and Summers 1978: 54-56). Kapakule is the tennis racket shaped fishpond located at the entrance to Pearl Harbor, which is the setting of many tales. One of which is of the *menehune,* or little people, building the fishpond in one night at the command of the gods, Kāne and Kanaloa (Sterling and Summers 1978: 42-43).

Located approximately 1.8 miles (1.9 km) west of Ka Makana Aliʻi, Puʻu Kapolei, was subject of numerous local ancient myths and chronicles. Sterling and Summers (1978) mention Puʻu Kapolei as being one of the most famous hills in the olden days and a major point of reference for travelers going east or west through Honouliuli. Additionally, Puʻu Kapolei was the landmark (juxtaposed to the setting sun) used to mark the end of Makaliʻi, or the Kau season, and the beginning of the Hoʻoilo season, when young sprouts emerged from the ground (Kamakau as cited in Sterling and Summers 1978).

The very name Kapolei translates as "beloved Kapo," who was the sister of the Goddess Pele (Pukui et al. 1974:89). Colorful tales further link the *puʻu* to Hawaiʻi's pantheon of gods and goddesses, including dramatic conflicts between them. One such tale involves Kamapuaʻa, the Goddess Pele, and her sister Kapo, where the amorous pig-god Kamapuaʻa assaults Pele at Puʻu Kapolei and is subsequently lured away from her as he pursues Kapo's detached "flying vagina"(*kohe lele*) that she placed on Puʻu Kuua (Pukui et al. 1974:200; Beckwith 1970). Additionally, the deity Kamaunuaniho was supplanted at Puʻu Kapolei by her grandson, Kamapuaʻa, to exact tribute from the commoners of the area (Nukuina as cited by Sterling and Summers 1978). Sterling and Summers (1978) list several accounts of a dwelling or heiau in Puʻu Kapolei belonging to the grandmother of Kamapuaʻa. As nearby Puʻu Kapolei has been home to deities, the setting for legends, as well as the landmark for the seasons, the nearby lands have likely been significant to Hawaiians in pre-Contact times.

Further to the west and south are a number of additional myths. Kamakau described western ʻEwa as the "rough country (*wiliwili*) of Kaupeʻa" and "the home of wandering spirits with no holdings, who ate spiders and moths for sustenance" (Kamakau 1964:83). Kamakau adds that the wandering souls of Kaupeʻa are often helped by *ʻaumakua* to escape from this domain (Kamakau 1991: 49). The description of west ʻEwa as being the "realm of wandering spirits" is supported by Pukui's chant on the subject (Pukui 1983: #1666 as cited by O'Hare et al. 2006) and Fornander's lament for Kahahana (Fornander 1919, Vol. 6, Part 2: 297 as cited by O'Hare et al. 2006).

3.3 Chronicles and Conflicts in Honouliuli Ahupuaʻa

Some tales portray Honouliuli Ahupuaʻa as being a place of "firsts," such as the origin of humans on Oʻahu and breadfruit in Hawaiʻi. The *ahupuaʻa* of Honouliuli was also noted for being the origin, home, refuge, and vacationing place for some of Oahu's earlier *mōʻī*, or ruling chiefs (Kamakau 1961, 1991; Lewis 1970). Yet, *kauwā* (slaves) lived in the ʻEwa District's as well. In addition, the *ahupuaʻa* was the location of key battles and treaties in Oʻahu's pre-Contact annals.

Some tales suggest that the first Hawaiians had settled in Honouliuli. In the legend, Ka-Lua-ʻŌlohe, Pearl Harbor was said to be the place where human beings first came to Oʻahu. This area is said to have many caves, which belong to the *ʻōlohe*, who were "born in the day" (Beckwith 1970).

The first planting of breadfruit in Hawaiʻi is said to have occurred at Puʻuloa, located about 4 miles (6.4 km) southeast of Ka Makana Aliʻi. According to tradition, Kahai, son of Moikeha, transported the species from Upolu, an island in Samoa, on his return trip home from Tahiti (Thrum 1907; McAllister 1933). Fornander (1919, Vol IV, Part I: 392) and Kamakau (1964) confirms that Puʻuloa is the location of Hawaiʻi's first breadfruit.

The story of Maʻili-kukahi, one of the chiefs who was celebrated for leading Oʻahu out of chaos and into a period of prosperity, confirms Honouliuli Ahupuaʻa as being the homeland of some Oʻahu *mōʻī*. Kamakau refers to Māʻili-kūkahi as a 'kind' chief and not culpable for abandoning Hawaiian taboos although he is said to have "relinquished [his] position as ruling chief and gave it to the commoners; and took the firstborn children of the commoners to rear and care for" (Kamakau 1961: 223). Māʻili-kūkahi's sovereign realm was eventually challenged by chiefs from Maui and Hawaiʻi Island, one of which was named Hilo. The Oʻahu chief came out victorious after a bloody battle and placed the heads of his foes for all to see at a major trail junction just outside of Honouliuli Village, which was thereafter called Poʻo-hilo (head of Hilo), after the decapitated chief from the island of Hawaiʻi (Kamakau 1991: 56).

According to the 1883 Dictionary of Hawaiian Localities, ʻEwa was a "…favorite residence of Oahu kings of olden times…" (Sterling and Summers 1978:1). Kamakau mentions that ʻEwa, from Puʻu Kuua to Maunauna at the northern extreme of the *ahupuaʻa*, was quite populous where Oʻahu *mōʻī* reigned before they ruled from Waikiki (Kamakau 1991: 54). Fornander tells the story of Keaunui, "the head of the powerful and celebrated Ewa chiefs" who is credited with cutting a navigable channel into the estuary of Pearl River near the Puʻuloa saltworks (Fornander 1880: 48 as cited in Sterling and Summers 1978:46).

Coastal Honouliuli was sought as a refuge and vacation area on Oʻahu, as is clear in several texts. For instance, the beach area now called Koʻolina, was noted as the favored vacationing place of Chief Kakuhihewa, a *mōʻī* of ancient times (Fornander as quoted by Lewis 1970). In addition, when Kahekili conquered Oʻahu, Kahahana, his wife, and 'friend' fled together to various locations in ʻEwa. One location was Poʻo-hilo in Honouliuli where they went into hiding before giving themselves up to the commoners, as they were "weary with life in the forest"(Sterling and Summers 1978: 6).

However, some traditional accounts paint a rather disparaging picture of central Honouliuli *ahupuaʻa* inhabitants. According to an 1899 newspaper, "the very dirty ones" lived in the large hollow above Puʻu Kuua, which is approximately 4.6 miles (7.4 km) northwest of Ka Makana Aliʻi ("*Na Wahi Pana o Ewa*" 1899 as cited by Sterling and Summers 1978: 32). Another tradition explains the origin of stigmas placed on the peoples of Puʻu Kuua:

> The Chiefs of old, who lived at that time, were of divine descent. The two gods looked down on the hollow and saw how thickly populated it was. The mode of

> living here was so that the chiefs and commoners mixed freely and they were so like the lowest of people (*Kauwā*). That was what these gods said and that was the time when the term *kauwā* [an outcast or slave] was first used, and was used for many years afterwards.
>
> After the first generations of chiefs had passed away and their descendants succeeded them, a chiefess became the ruler. It was customary for the chiefs of Oahu to visit this place to see the local chiefs. They did this always. When the time came in which a new chiefess ruled, an armless chiefess, she ran away to hide when other chiefs came to visit as usual because she was ashamed of the lack of an arm. Because she was always running away because of being ashamed the chiefs that visited called her the low-born (*kauwā*). Thus the term remained in the thoughts down to this enlightened period. She was not truly a kauwa but was called that because she behaved like one. This was how they were made to be kauwas. When the ruling chief wished to go to Waikiki for sea bathing he asked the chief just below him in rank, "how are my planting places at Puu-Kuua, have they not produced young suckers?" The chief next to him answered, "There are some suckers," and sent someone for them. When the men, women and children least expected it, the messenger came to get some of the children. The father stood up and took his sons to Waikiki. Then when the ruling chief went sea bathing, he sent an attendant to get the boys and take them to a shallow place where the ruling chief would come. Then the ruler placed a hand on each of the boys, holding them by the necks. The words he uttered were, "My height has not been reached (by the sea)! My height has not been reached!" (*Aole i pau kuu loa, aole pau kuu loa*). He advanced and held on to the boys until the sea was up to his chest. The boys floated on the water face down. The father on shore called out, "Lie still in the sea of your Lord," and so on.
>
> The sea of Waikiki is said to have been used to kill men in and the other place is Kualoa. The inhabitants of Puu-Kuua were so mixed, like taro beside an imu. There were two important things concerning this place. (1) This place is entirely deserted and left uninhabited and it seems that this happened before the coming of righteousness to Hawaii Nei. Not an inhabitant is left. (2) The descendants of the people of this place were so mixed that they were all of one class. Here the gods became tired of working and returned to Kahiki. ("Na Wahi Pana o Ewa" 1899 as cited by Sterling and Summers 1978:32-33).

The peoples of Puʻu Kuua became viewed as pariahs for not abiding by social codes, and as a result, they were persecuted to near extinction. This story also suggests that the pre-Contact population of central upland Honouliuli Ahupuaʻa may have thrived previous to this campaign of extermination.

Warfare was another constant theme in the ʻEwa District. Fornander (1919, Vol IV, part II: 364) wrote about the "battle" of Keahumoa Plain, which was supposed to be the final battle of celebrated chief, Kualiʻi. In this account, two warrior brothers sought higher positions in life, so they arranged for 12,000 of Kualiʻi's men to meet with 1,200 Koʻolau warriors to battle at Keahumoa, ʻEwa. However, they did not plan to fight, but to unite both sides. The youngest brother, Kamakaaulani, presented a *mele*, or chant, to Kualiʻi while the older brother, Kapaahulani, led the opposing side to the battleground. When the two sides met, the *mele* was

successful and the battle was prevented. After the treaty, the island of Oʻahu was united. When chiefs of other islands found out about the unity, they joined forces to unite under Kualiʻi. Sterling and Summers (1978: 38) list several versions of this battle. Another battle referred to as "Battle of Kipapa" was part of the story of Maʻili-kukahi, where Big Island's chief, Hilo, attempted to take over Oʻahu unsuccessfully in a particularly bloody battle. His head was placed at a crossroads just above Honouliuli Village, which was since called Poʻohilo (Kamakau 1991: 56). A later conflict was the Battle of ʻEwa, which took place in several places within ʻEwa in the mid-1790's. In this battle, Ka-ʻeo and Kalani-ka-pule fought, and with the aid of European weaponry, Kalani-ku-pule overcame Ka-ʻeo (Kamakau 1961; as cited in Sterling and Summers 1978: 12).

3.4 Traditional Accounts of Natural Resources in ʻEwa Plains

Although historic accounts of water in west ʻEwa are rare, fresh water is documented at the spring Hoaka lei at Kualakaʻi on the ʻEwa coastline, in the oral history chant, He Moʻolelo Kaʻao No Hiʻiaka I Ka Poli O Pele, translated by Pukui et al. (1974:119) and by Kepā Maly (1999:31).

According to ancient myths, the ʻEwa Plain was home to a variety of wild plants and birds. The legend, He Moʻolelo Kaʻao No Hiʻiaka I Ka Poli O Pele, is the goddess Hiʻiaka's account of her journey across ʻEwa. In this legend, first published in Hawaiian in the newspaper *Ka Hoku o Hawaiʻi* (September 18, 1924 -July 17, 1928), important geographical locales as well as many trees, plants, and flowers were mentioned. Flora mentioned in the tale included: *nene* grasses, *kupukupu* ferns, *noni* trees, *maʻo*, varieties of *lehua*, *koaiʻa*, *ʻilima*, *ʻohai*, *kukui*, *kaunoʻa*, *ʻuala*, *pilipili-ʻula*, *wiliwili*, and *noho*. Emerson (1978:167) translated parts of this legend, and more recently Kepā Maly (1999:31) translated parts relating to ʻEwa. Maly (1999) paraphrases a portion of his translations of the Hiʻiaka legend chant:

> Descending to the flat lands of Honouliuli, Hiʻiaka then turned and looked at Puʻuokapolei and Nawahineokamaʻomaʻo who dwelt there in the shelter of the growth of the ʻohai (*Sesbania tomentosa*), upon the hill…When Hiʻiaka finished her chant, PuʻuoKapolei said…So it is that you pass by without visiting the two of us. Lo, we have no food with which to host you. Indeed, the eyes roll dizzily with hunger. So you do not visit us two elderly women who have cultivated the barren and desolate plain. We have planted the *ʻuwala* (sweet potato) shoots, that have sprouted and grown, and have been dedicated to you, our lord. Thus as you travel by, pull the potatoes and make a fire in the *imu*, so there will be relief from the hunger. For we have no food, we have no fish and no blanket to keep us warm. We have but one Kapa (covering)…in the time when the grasses dry, and none is left on the plain, we two are left to live without clothing. (Maly 1999:35)

Traditional *mele,* or chants, refer to and other localities on lands stretching from Puʻu o Kapolei to Kalaeloa as well. The nature of these lands in ancient times is suggested through these *mele*. Kamakau, in the mid- to late-1800's wrote articles in newspapers titled, *Kuʻokoʻa* and *Ke Au ʻOkaʻa,* which shed light on ancient Hawaiian life, customs, and oral traditions. These articles

were translated into English and compiled in several manuscripts in the 1960's then reprinted several times. For instance, Samuel Mānaiakalani Kamakau published numerous *mele* in

Nupepa Kuokoa during the late 19th Century. One of which describes the people, terrain, vegetation, and climates of various locations within the ʻEwa Plain:

> *Me he kanaka la ka ohai o Kaupea,*
> People are like the *ohai* blossoms of Kaupeʻa
>
> *Ka wiliwili haoe kaune i ka la,*
> The *wiliwili* appear to stagger in the sun
>
> *Kulolia i ke kaha i Kanehili,*
> Stricken on the plain of Kānehili
>
> *I ke kaha kahakai o Kaolina – e,*
> At the shore of Ka-ʻolina (Koʻolina),
>
> *He wahi olina na ka la i Puuloa…*
> There is a place of joy from the sun at Puʻuloa
>
> (Kamakau, in *Nupepa Kuakoa*, August 10, 1867:3; Translated by Maly, in Belt Collins 2006:2-15)

Kamakau also published several proverbs about the area in the Hawaiian newspaper, two of which are translated as:

> *A o kona oliliko ana e ulili haamalule ana i Puuokapolei*,
> And Puʻuokapolei which shimmers in the daylight;
>
> *A ua kolilii koliliko kona wailiula i ke kaha o Kanehili ka hele o ka wiliwili me ka lau o ka maomao*
> It is on the arid flat lands, of Kānehili,
> with the mirage forming waters,
> that the *wiliwili* and *maomao* grow,
> with their leaves scattered in the wind
>
> (Kamakau, in *Nupepa Kuakoa*, August 10, 1867:3; Translated by Maly, in Belt Collins 2006:2-14)

Another *mele* published in Nupepa Ka Oiaio in 1895 by Moses Manu, helps to reveal the lands of Kaupeʻa as the ancient Hawaiians viewed it. The *mele* is as follows:

> *O-u o lea ka manu o Kaupea,*
> The ʻŌʻū is the joyful bird of Kaupeʻa,
>
> *Ka O-o manu leo lea o Puuloa,*
> The joyful voiced ʻŌʻō is of Puʻuloa,
>
> *E hoonaele ana i ka pua o ka Wiliwili,*
> Softening the blossoms of the Wiliwili,

Inu iaola i ke koena wai lau noni
Drinking the drops of nectar from the noni,

Inu ka manu ano kunewa…
The birds drink and pass time…

(M. Manu in *Nupepa Ka Oiaio*, May 10, 1895:1; Translated by Maly, in Belt Collins 2006:2-15)

Marine resources were also plentiful along the coasts of the ʻEwa Plain. Kamakau (1991) in Ka Poʻe Kahiko: The People of Old, speaks of one ʻEwa guardian ancestor deity, Kanekuaʻana, also interpreted as a *moʻo,* or guardian water lizard, who was revered for providing her faithful descendants and *kamaʻāina* with an abundance of *iʻa* or marine resources from Halawa to Honouliuli. Further, Mary Kawena Pukui (1943), states that Kanekuaʻana was responsible for bringing the *pipi,* or pearl oyster, from Tahiti in ancient times (Pukui 1943 as cited in Sterling and Summers 1978:49-51). During times of scarcity, her devotees erected *waihau* and *heiau* to Kanekuaʻana where pigs, bananas, and coconuts were sacrificed, rather than people. Kamakau (1991) reports on the outcome of one such sacrifice:

> What blessings did they obtain? *Iʻa.* What kinds of *iʻa*? The *pipi* (pearl oyster) – strong along from Namakaohalawa to the cliffs of Honouliuli, from the *kuapā* [walled] fishponds of inland ʻEwa clear out to Kapakule. That was the oyster that came in from the deep water to the mussel beds near shore, from the channel entrance of Puʻuloa to the rocks along the edges of the fishponds. They grew right on the *nahawele* mussels, and thus was this *iʻa* obtained…the *pipi* were found in abundance – enough for all ʻEwa – and fat with flesh. Within the oyster was a jewel (*daimana*) called a pearl (*momi*)…They were great bargaining value (*he waiwai kumukuʻai nui*) in the ancient days, but were just "rubbish" (ʻ*opala*) in ʻEwa (Kamakau 1991: 83)

Though the project area is located beyond the margins of the areas touted as abundant in natural resources, it appears central and nearly equidistant to these important areas. Thus, pre-Contact cultural activities may have taken place in this area, such as travelling to and from Honouliuli Village to other locales in the *ahupuaʻa,* with the possibility of trails, trail markers, temporary encampments, or other activity areas. Conversely, this area was comparatively void of resources, yet abundant in sinkholes, making it ideal for human interments.

4.0 HISTORIC ACCOUNTS

Since the time of European Contact, ʻEwa District has had an intriguing history and has been the stage for several significant milestones of the island's history.

4.1 ʻEWA DISTRICT AND HONOULIULI AHUPUAʻA AT CONTACT

The written account of ʻEwa begins with the arrival of Captain George Vancouver in 1793. Apparently, the lands of ʻEwa garnered little comment in early written history, save for those of derogatory nature. According to Vancouver (1798), the conditions of the area between Waianae and Koʻolau Mountains were not pleasant, stating:

> This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of natural fertility; although we were told that a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced (Vancouver 1798 as cited by Sterling and Summers 1978: 31).

Vancouver's crewmen commented further on the condition of the few canoes that came out to greet them from west ʻEwa, calling them "small and indifferent" and "furnished with little for barter" (Vancouver 1798 as cited by Lewis 1970: 6). Later, Vancouver wrote of the relatively dismal condition of west Honouliuli coast, stating:

> From these shores we were visited by some of the natives, in the most wretched canoes I had ever yet seen amongst the South-sea islanders; they corresponded however with the appearance of the country, which from the commencement of the high land to the westward of Opooroah (Puuloa), was composed of one barren rocky waste, nearly destitute of verdure, cultivation or inhabitants, with little variation all the way to the west point of the island (Vancouver 1798 as cited by Lewis 1970: 6).

The political center of ʻEwa during the Contact period is still disputed. McAllister (1933: 106) describes a place named Lepau, which sits on the Waipiʻo Peninsula, less than 4 miles (6.35 km) east of Ka Makana Aliʻi, as a "dwelling place of the alii." Silva (1987) suggests that a place called Halaulani on the same peninsula was home to chiefs. Conversely, some argue that the political center was much further north at Lihue between Puʻu Kuua and Maunauna (Cordy 1996).

The Battle of ʻEwa is stated by Kamakau (1961) to have occurred in 1794, shortly after European Contact. This battle is said to have several phases, taking place in ʻEwa District and utilizing European weaponry. It is said that Kalanikupule, high chief of Oʻahu, overcame Kaeokulani, who ruled Kauai and Maui at the time.

4.2 HONOULIULI AHUPUA'A IN THE EARLY TO MID-1800S

The 'Ewa Plain was described as a near uninhabitable place in early accounts, however, Honouliuli Village was viewed more as an oasis with a sizable population, aquatic abundance, and burgeoning agricultural system. As seen in the Land Commission Award's Native Testimonies and early maps of Honouliuli, land adjacent to West Loch was intensively farmed with a variety of traditional agricultural methods from early Contact times into the late 1800's (Dicks et al. 1987, Appendix A; Malden 1825; Monsarrat 1878; Figures 6 and 7). The coastal areas were also famous for their marine resources and inland fishponds, as evident in oral and written history. Connecting Honouliuli Village and the trail leading from Honolulu to Waianae was a trail, often referred to as Kualaka'i Trail, which appears in the Malden 1825 map of the south coast of O'ahu to pass through or adjacent to the Ka Makana Ali'i project area (Figure 6). The ancient trail leads from Honouliuli Village to Keoneula (Hau Bush) with a leg leading to Kualaka'i (Figures 6, 10, and 12).

Edwin Hall, Hawaiian Minister of Finance, described west 'Ewa as a "barren, desolate plain" in the early 1800s after traversing much of the island of O'ahu (Hall 1839 as quoted in Lewis 1970: 8). Yet, according to maps of the early to late 1800s (Malden 1825; Monsarrat 1878; Figures 6 and 7), Honouliuli was labeled as the "Watering Place" and depicted as a relatively large agricultural community.

Honouliuli Village, which is located approximately 2.4 miles (3.9 km) northeast of Ka Makana Ali'i, had an abundance of natural resources, such as rich soil, marine life, and fresh water since pre-Contact times as depicted by early maps (Malden 1825; Monsarrat 1878; Figures 6 and 7) and written accounts (A. Campbell 1819; Chamberlain Ms.; Kamakau 1991). These vital elements permitted the development of an extensive system of irrigated taro patches or *lo'i* as well as landlocked and shoreline fishponds previous to the drilling of the first artesian well commissioned by James Campbell in 1879. Captain George Vancouver described the 'Ewa plain as deficient in people and fertility, but said he was informed that inland "…a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced…" (Vancouver 1798, Vol 3: 361-363). Archibald Campbell later writes of his experience travelling through 'Ewa in his 1809 essay, "Voyage Round the World," by stating:

> We passed by foot-paths winding through an extensive and fertile plain, the whole of which is in the highest state of cultivation. Every stream was carefully embanked to supply water for the taro beds. Where there was no water, the land was under crops of yams and sweet potatoes. The roads and the sides of the mountains were covered with wood to a great height. We halted two or three times, and were treated by the natives with the utmost hospitality (A. Campbell 1819: 145).

Maps from early to mid-1800s depict Honouliuli as having extensive agricultural fields and fishponds (Malden 1825, Monsarrat 1878; Figures 6 and 7). Additionally, Native Testimony given at the time of the Mahele 'Āina in 1848, list scores of taro patches (*lo'i kalo*), vegetable plots (*māla*), fishponds (*loko i'a*), pig pens (*pā pua'a*), pastures (*kula*), hala groves (*ulu hala*), and house sites within Honouliuli Valley (Dicks et al. 1987: Appendix A and B), attesting to

intensive agricultural activities and habitation density in the area. Furthermore, several well-known varieties of taro are associated with the area, one being the *kaikoi* taro that comes from the "land of the silent fish," which is another name for Pearl Harbor (Sterling and Summers 1978: 8).

However, after the arrival of Europeans, areas of natural abundance were severely impacted by exotic species and agricultural practices. S.E. Bishop wrote in 1836 that *mauka* areas were of denuded of vegetation due to intensive cattle ranching to the extent that "vast quantities of earth" were washed down into the lagoons, filling them with sediment, causing a near extinction of oysters and clams (Bishop 1901: 87 as cited in Sterling and Summers 1978). The reduction of marine resources and choking of wetland agriculture with upland sediments may have hastened the exodus of surviving Honouliuli villagers to seek employment and western comforts of the 'Ewa Plantation and villages.

Additionally, Honouliuli Ahupua'a was host to one of the earliest Roman Catholic Churches in Hawai'i (Figure 8), which helped indoctrinate Honouliuli inhabitants into a western lifestyle and values. By the mid-1800s, Honouliuli Village's population experienced a serious decline in Native Hawaiians, primarily due to disease. Following the development of 'Ewa Plantation in the late 1800's, parishioners of Honouliuli's Catholic Church moved their homes and subsequently their house of worship closer to the mill, which became 'Ewa Villages - the center of Honouliuli Ahupua'a's economy and its densest population center until the modern era.

Honouliuli Ahupua'a experienced a severe population decline in the early 1800s, despite the fecundity of the land. Levi Chamberlain, who circled O'ahu in 1828 to inspect missions and schools, held a small assembly for scholars in Waimanalo, west 'Ewa. The assembly took place in the house of a "head man" and was attended by people who lived in the area (Lewis 1970:7). Thus, during the early 1800's 'Ewa still had a modest population of Native Hawaiians who were receptive to Christianity and European-style schools.

In 1832, missionaries carried out a census in Honouliuli, recording 1,026 people with 25% of 'Ewa living in Honouliuli. L. Smith wrote of Honouliuli Village's population in 1830s, stating that within the village was a "populous neighborhood" (Smith 1835: 4). Kamakau (1961) stated that east 'Ewa experienced a spike in Native Hawaiian population growth in the mid 1800s, followed by a severe drop, to near extinction, as a result of European diseases. Further, Kamakau stated "Honouliuli had over ten school houses with their teachers" and after the acute population decrease, "whole villages have vanished, leaving not a man" (Kamakau 1961: 424-425). L. Smith, who was the first missionary to build a house and church in 'Ewa, said in the 1830's that, "the people of Ewa are a dying people" and for each birth were at least eight to ten deaths (Smith 1835: 8 as quoted by Lewis 1970: 8). Artemis Bishop, Smith's successor, listed small-pox, cholera, and measles as responsible for decimating Native Hawaiians of 'Ewa.

Additionally, Bishop stated that after several years of population decline, about half of Honouliuli's remaining population died within a few months in 1854 despite his attempt to vaccinate them (Bishop 1835: 1). Unfortunately, the people of Honouliuli, like other Hawaiians, had little chance of survival from these foreign diseases.

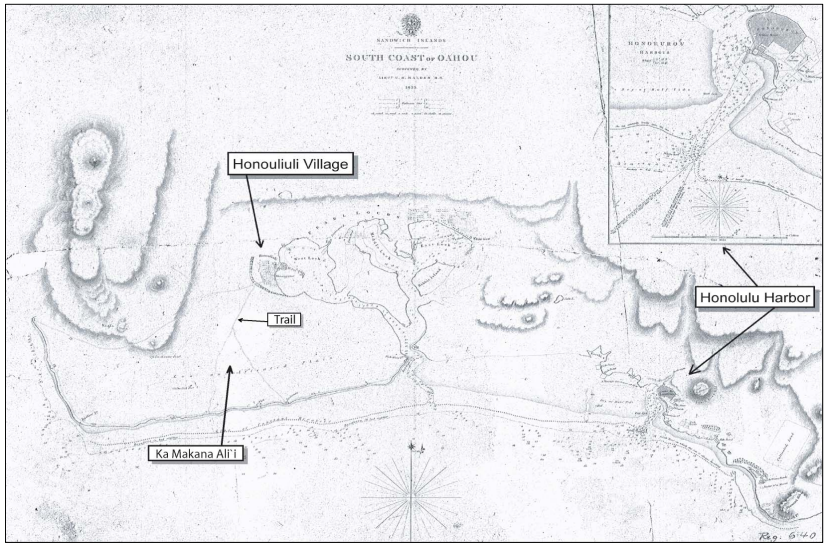

Figure 6. Malden (1825) map, south coast of O'ahu with Honouliuli and Honolulu depicted as well as the approximate location of Ka Makana Ali'i project area.

L. Smith, also noted in 1835 that the people of 'Ewa were generally of ill health and over-taxed by O'ahu's chiefs (Smith 1835 as cited by Lewis 1970). Smith expanded, by saying that the people of Honouliuli were "almost constantly employed for the chiefs – making salt – getting timber-wood and money for their annual tax" (Smith 1835:1).

Christianity was met with mixed reception by Native Hawaiians of Honouliuli in the early 1800's. However, some of the earliest detailed accounts of 'Ewa are from mission station reports. These reports doubled as a commentary on Honouliuli's demographics and as a progress report of conversions. Smith mentioned the presence of a school and provided a count of students tested in 'Ewa District in his "Oahu Station Reports - 'Ewa to Waianae, from 1835-1863," stating:

> There have been but two other Schools at Ewa during the year [be]sides those taught at the station.
>
> Two young men residing at Honouliuli have taught one School of children & one of adults. These Schools have made considerable improvement. Samuel has been reading book[s] of the adults. They had also an exercise in the Almanac; & it appeared at our examination or "hoike" recently held, that they could answer almost any question that could be asked from that book.
>
> We have had but one hoike during the year, & that took place on the 20th of May, & was composed of persons who had attended School & no others. Others would have gladly joined us as Scholars on that occasion, but I told them they had no part nor lot in the matter except as Spectators.
>
> The following is a list of the Scholars as they were examined.

No. of children from Honouliuli	31
*Do of adults	19
Total	50
No. of adult females at the Station	51
*Do of males	73
*Do of children	54
Choir of Singers	122
Total taught at the Station	300
	50
Total taught at Ewa	350

(Smith 1835:6)

> *Do is a form of short-hand used by L. Smith that appears to imply number of types of individuals in Honouliuli.

Yet, while walking in 'Ewa's hinterland during the same year, Smith happened upon a mound of stones with a "heathen god" atop, described as a "small stone dressed in tapa" (Smith 1835:2 as quoted by Lewis 1970:8). Thus, it is likely that some Native Hawaiians still revered old gods in the early 1800s.

The conversion to Christianity proved to have some positive outcomes according to missionaries as seen in a later report from Artemis Bishop from the mid 1800s:

> Four protracted meetings have been held during the year, within the bounds of my field of labor, to wit, at Halawa, Waiawa, Honouliuli, and Waianae. They were all, with the exception of the one at Halawa, well attended, and solemn, and were followed by decidedly beneficial effects. The frequent repetition of these meetings however in the same place, does not appear to me to be attended with very striking effects, unless it be in a time of special seriousness among the people. Such meetings however continue to be popular, and prove beneficial or not in proportion to the spirit with which they are conducted. (Bishop 1841:1)

Another station report for ʻEwa was submitted in 1846 by Bishop, revealing the mixed reception of Christianity in Honouliuli during the mid-1800's. Bishop writes:

> The state of religious apathy continued as heretofore for several years past, down to the middle of last year, without anything remarkable to disturb the false security that pervaded the community. About the first of July last, I was visited by several inquirers from Honouliuli a settlement on the western part of the district, who appeared to be anxious about their salvation. This was the first indication of anything special among my people. Soon afterwards I was invited to spend a day at the place and meet the people in religious meetings. I went accordingly and we had a full house and attentive listeners. Several who attended from neighboring villages, requested that I would likewise spend a day in religious meetings with them. As I was desirous that the people should generally come out, I required that the invitation should come from them, and special effort be previously made to obtain their presence. As I had been so long discouraged with the slender attention paid to social religious meetings which I had appointed in the neighboring villages, I feared that without a special effort on the part of the *kamaainas*, the appointment might prove a failure. But as I was happily seconded by my elders and other *lunas*, my appointments were well attended, and the preaching was listened to with seriousness and solemnity. My first efforts were mainly directed to the slumbering [church] members. These however gradually began to awake to prayer and effort to arouse others. Daily prayer meetings were after a time established in every village in the district, and where suitable houses for meetings were not to be found, new ones were in the time of a few months erected, and two days meetings were appointed at their dedication. These houses that exist in all the principal villages are distinct from the school houses, and are consecrated exclusively to religious meetings. About the close of the year a general seriousness pervaded the minds of the people throughout the district, the church was filled on the sabbath, and religious were thronged. Many backsliding professers were awakened, and many apostates had publicly confessed their sins, and sought to be restored to the bosom of the church. The no. of inquiries from the ranks of the world now amounted to upwards of 200. But as there appeared so little excitement, and everything went on so still, I had not dared to call it a revival. Nor have I yet ventured to give it that name; or scarcely to write much about it to my brethren, lest it should prove in the end a false illusion to the greater part of the young converts. I have all along preached to them the terms of the law, as well as the invitations and hopes of the Gospel – to lead them to a sense of sinfulness as well as to faith in the

> blood of Jesus, but I fear that a great multitude of them, do not feel as deeply as they mouth their utter unworthiness, notwithstanding their full and ample confessions with the lips. But it is not easy for this people to feel without animal excitement, which I have from the first falling away for now nearly a year, my hopes are more confirmed that their repentance and faith are sincere. Still I would hope with trembling, knowing as I do the fickle character of this people (Bishop 1846:1).

Bishop's struggle with the Native Hawaiian conversion to Christianity was endured in vain, however, as the majority of Honouliuli peoples would be wiped out by disease.

4.3 Honouliuli from the Mid- to Late 1800s

Despite the severe population decline, Christianity and European ways persisted in Honouliuli Ahupuaʻa, as they did all over Hawaiʻi. Agriculture, however, would not only persist in the area - it would dominate in the form of sugarcane.

According to Tuggle and Tomonori-Tuggle (1997), tax records from 1855 to 1888 reveal that the principal communities of the *ahupuaʻa* were in or flanking Honouliuli Gulch, as well as Lihue, Puʻuloa, Kualakaʻi, and Waimānalo. Only a total of 44 individuals were taxed between these years, although this number likely represents head-of-households. Taxable assets included, but were not limited to, "fishnets, boats, and houses" (Tuggle and Tomonori-Tuggle 1997: 38). Hence, at this time, small pockets of Native Hawaiian communities persevered in Honouliuli.

Although Catholic missionaries under Father Alexis Bachelot arrived in Honolulu in 1827, Catholic missionaries did not find Hawaiʻi receptive until the Edict of Toleration was issued by King Kamehameha III in 1839, which allowed Catholics to set up their own church to convert Hawaiians (Schoofs 1978). Schoofs (1978) commented on the little known Roman Catholic Church of Honouliuli, which is also depicted on M.D Monsarrat (1878; Figure 8) and W.D. Alexander (1873) Honouliuli maps. According to Schoofs (1978), the Roman Catholic Church of Honouliuli was overseen by Father Raymond Delalande and the location where baptismal records of leeward Oʻahu were kept. O'Hare et al. (2006) refers to this church as "Kapalani Catholic Church," which is taken from the description of LCA No. 1720 by the claimant, Hilinae in the late 1840's (Dicks et al. 1987, Appendix A: 9; O'Hare et al. 2006: 38). Although no other sources were found referring to the church as "Kapalani," this is the earliest record of a church in this area. In addition to Hilinae's native testimony, another is given by Kaohai (LCA No. 5670B), stating that his house site adjoins "the Catholic Chapel yard" (Dicks et al. 1987, Appendix A: 10) further upholding the existence of Honouliuli's Roman Catholic Church.

O'Hare et al. (2006), in a very thorough report about a nearby property, mentions the relationship of the church to Kepelino (Zepherino) Keauokalani, which translates as 'to-be-the-chief-of-the-nine-districts', who was a descendant of Kamehameha I and the historian Namiki (on his mother's side). O'Hare et al. (2006) found that Kepolino was a Catholic School teacher in various areas and had acquired a bad reputation as a prankster. As a result of his reputation as a bad administrator and accusations of "dancing and thieving" during his tenure as a

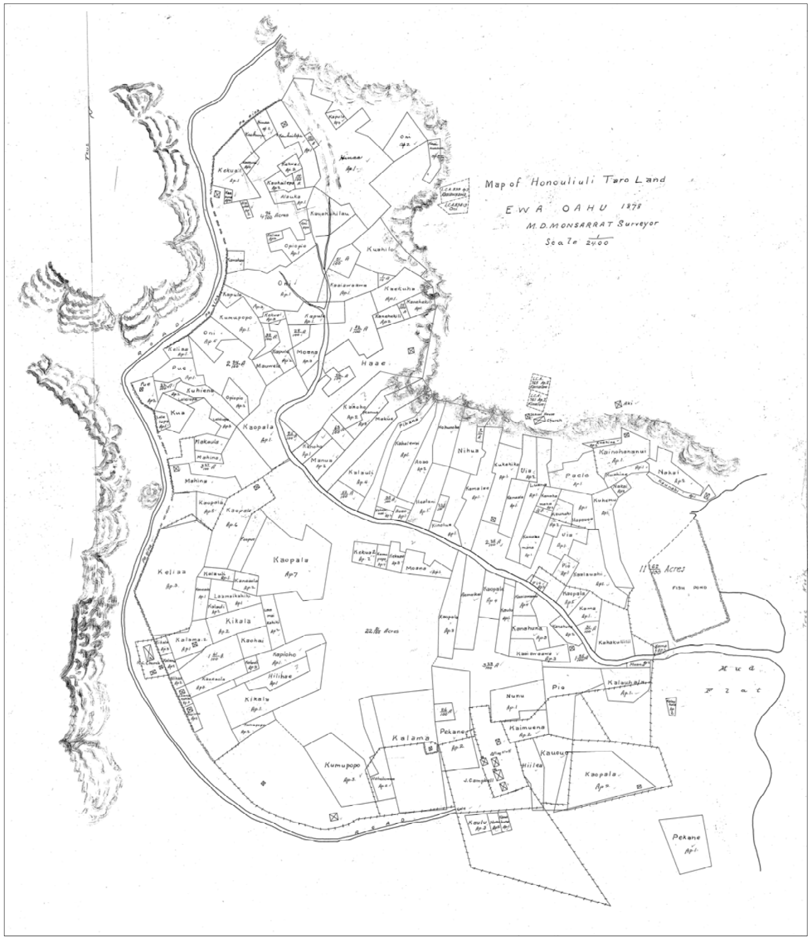

Figure 7. 1878 Monsarrat map of Honouliuli Taro Lands.

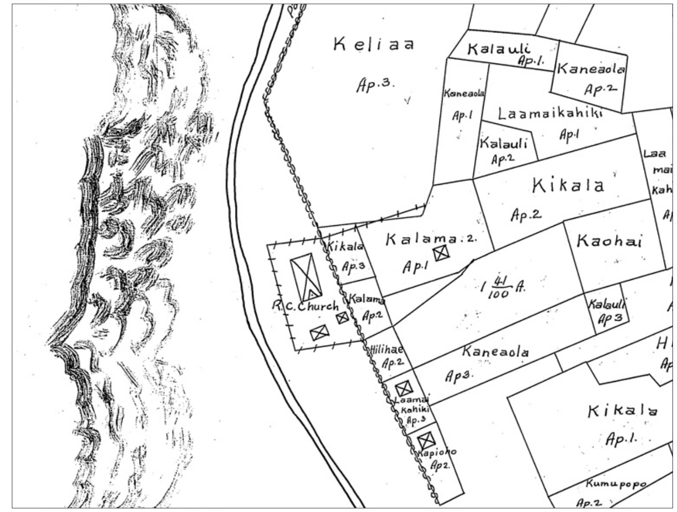

Figure 8. Portion of Monsarrat (1878) map showing old Roman Catholic Church.

Honouliuli school teacher in 1851, Kepolino was given a letter by the Minister of Public Education and Catholic Priests of Honouliuli denying further teaching positions, which were published in Catholic newspapers (O'Hare et al. 2006: 39). Kepolino's colorful story further verifies the establishment of a Catholic Church as well as Catholic school house in the village of Honouliuli located less than 2.25 miles (3.62 km) east of the project area in the mid-1800s.

'Ewa Plain's growth, stemming from the development of sugar cane plantations, and the decline of Honouliuli's Native Hawaiian population due to disease were key factors in the abandonment of Honouliuli's Roman Catholic Church. According to Schoofs (1978), "there was no point in having a chapel in both places…" and further states:

> The Honouliuli Church, located close to Pearl Harbor, had by the 1880's outlived its usefulness and become dilapidated. It was therefore abandoned and replaced by a simple structure erected close, too close, to the mill ['Ewa Plantation]. The location was unfortunate, but the little church had to accommodate the Catholic people of Ewa for 30 years.
>
> In the late 1920's, when the patchwork on the church had become impossible, plans were made for a new church in a better location. Fortunately the Catholic mission still owned the former church property in Honouliuli, and Bishop Alencastre was able to exchange it for a piece of land owned by the Campbell Estate and situated right in Ewa town, on the Renton Road, close to the Ewa public school (Schoofs 1978: 111-112).

Hence, the Roman Catholic Church of Honouliuli was not maintained and subsequently abandoned due to the exodus of Honouliuli Villagers, who survived European disease, into plantation centers such as ʻEwa Villages. Yet, Schoofs (1978) states that during the late 1800s, a Catholic cemetery existed in Honouliuli. Schoofs reported, "While most of the communities along the west coast of Oʻahu disappeared in the course of time, Honouliuli remained on the map until in its turn it was replaced by the growing plantation villages of ʻEwa. But, in 1891 Honouliuli was still important enough to acquire its own Catholic cemetery" (Schoofs 1978: 110). The location of the cemetery is still unknown.

As the drama of Honouliuli's Roman Catholic Church unfolded, another major event was occurring - the Great Mahele. The Land Commission granted approximately 43,250 acres of unclaimed lands in Honouliuli to chiefess Miriam Keʻahikuni Kekauʻōnohi in 1848. However, nearly 150 acres of Honouliuli Ahupuaʻa were designated as *kuleana* awards for commoners. Tuggle and Tomonori-Tuggle (1997) maintain that 72 awards were made, all of which appear to have been in or adjacent to Honouliuli Gulch (Tuggle and Tomonori-Tuggle 1997). Kekauʻōnohi's death in 1851 transferred her lands to her husband, Levi Haalelea. Most of Honouliuli was then sold to J.H. Coney for cattle ranching after Haalelea's death, who in turn sold 42,000 acres for $95,000 to James Campbell in 1877, an Irish born entrepreneur (Lewis 1970; Kelly 1991).

While the ʻEwa Plain had a sizeable cattle population by the mid-1800s, James Campbell consolidated great portions of Honouliuli for ranching, running over thirty-two thousand head of cattle. Honouliuli Village area became the nucleus of Campbell's prosperous ranch (Figure 7). In the summer of 1879, Campbell commissioned James Ashley to drill Hawaiʻi's first artesian well using a hand-operated rig near Campbell's ranch house in Honouliuli (Kuykendall 1967). The true location of the original well is disputed, but undoubtedly lies close to the intersection of Old Fort Weaver Road and Fort Weaver Road, which lies ca. 2.3 miles (3.7 km) northeast of the project area. In 1889, Campbell leased his lands, from Pearl Harbor to Waimanalo, to Mr. B.F. Dillingham of the Oʻahu Railway and Land Company for the next 50 years, who extended the railway from Pearl Harbor to Waianae (Lewis 1970; Figure 11). Dillingham then started the 11,000 acre ʻEwa Plantation Company in 1890 roughly to the west of West Loch and the Oʻahu Plantation in 1894 to the north of West Loch, initially planting sugarcane at Honouliuli and ʻEwa by irrigating with underground water (S. Campbell 1994; Figure 7). During that period, cattle were still ranched in the margins of the cane fields.

The rise of sugar plantations such as the ʻEwa and Oʻahu Plantations came with the increased demand for sugar in the United States, which was a result of the California gold rush in 1848 and the Civil War of 1861 as well as the 1875 Reciprocity Treaty that allowed Hawaiʻi sugar export rights to the U.S. (Hawaiʻi's Plantation Village n.d.). The plantations were also, in part, the outcome of James Campbell and B. F. Dillingham's "Great Land Colonization Scheme" failure of 1886, where the entrepreneurs originally set out to sell Honouliuli land to homesteaders, but opted instead for large-scale cultivation after drilling the first artesian well (OʻHare et al. 2006). These visionaries successfully transformed vast portions of the coral plains into fertile agricultural land by grubbing and deeply plowing upland areas and directing run-off sediments onto the plains. This feat allowed for both lucrative plantations, and subsequent merger of the two, to operate for nearly a century (S. Campbell 1994).

Part of the plantations' success came from the importation of cheap foreign labor to compensate for the severe Native Hawaiian population deficit due to European disease. At first, the Chinese were brought in to work the fields and mills for the length of their contracts. However, U.S. sugar demand mandated a rise in production, so the plantations began to recruit from Portugal, Japan, Puerto Rico, Okinawa, Korea, and the Philippines. The plantations were initially all- inclusive, providing housing, food, medical and meager wages to all employees and their families. A 1927/1928 US Geological Survey Map shows segregated villages for different ethnic groups represented at ʻEwa Plantation, which was incorporated into a map of Historic features located in Honouliuli Ahupuaʻa by Tuggle and Tomonori-Tuggle (1997; Figure 10). A full size copy of this map as well as key is provided in Appendix F.

4.4 ʻEwa Plains in the Early 1900s

By the turn-of-the-century, large-scale agriculture, primarily sugarcane and sisal, dominated the ʻEwa Plain, leaving only small pockets of traditional agriculture and family farms, primarily in Honouliuli Village area. As a result, plantation villages spread throughout the eastern ʻEwa Plain, including nearby Varona Village. Plantation sugar mills became the hub of activity and plantation life, attracting commerce and more settlers. By 1902, was able to produce over ten tons of sugar for every acre, outweighing its Hawaiian competitors by 6 tons an acre and Cuban competitors by 7.5 tons an acre. Another development would forever change the face of west ʻEwa – the leasing of land by the United States for military purposes (Lewis 1970; Kelly 1991; Tuggle and Tomonori-Tuggle 1997; Figures 9, 10, 12-14).

Agriculture was still the main focus of land use in Honouliuli Ahupuaʻa after the turn-of-the-century. Handy (1940) writes of agricultural terraces or vestigial agricultural structures being visible on the 1917 U.S. Geological Survey Map of Oʻahu, stating, "Large terrace areas are shown…bordering West Loch of Pearl Harbor, the indication being that these are still under cultivation. I am told that taro is still grown here. This is evidently what is referred to as "Ewa taro lands" (Handy 1940 as cited by Sterling and Summers 1978: 31). Of course, sugar cane dominated most of the ʻEwa Plain, yet sisal proved to be a lucrative crop for Honouliuli in the early 1900s. Sisal had gone from being an experimental crop in mid-1890 to being farmed on over 2000 acres, producing up to 445 tons of fiber a year (Kelly 1991; Figure 9 and 10). In addition, there are several testimonies from local *kūpuna* and longtime residents of the area that an area once existed just 0.6 miles northeast of Ka Makana Aliʻi where plants for *lāʻau lapaʻau*, Traditional Hawaiian herbal healing, were maintained, harvested, and administered (Mooney and Cleghorn 2008e).

By this time, Honouliuli Village, once considered the 'village of gold,' was no longer a destination, but a stopping point for those travelling on Old Ft. Weaver Road from Farrington Highway to Puʻuloa and plantation villages, and southeast ʻEwa Plain, now considered ʻEwa Beach. A handful of general and feed stores, a barber shop, a gas station, and mechanic shop had been erected sometime in the early 1900s to take advantage of this traffic. These were the western-most stores of the ʻEwa Plain. However, traffic along the old thoroughfare would sharply decline in later years with the coming of a new Ft. Weaver Road. As a result, Honouliuli Village would fall deeper into obscurity.

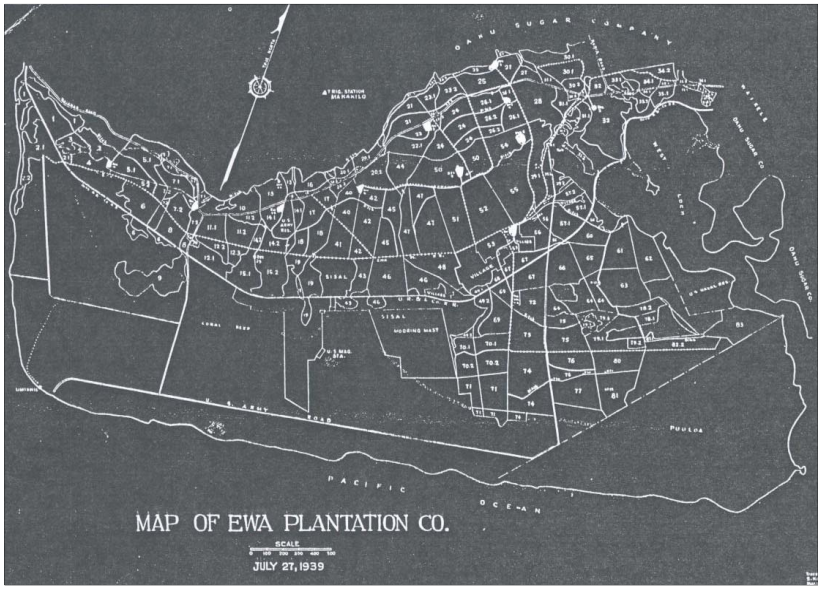

Figure 9. 1939 ʻEwa Plantation map.

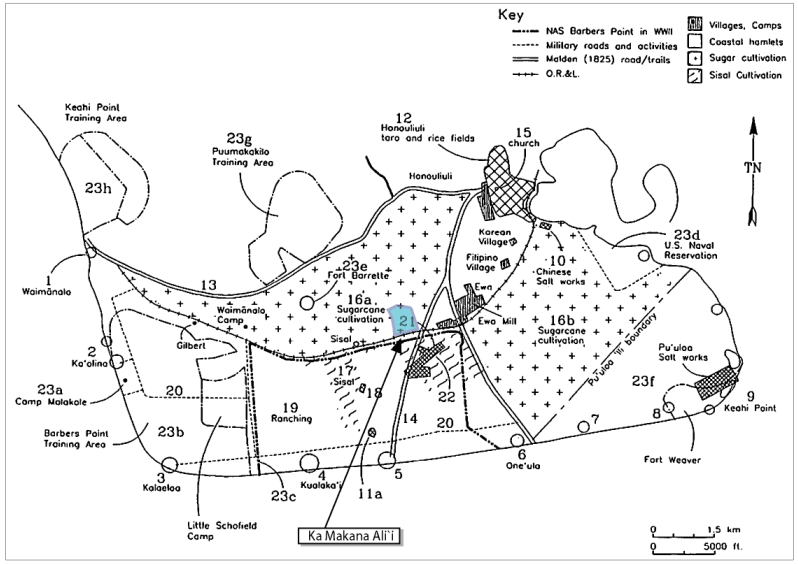

Figure 10. Historic features of Honouliuli (from Tuggle and Tomonori-Tuggle 1997, Figure 5; key provided in Appendix D of this report).

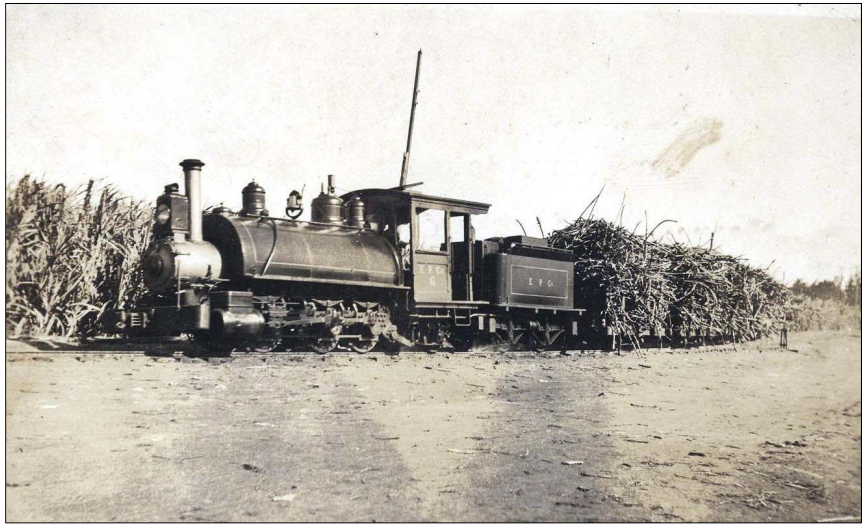

Figure 11. ‘Ewa Plantation Locomotive #6, 1926 (courtesy of the Hawaiian Aviation website Accessed 2011, State of Hawai‘i Department of Transportation, Airports Division).

The United States would show increased interest in this area after the annexation of the islands to the U.S. in 1899. In 1901, dredging began to deepen and widen Pearl Harbor and repeated in 1908 and in the 1920s. During this time, the U.S. Navy built support and dry dock facilities in the Pearl Harbor area. In the early 1930’s, the Navy constructed an ammunition depot on a 213 acre parcel at West Loch that was leased from the Campbell estate (O’Hare et al. 2006: 52). A Magnetic Observatory was built in Honouliuli near the U.S. Coast Guard Air Station Barber’s Point in 1902 by the U.S. Coast and Geodetic Survey. This facility was designed to measure movements of the earth and its magnetic field. (Kelly 1991; Tuggle and Tomonori-Tuggle 1997).

In the 1925, the U.S. Navy leased a 3,000 square foot piece of land from the Campbell estate to build a mooring mast for the dirigible *Akron* (Figures 9 and 10; Appendix D). However, records dispute the description of the property, suggesting that the ‘Ewa mooring mast was approximately 206 acres of grassy area that was used to land blimps. During this time, the Navy laid approximately 18 miles of roadway and built several camps and installations (O’Hare et al 2006: 52). By 1940, the U.S. Navy leased an additional 3,500 acres from Campbell estates to build the Marine Corps Air Station at ‘Ewa, which subsequently became NAS Barber’s Point (Kelly 1991: 166; Welch 1987).

In early 1941, the U.S. Marine Corps completed the airstrip, known as ‘Ewa Field, for peacetime training and began an expansion of Naval Aviation facilities at Barber’s Point. In October of the same year, construction of runways began at Barber’s Point, using excavated local coral for paving (Kelly 1991: 166; Welch 1987). ‘Ewa Field, now defunct, was constructed near to the old Mooring Mast and located across the train tracks and Roosevelt Road – less than 800 feet (300 meters) south of the project area (Figures 9, 10, 12; Appendix D). However, the Pearl Harbor attack on December 7, 1941, devastated much of the airstrip as well as its aircraft. As World War II commenced, the airstrip was swiftly completed by April 1942 – used as an active airstrip throughout its construction process. Upon completion, the main runway was over 8,000 feet long and 1,000 feet wide and the crossing runway 8,400 feet long and 750 feet wide.

The Marine and Naval Air Stations had some 12,000 enlisted personnel at its peak, but by 1947, the number went down to 1,645 (Kelly 1991: 168). To accommodate the military personnel, housing construction began for the men and their families at Barber’s Point in 1951. In 1956, plans for a second military housing complex were initiated.

During World War II, accommodations of a different sort were prepared approximately 3.5 miles (5.6 km) north of the project area. The Honouliuli Internment Camp was built on March 1, 1943, on 160 acres of land in Honouliuli Gulch just north of what is now the H-1 Freeway, west of Kunia Road (Figure 13). The camp, which was comprised mostly of crude wooden barracks and tents within barbed wire fences, was designed to hold up to 3,000 people, although its occupancy never exceeded 320 people. Most internees were non-combatant local males of Japanese ancestry. Yet, German, Italian, and Japanese prisoners of war were also held at the internment camp (Gabbard 2007; Wilson 2008).

Figure 12. ʻEwa Field Auxiliary Base, July 29, 1941 (courtesy of the Hawaiian Aviation website Accessed 2011, State of Hawaii Department of Transportation, Airports Division).

Figure 13. Honouliuli Internment Camp 1940s (courtesy of Honolulu Advertiser, 17 December 2008).

5.0 PREVIOUS ARCHAEOLOGY

One of the earliest documentations of archaeological sites are the Boundary Commission survey records (1862-1935), which established boundaries and descriptions of features in properties slated for personal ownership according to new legislation under the Mahele ʻĀina of 1848. A list of noteworthy archaeological studies in the ʻEwa Plains of Honouliuli Ahupuaʻa is presented in Table 2. Initially, most research took place in west Honouliuli Ahupuaʻa, but in the early 1980ʻs, the focus was turned to the east side of the *ahupuaʻa* as a result of increased residential and commercial development.

Table 2. Significant Archaeological Investigations of the ʻEwa Plains, Honouliuli Ahupuaʻa

Author and Date	Investigation Type	Focus/Findings	Location
Thrum, T. G. 1906, 1917	Survey, *heiau* study	108 *heiau* on Oʻahu; 1 heiau in Puʻu Kapolei	All Oʻahu; Puʻu Kapolei
Stokes, J.F.G. 1909	Inventory Survey	Walled fish traps	Pearl Harbor
Emory, Kenneth 1933	Inventory Survey	House site, possible *heiau*	Puʻu Kapolei
McAllister, J. Gilbert 1933	Inventory Survey	General archaeology; 8+ sites in Honouliuli Ahupuaʻa	All Oʻahu; Honouliuli Ahupuaʻa
Kikuchi, William 1959	Site Letter Report	12-16 Burial removals from limestone sinkhole	Campbell Industrial
Soehren, Lloyd 1962, 1966	Site Letter Report	Burial removal from sinkhole, recording of house site, fishing shrine, and modified sinkhole	NAS Barber's Point; west ʻEwa Plain
Lewis, Ernest 1970	Summary of Historical Data, Reconnaissance Survey	Historical background of Honouliuli; west ʻEwa Plain: house sites and house compounds, cairns, mounds, *ahu*, modified sinkholes (n=17)	Campbell Industrial Park, Barber's Point Deep Draft Harbor, Kalaeloa
McCoy, Patrick 1972	Survey	Stone structures within *ʻili*	Puʻuloa
Barrera, William 1975	Reconnaissance Survey	24 sites related to temporary habitation or fishing, Midden, artifacts, possible horticultural features	Campbell Industrial Park, Barber's Point
Sinoto, Aki 1976, 1978a	Survey, testing	44 new sites (B6-58 through 137); re-recorded Lewis 1970 and Barrera 1975 sites; extinct avifaunal analysis	Campbell Industrial Park, Barber's Point
Sinoto, Aki 1978b	Reconnaissance Survey	10 burials, some historic burials found in sinkhole	NAVMAG - West Loch
Jourdane, E. 1979	Reconnaissance Survey	8 sites	ʻEwa Marina, Oneʻula Beach
Davis, B. D. 1979	Survey	107 features	Oneʻula
Ahlo and Hommon 1983, 1984	Reconnaissance Survey, testing	No sites found	Honouliuli Solid Waste Processing and Recovery Facility
Rosendahl, Paul 1987	Reconnaissance Survey	4 sites (no. 3314-3317) midden, cemetery complex, occupation site, artifact collection area	West Loch Estates – Residential Increments I and II

Author and Date	Investigation Type	Focus/Findings	Location
Dicks et al. 1987	Reconnaissance Survey	7 sites (habitation site 3321 has dates from 6th-9th century w/ later occupations in 1300-1600AD, and 1700-1800's AD); other sites: fishponds, pondfields, and cemetery.	West Loch Estates (Golf Course and Parks)
Welch, David J. 1987	Archaeological Reconnaissance	2 sites (50-80-12-3721 is a complex of 5 traditional structures and 50-80-12-3722 is likely a historic wall used to separate cattle from the sisal plantation	Former ʻEwa Marine Corps Air Station, sites are located ca. 0.5 miles southwest of Ka Makana Aliʻi
Davis, Bert 1988	Subsurface Survey	No sites Found	ʻEwa Gentry
Kennedy, Joseph 1988	Letter Report	No sites Found	ʻEwa Gentry
Bath, Joyce 1989	Site Letter Report	Burial removal	Hōʻaeʻae Point
Hammatt et al. 1990	Archaeological Reconnaissance	No prehistoric sites found; no pre-ʻEwa Plantation historic sites found; Recordation of existing and demolished features in the ʻEwa Villages Complex	ʻEwa Villages Complex, from Fernandez Village to Varona Village and from Tenney Village to "C" Village area
National Park Service 1990	NRHP Registration (NPS Form 10-900)	ʻEwa Plantation Historic District defined and evaluated for significance; typical house structures described	ʻEwa Plantation Co. Mill complex and villages
Haun, Allen 1991	Survey	42 sites with 385 features (indigenous: habitation, agriculture, burial, religious, storage, collection of water, boundary marking; non-indigenous: cattle ranch and military)	NAS Barber's Point
Hammatt and Shideler 1991	Inventory Survey	No sites found	St. Francis Medical Center West, ʻEwa
Goodman and Cleghorn 1991	Testing	No sites found	Laulani Fairways Housing project at Puʻuloa
Kennedy et al. 1991	Inventory Survey and Testing	25 sites (ranching, military, and mining)	NAVMAG – West Loch
Landrum et al. 1993	Survey	Reviewed 197 previously identified sites; re-recorded 400 reported features	USN facilities on Oʻahu; NAVMAG West Loch
Moy, Tonia 1995	National Register of Historic Places - Registration Form	Historic American Buildings Survey (HABS) Forms for many Tenney Village homes and several Renton Village homes, but no HABS forms for Varona Village homes	ʻEwa Sugar Plantation Villages
Jensen and Head 1995	Reconnaissance Survey	On base: 8 isolated feature sites (historic and military); off base: 254 sites (historic, military, and Native Hawaiian)	West Loch Branch
Tuggle and Tomonori-Tuggle 1997	Synthesis of Archaeological Studies	General history, mythology, and archaeology	Entirety of ʻEwa Plain
Hammatt and Chiogioji 1997	Archaeological Reconnaissance Survey	Plantation era infrastructural remains; area previously disturbed	Road Corridor for Proposed North-South Road, linking Kapolei to ʻEwa Beach, adjacent to Ka Makana Aliʻi (to east)

Author and Date	Investigation Type	Focus/Findings	Location
Wolforth and Wulzen 1998	Data Recovery (controlled excavation, backhoe trenching, and monitoring	Agricultural pondfields: chronology and use	West Loch Estates – Residential Increment I and Golf Course and Shoreline Park
McIntosh and Cleghorn 2003	Archaeological Survey	No sites found	ʻEwa Gentry Makai
Collins and Jourdane 2005	Site letter report	Burial removal	Old Ft. Weaver Rd., Honouliuli
Oʻ Hare et al. 2006	Inventory survey	5 sites: taro lands, Kapalani Church, Pipeline Village, Drivers/Stable Village	Hoʻopili Project, 546 acres between Honouliuli Town and Kapolei
Oʻ Hare et al. 2007	Archaeological Assessment	No sites found	ʻEwa Industrial Park, 48.18 acres
Mooney and Cleghorn 2007a, 2007b	Archaeological Assessment and CIA	No sites found	Campbell Industrial; near Barbers Point Deep Draft Harbor; ca.3.5 miles W of Ka Makana Aliʻi
Mooney and Cleghorn 2008c, 2008d	Archaeological Assessment, Backhoe Testing, and CIA	No sites found; area previously disturbed; project area in Honouliuli Village/Taro lands vicinity	23 acres N-NW of Old Ft. Weaver and Ft. Weaver Road, ca. 2.2 miles N-NE of Ka Makana Aliʻi
Mooney and Cleghorn 2008a, 2008b	Archaeological Assessment and CIA	No sites found; area developed for the Makakilo Golf Course, now defunct	34 acre Makakilo Quarry Expansion and associated 360 acres, ca. 2 miles NW of Ka Makana Aliʻi
Mooney and Cleghorn 2008f/Pacific Legacy, Inc.	Archaeological Monitoring Report	Three potential sinkholes, historic military structural remains, historic rubbish	Ke Kama Pono Facility At York Town Road, Kalaeloa (Former NAS Barber's Point), ca. 1.5 miles southwest of Ka Makana Aliʻi
Fung Associates, Inc. 2009	Inventory and Condition Assessment of Historic Structures	Inventoried Homes in Tenney and Renton Village; no Varona Village homes were inventoried	ʻEwa Plantation Villages
Mooney and Cleghorn 2011b (report submitted to SHPD)	Archaeological Inventory Survey	Five Historic Sites: 4 associated with plantation homes, one Historic streetlamp	Varona Village

5.1 Early Archaeological Investigations of Honouliuli Ahupuaʻa

During his extensive survey of Oʻahu in the early 1930s, McAllister (1933) recorded 14 sites in Honouliuli and Puʻuloa Ahupuaʻa including the remnants of Puʻu Kapolei's *heiau*. While Sites 133-137 are in the upland region of the *ahupuaʻa*, sites 138 and 146 are located in the ʻEwa Plains and sites 139-145 are positioned on the shore of West Loch – all under 5 miles from Ka Makana Aliʻi. Table 3 lists descriptions of sites 133-146 and Figure 14 maps their locations.

Table 3. McAllister's (1933:107-108) sites located within Honouliuli and Puʻuloa Ahupuaʻa.

Site No.	Description	Location
133	Small enclosure 25'X30', faced walls 2'-5' tall filled w/smaller stones, purported *heiau*	Foot of Puʻu Kanehoa
134	Puʻu Kuina Heiau, destroyed, only a terrace remains	Foot of Mauna Kapu
135	Number of enclosures w/low faced walls, largest enclosure is 85'X100', all on level terrain, possible kuleana sites	Kukuilua's land
136	Small platform, destroyed, 4'-6'sq. made of coral and basalt	Near Mauna Kapu
137	Puʻu Kuua Heiau, destroyed	Waianae Mtns. 1,800' AMSL
138	Puʻu Kapolei Heiau, destroyed	Kapolei, ca. 100' from sea
139	Kalanamaihiki Fishing Shrine (*koʻa*), 2 lrg. Rough stones 2.5' in size, 6 or 7 stones avg. 1' in size piled next to lrg. Stones	Kapapahui, (point of land where Honouliuli Gulch meets West Loch)
140	Fishpond adjoining Laulau-nui Island to Kapapahui, 4-5 acres, 900' L X 7' W X 3.5' H outer wall, no outlet gates	Between Laulau-nui Island and Kapapahui
141	Kaihuopalaai, entire West Loch, starting point of the mullet run to Lāʻie	Pearl Harbor, west
142	Kapamuku or Pamoku fishpond, 3 acres, 660'L X 6' W X 3.5'H, no outlet gates, loosely piled stones	Puʻuloa/Waipiʻo Peninsula
143	Okiokilepe fishpond, 6 acres, 1000'L X 6.5'W X 4'H outer wall (made of coral), no outlet gates	Puʻuloa, across from Waipiʻo Peninsula
144	Fish traps and fishing shrine, destroyed	Pearl Harbor Inlet
145	Puʻuloa, place of first breadfruit planting	Southeast end of the ʻEwa Plains
146	Ewa Coral Plains, area of many sites (e.g. Puʻuloa Salt Works, extent of old stone walls, and modified pits)	Entire ʻEwa Plains

5.2 Recent Archaeological Investigations by Honouliuli Ahupuaʻa Locality

ʻEwa Villages, ʻEwa Gentry and ʻEwa Gentry Makai

Davis (1988) conducted archaeological testing for Bishop Museum in Ewa Gentry, located ca. 0.95 miles east of Ka Makana Aliʻi, in an area previously utilized for sugar cane cultivation. No archaeological sites were identified during testing. Previously, Kennedy (1988) conducted a surface survey in the same area that failed to detect archaeological sites.

A series of evaluations have been conducted in the ʻEwa Plantation Mill Complex and Village area from the mid-1980's to the present day (Pagliaro 1987; National Park Service 1990; Hammatt et al. 1990; Moy 1995; Fung Associates, Inc. 2009) to determine the Historic significance, restoration potential, and monitor the condition of the Historic District. Pagliaro (1987) states that ʻEwa Plantation manager, George F. Renton, Jr., decided to invest five million dollars in 1920 on infrastructure and housing upgrades, nearby Varona Village being one of the last housing improvements to the plantation under this fund. According to the NHRP Registration form (National Park Service 1990), Varona Village was initially built in 1939 under the name of "B" Village. Another moniker given to Varona Village was "Filipino Camp" (Moy 1995). Locals also called the village "Brooklyn," because this village was separated from the other villages by a bridge crossing Kaloʻi Gulch, which they nick-named the "Brooklyn Bridge" (National Park Service 1990). The homes were described as mostly "Varona Village Types A and B," which were "small, simple rectangular homes 20 feet wide by 38 feet deep, with corrugated metal roof, small eaves, board-n-batten single wall construction, pine floors and

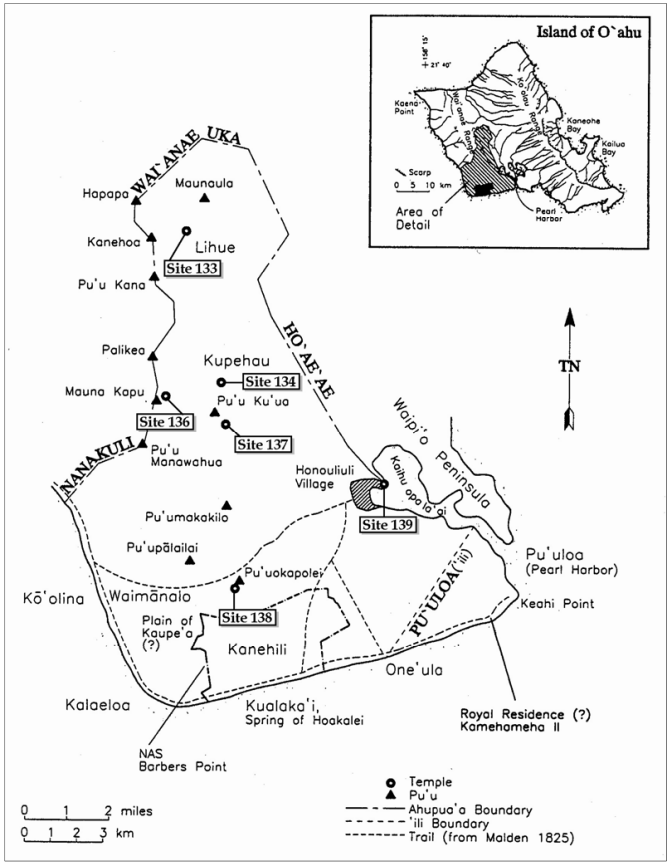

Figure 14. Points of interest in Honouliuli Ahupuaʻa, see Table 3 for site descriptions (map adapted from Tuggle and Tomonori-Tuggle 1997: Figure 4).

canec ceilings" (Moy 1995: 9). However, there were a few houses brought in from Puʻuloa in 1943, which are similar to those of Renton Village (Moy 1995). Additionally, Varona Village sported a large, board-and-batten community hall that was constructed in 1934 for the Filipino Community Association, which is now demolished (Moy 1995). Cultural Surveys Hawaiʻi completed an archaeological reconnaissance of 616 acres of ʻEwa Villages, which included: various sites associated with ʻEwa Plantation infrastructure (e.g. depot, reservoir, etc.), Plantation Cemetery, Buddhist Temple, Japanese School, Renton, Tenney, and Varona Villages as well as former "C", Mill, and Middle Villages (Hammatt et al. 1990). In this study, a sum of 9 sites were recorded, including a historic cemetery, reservoir, a communal bathhouse, OR&L tracks, village store with saimin stand, and a roundhouse. However, no prehistoric sites were detected.

In 1997, Hammatt and Chiogioji performed an archaeological survey of approximately 2.8 mile (4.5 km) long corridor for the proposed North-South Road in Honouliuli Ahupuaʻa. A segment of this corridor borders the subject property's northern edge. In this study, Hammatt and Chiogioji found that, "virtually the entire corridor has been extensively graded repeatedly over the past century by the ʻEwa Plantation Company…in association with sugar cultivation and the construction of plantation infrastructure" (Hammatt and Chiogioji 1997: i). The ʻEwa Plantation Villages Historic District and Oʻahu Railway and Land Co. Right-of-Way, which had previously been placed on the National Register of Historic Places, were encountered in this survey. Yet, no prehistoric sites were detected.

McIntosh and Cleghorn (2003) conducted an archaeological survey for the ʻEwa Gentry Makai residential housing, commercial and industrial mixed uses, community facilities and open spaces development at a 283-acre parcel in ʻEwa (TMK 9-1-10:7 and 9-1-69:5). The project area was, at the time, agricultural land formerly used for sugar cane production and limited grazing activities. No sites were found.

Puʻu Kapolei

The first investigation was in the early 1900's, where T. G. Thrum documented a *heiau* at Puʻu Kapolei (Thrum 1906:46), which is located in south-central Honouliuli. Thrum revisited the site in his second monograph on *heiau*, misnaming it Paloleʻi (Thrum 1917). Later, Emory (1933) took pictures and mapped a well-preserved house site and possible *heiau* near Puʻu Kapolei before the remnants were dismantled. McAllister arrived at Puʻu Kapolei shortly after and noted that the site, which he numbered 138, was ruined as its stones were removed and crushed to provide material for new construction (McAllister 1933: 108). He registered that on the side of Puʻu Kapolei was a large rock shelter, rumored to be the dwelling of legendary Kamapuaʻa and his grandmother, as well as a *heiau* that was later destroyed.

Honouliuli Village Area

The earliest recording of a site in this area was done by McAllister (1933), which was a *koʻa* named Kalanamaihiki (site 139). This fishing shrine is still perched on a hill within West Loch's Shoreline Park on a spit of land called Hōʻaeʻae Point across from Laulau-nui Island. This site is located 2.65 miles east of the project area (Figure 14; Table 2).

In 1987, Paul Rosendahl, Ph.D., Inc. (PHRI) performed an archaeological survey of the 232 acre West Loch Estates Residential Increment I, Golf Course, and Shoreline Park development. This project, which divides the area into upper valley, lower valley, coastal margin, and Hōʻaeʻae Point, covered a small section of the current project area's east side and spanned east to the shores of West Loch. The survey revealed four new sites (No. 3314-3317) despite the fact that most of the project area was modified by historic period agriculture. Sites 3315 through 3317 were of historic age, with 3316 being a small cemetery complex located less than 200 meters from the southern tip of the project area and the other two sites being surface artifact scatters. Site 3314 was a disputed midden layer (Wolforth and Wulzen 1998: I-28). Later in the year, PHRI (Jensen et al. 1988) conducted a field survey and subsurface testing in the same area, which yielded seven additional sites (No. 3318-3324). These sites consisted of pre- and post-Contact era habitation and burial sites. This study also suggested that traditional agricultural use of Honouliuli Gulch may have been ongoing for nearly one thousand years. Wolforth and Wulzen (1998) performed data recovery, which peered deeper into the intensity of habitation and agriculture as well as the chronology of these activities in the Honouliuli Stream Floodplain. Further, Wolforth and Wulzen (1998) surmised that the lower valley eventually filled with sediment from upland erosion, which caused the lowland marsh and pond-field system to dry out. As a result, the region became a collage of wet and dry fields with some houses, pastures, and gardens.

Perhaps the most thorough of recent archival investigations performed in the area was O'Hare et al. (2006), which was conducted on several parcels encompassing nearly 1,630 acres, one of which is located less than 1.7 miles east-northeast of Ka Makana Aliʻi. Backhoe testing was performed in areas that were identified by Hammatt and Shideler (1991) as historic habitation and/or agriculture. The findings were four additional features related to sugar cane cultivation, which were attributed to previously recorded Site 50-80-12-4344 that is located approximately 2.5 kilometers south of the current project area. While O'Hare et al. (2006) were not successful in finding physical remains of Honouliuli Taro Lands, "Kapalani" Catholic Church, Drivers and Stable Village, nor Pipeline Village, their report functions as a well-researched and comprehensive synthesis of these areas within Honouliuli.

More recently, Mooney and Cleghorn (2008c and 2008d) performed a CIA as well as archaeological survey and backhoe test excavations in two parcels at the corner of Old Fort Weaver and new Fort Weaver Roads. The archaeological testing yielded no new archaeological sites. However, results indicated a 3 to 5 feet (0.9 to 1.5 m) deep layer of construction fill with a significant amount of illegal dumping that lies over nearly all of the original ground surface.

Puʻu Makakilo Area

Puʻu Makakilo is located approximately 2.1 miles (3.4 km) north of the proposed Ka Makana Aliʻi. In 1988, a letter report was written by Aki Sinoto for the Makakilo Golf Course survey. On the southeastern flank of Pu'u Makakilo, Sinoto sates:

> As anticipated, large portions of the project area have been and still undergo severe erosion. Barren areas of exposed substrate is interspersed with areas dominated by dry grasses and small kiawe. Steep erosional gullies with vertical walled heads, bare areas of sheet wash, and pedestaled rocks attest to the severe and continuing erosion (Sinoto 1988:1).

While no significant archaeological sites were located in the survey, Sinoto did discover a deteriorated wall segment inside of Puʻu Makakilo that may have served as erosion control in historic times. However, due to its deteriorated state the site did not warrant further archaeological investigation nor preservation (1988:1).

In more recent times, four archaeological investigations have been performed within a mile radius of Puʻu Makakilo with modest finds (Hammatt et al. 1991, Nakamura et al. 1993, and Rasmussen 2006). However, several other investigations have been conducted in nearby Waimanalo, Kaloʻi, and Makaiwa Gulches, recording abundant archaeological sites (Bath 1989, Bordner 1977, Hammatt et al. 1991).

Mooney and Cleghorn completed archaeological and cultural impact assessments for the 34 acre expansion of the Makakilo Quarry and associated 360 acre visual impact modifications (Mooney and Cleghorn 2008a and 2008b). Review of previous archaeological investigations indicated that most the project area was part of a larger area surveyed previously. Further, most of the project area was found to be heavily bulldozed and reshaped for the now defunct Makakilo Golf Course during the January 2008 surface survey. No new sites were found.

Oneʻula

Elaine Jourdane (1979) performed a reconnaissance survey at Oneʻula, located about 2.15 miles (3.5 km) south of the project area, where she recorded eight pre-contact sites outside of the cane fields (as cited in Wolforth and Wulzen 1998). Davis (1979) returned to the area later that year and found 107 pre-Contact features. Shortly after, the area was revisited by Hommon and Ahlo (1983) who performed subsurface testing without any findings. Hammatt (1984) returned to the same area to evaluate the previous surface findings and relocated 33 of the features found by Davis (1979), which he attributed to 8 new sites. Hammatt (1984) suggested further investigations be performed on the features that would be impacted.

Kalaeloa/Barber's Point and Campbell Industrial

Little archaeological investigation was performed in Honouliuli Ahupuaʻa during the 1940s-50s, however, investigations picked up just prior to 1960. In 1959, William Kikuchi was the first to investigate the area when he was called to remove 12-16 inadvertently discovered burials at the Standard Oil Refinery at Barber's Point (Kikuchi 1959). Soon after, Lloyd Soehren (1962) recorded and removed a burial before excavating and recording a fishing shrine in NAS Barbers Point (Soehren 1966). This shrine was reported to be destroyed by Barrera (1975:1) and re-examined by Davis in 1982, where he performed supplementary excavations (Davis 1995).

By 1970, archaeological methods had evolved to standards with a more scientific and thorough approach. Lewis' 1970 investigation of Barber's Point and Campbell Industrial area was the first to address the ʻEwa Plain in this manner. In this study, Lewis (1970) recorded an array of house structures and habitation complexes, cairns and mounds (*ahu*), as well as modified sinkholes. Equally important, Lewis (1970) compiled a wealth of Historic documents and traditional chronicles on the ʻEwa Plains as a background for his report. With more innovative methods, Lewis (1970) was able to make some viable postulations about lifeways and the decline of early ʻEwa Plain populations.

In 1975, Barrera revisited the Campbell Industrial Park/Barber's Point area, studied by Lewis in 1970, and located twenty-four sites related to temporary habitation or fishing as well as midden, artifacts, and possible horticultural features (Barrera 1975). Just a year later, Aki Sinoto (1976) performed mapping and test excavations in the same area that would further enlighten archaeologists about the dynamics of early ʻEwa Plain populations and their environment. During his investigations, Sinoto (1976, 1978a) discovered many well-preserved habitation sites, including: C-shapes, enclosures, and modified sinkholes. Additionally, Sinoto (1976, 1978a) found a wealth of *in situ* cultural deposits and extinct avifaunal remains within the sinkholes.

An extensive archaeological and paleontological study was carried out on 89 acres for the Barber's Point Deep Draft Harbor in the early 1980's by the Bishop Museum (Davis 1990). In this investigation, 79 sites were identified, including modified sinkholes and habitation sites.

Haun (1991) performed an archaeological survey of NAS Barber's Point, where he identified 385 features within 42 sites that he claimed were "some of the best preserved and most extensive prehistoric remains known for the ʻEwa Plain" (Haun 1991:1).

Tuggle and Tomonori-Tuggle (1997) authored a synthesis of archaeological and historical investigations performed on the ʻEwa Plain. This comprehensive manuscript examines the prehistory, history, previous archaeology, and the natural resources found on ʻEwa Plain. In 2008, Mooney and Cleghorn (2008f) performed archaeological monitoring for the construction of the Ke Kama Pono Project located on York Town Road within the former Naval Air Station (NAS) Barber's Point. Three potential sinkholes were encountered; one after the site was cleared of vegetation and two during excavations. While foundation remnants from a late historic military structure (demolished in the late 1980's) were encountered and one historic bottle was found, no significant cultural remains were identified during excavations.

West Loch, Pearl Harbor

On the eastern edge of Honouliuli Ahupuaʻa, John F. Stokes (1909) composed a detailed study on the fish traps, ponds, and shrines that were located in and around Pearl Harbor. Later, McAllister (1933:28-32) mapped and recorded several fish ponds and traps of Pearl Harbor (sites 140, 142-3), revisiting one (site 144) previously recorded by Stokes in 1909. Additionally, McAllister (1933) gave West Loch itself the site number 141.

Situated under 4.5 miles (7.15 km) to the east is National Register site 9992, which is the Pearl Harbor Naval Base. This site is comprised of all three lochs of Pearl Harbor and associated U.S. Naval facilities as well as several islands and islets within.

Puʻuloa

Puʻuloa, which lies approximately 3-4 miles (4.8 – 6.4 km) southeast of Ka Makana Aliʻi, has been the focus of several investigations. The first report was written by Patrick McCoy (1972), who documented several stone structures when surveying *ʻili* in the proposed Puʻuloa Elementary site. Kennedy et al. (1991) conducted an archaeological inventory survey for the then proposed Puʻuloa Golf Course, now named the New Ewa Beach Golf Club. This survey yielded 72 prehistoric, historic and modern sites. Sinkholes containing cultural material, C-shapes, enclosures and mounds dominated the site types. Later, Kennedy and Denham (1992)

performed data recovery at sites scheduled for impact during golf course construction, which concluded that the earliest occupation of the area occurred between A.D. 1020-1480.

5.3 ʻEWA PLAIN SETTLEMENT PATTERNS

In the first and foremost synthesis of archaeological investigations conducted in the ʻEwa Plain, Tuggle and Tomonori-Tuggle (1997) proposed a pre-Contact Hawaiian settlement model. In this model, eight major zones of settlement were suggested for the period representing the height of Hawaiian occupation in the area. According to the ʻEwa Settlement Model map (Tuggle and Tomonari-Tuggle 1997:Figure 22), the project area is located on the southern edge of zone 2 (Figure 13). All settlement zone descriptions are provided in Appendix C. Zone 2 is described by Tuggle and Tomonari-Tuggle (1997:117) as follows:

> 2. Permanent agriculture settlements developed along the upper ʻEwa Plain, associated with the alluvial fans and soil of the upper Plain. Most of the cultivation was dryland, but included some runoff cultivation and some irrigation in a few of the spring-fed gully mouths.
>
> This is based on the environmental conditions of the area and archival data regarding water potential. It is probably not testable, except for the possiblilty of site discovery in small undeveloped gulches.
>
> 2a. This area was the first area of agricultural expansion outside the Honouliuli floodplain region, and probably consisted of small settlements at the mouths of gullies.
>
> This proposition is based on the agricultural potential, but may not be testable because of site destruction.

Hence, according to this settlement model, the Ka Makana Aliʻi project area and Keoneula Road corridor could have been an area utilized for permanent habitation and agriculture in pre-Contact times. It is possible that cultural deposits lie encapsulated under plantation era soils.

Another major feature of ʻEwa Plain is the Kualakaʻi Trail (Figure 6). While the exact location is unknown and physical evidence of the trail has not been identified, there is a high probability that archaeological deposits relating to the trail may still exist under plantation era soils. Archaeological deposits that may be encountered subsurface could include features of the trail itself, such as curbing and/or features related to temporary camp sites as well as isolated artifacts left behind by travelers.

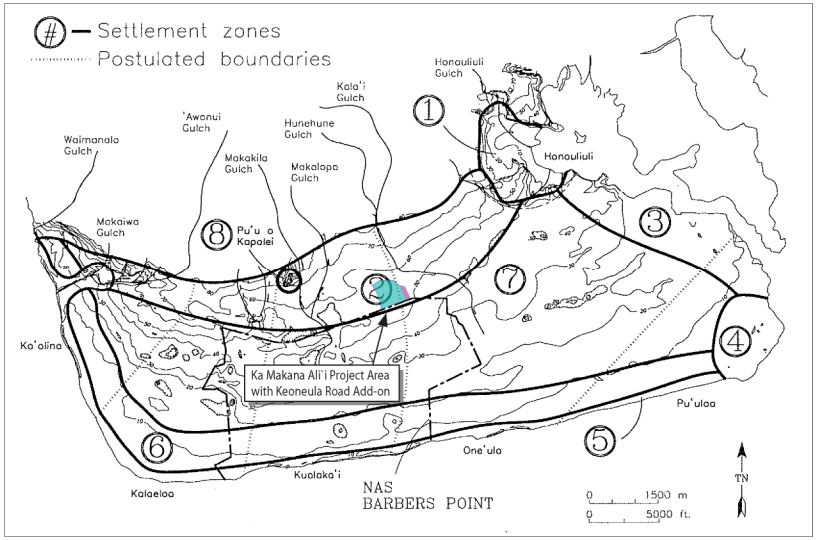

Figure 15. 'Ewa Settlement Model with Ka Makana Ali'i project area and Keoneula Road Corridor distinguished (adapted from Tuggle and Tomonari-Tuggle 1997:Figure 22).

6.0 FIELD METHODS

As much of the 'Ewa Plain is a buried *karst* landscape, characterized by numerous solution pits or sinkholes that may have been utilized for human burials and other cultural practices, the Office of Hawaiian Affairs (OHA) argues that subsurface testing aimed at locating and investigating buried sink holes must be performed prior to development in the 'Ewa Plain. To address the concern that buried sinkholes may be disturbed during project construction, a surface survey and subsurface testing was performed in the proposed Ka Makana Ali'i project area and the projected Keoneula Road corridor by Kimberly M. Mooney, B.A., between 11 July through 22 July 2011 under the general direction of Paul L. Cleghorn, Ph.D.

Surface Survey was performed by sweeping the project area and additional ca. 6 acres of road corridor on foot, inspecting all areas – avoiding all modern construction features, including the large borrow pit, the three stockpiles of excavated sediment, and large excavated area surrounded with a circular berm (Figure 16). These modern features represented a total of nearly 32 acres of the ca. 67 acres making up the Ka Makana Ali'i project area and roughly 6 acres of the Keoneula Road corridor. Appendix A provides a sample of project area photographs.

To improve manageability of gathered data for the relatively large property, the entire project area was divided into four quadrants representing the Northwest, Northeast, Southeast, and Southwest portions of the property (Figures 16, 26, 37, 46, and 54; Table 4). Initially, a virtual grid system was designed to plan out locations to perform subsurface testing, using a Google Earth aerial image of the project area matching landmarks visible at ground level with those seen on the aerial image. A Garmin GPS unit was then used to mark tested areas, which helped to gauge distance from already tested areas and was used to update the aerial images daily to test the project area as evenly as possible.

The strategy for testing was established in the Revised Testing Proposal, where construction plans for the development assumed that removing approximately 8 inches of top soil would expose the limestone *karst* deposits. As the estimated depth of alluvial overburden was ca. 8 inches, the initial plan to test for the presence or absence of sinkholes was to remove the alluvium by grading down to the limestone *karst* with a backhoe, also referred to as a wheeled excavator or hoptoe, exposing the tops of sinkholes visible in the base of the excavation as reddish brown circular stains contrasting to a white karst plain. This alluvium removal process, referred to in this investigation as a "test scrape," was to be performed by scraping the inner blade of a backhoe loader bucket against the ground surface over a distance of 30 feet and removing the spoils repeatedly until the limestone karst, and potentially sinkholes, were revealed.

However, following four unsuccessful attempts in four different locations to expose the *karst* layer (scraping down ≥19.7 inches or 0.5 meters) using the test scrape method, the strategy was modified. Backhoe trench excavations were then performed to locate the depths of the *karst*

limestone in all areas of the property, including the proposed Keoneula Connector Road corridor (200 ft. east of HECO lines), excluding the borrow pit and stock piles.

Subsurface testing consisted of closely monitored backhoe trenching, which was carried out by a backhoe with a 12 inch (30.48 cm.) wide scoop for the first week and a 24 inch (60.96 cm) wide scoop during the second week, as the 12 inch scoop created a trench too skinny to record properly. The stratigraphy of each trench was recorded by scaled soil profile drawings and by taking photographs of trench walls. Sediment layers were then analyzed by color, using a Munsell Soil Color Chart (2000), as well as texture, structure, consistency, and boundary. All trench locations were marked by GPS, which is proved in Appendix B and uploaded into Google Earth, which rendered an aerial map of the test trench and test scrape locations and is provided in Figure 25. Photographs of test excavations are also provided in Appendix A.

7.0 SURFACE SURVEY RESULTS

An archaeological pedestrian survey was performed in the project area by Kimberly Mooney, B.A. on 11 July 2011.

The project area topography is marked by several modern construction related features, such as the large Borrow Pit located at the south, three distinct areas of stockpiled sediment, varying in size and shape, and large excavated areas (Figures 16-24). However, some scattered areas, particularly on the central west and east margins, appeared relatively level and free of modern disturbances. Dirt access and old plantation roads criss-cross the landscape as well. Scatters of construction debris and irrigation material as well as mounds dumped household and landscaping rubbish can be found throughout the east and west margins of the project area. Much of the dumped materials are found beneath vegetation, suggesting that the dumping occurred a number of years ago.

Vegetation in the subject area, appeared to be by and large unused property dominated by hardy exotics such as *kiawe* (*Prosopis pallida*), *koa haole* (*Leucaena leucocephala*), *klu* (*Acacia farnesiana*), lantana (*Lantana camara*), *‘opiuma* (*Pithecellobium dulce*), amaranth (*Amaranthaceae sp.),* and *cherry tomato (Solanum lycopersicum var. cerasiforme)* with various grasses (*Pennisetum spp.*), shrubs and vines. However, some native plants were spotted in the project area, such as red and yellow *‘ilima* (*Sida fallax*), *‘uha loa* (*Waltheria indica*), and *maunaloa‘ula ‘ula* (*Canavalia cathartica)*.

Dirt roads, dirt paths, jumps, and berms related to access and unofficial dirt biking and off-roading can be found throughout the property (Figures 17 and19). These features had evidence of very recent use by a variety of off-road vehicles, including motorcycles, four-wheelers, cars, and trucks as well as non-motorized dirt bikes. The highest concentration of off-roading features were found on and around the Borrow Pit and Stockpile 2.

Several existing utility features were also found in the Northeast Quadrant of the project area. Several modern Sewer main manholes protected by bollards were identified as well as storm drains, telephone poles, and HECO power lines.

No archaeological sites were encountered during the survey. Photographs of the survey area are presented in Appendix A.

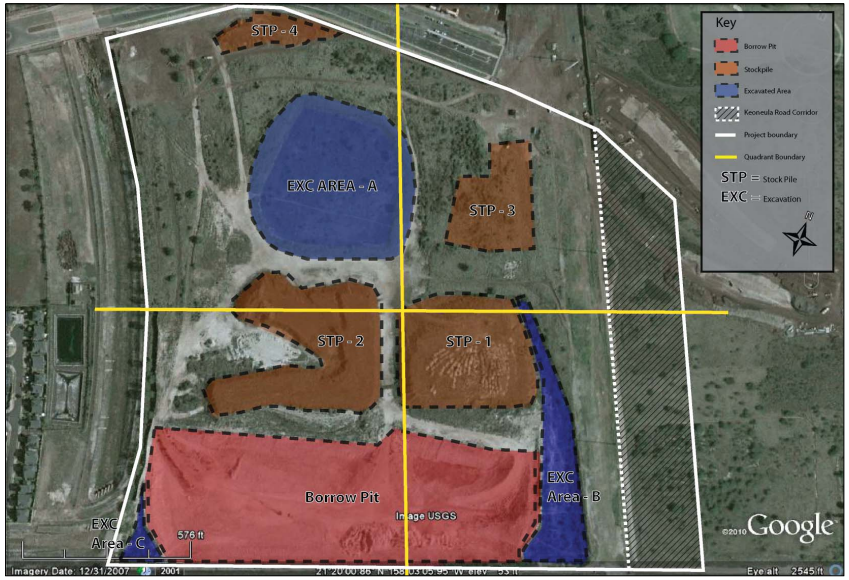

Figure 16. Modern construction features of project area (adapted from Google Earth image).

Figure 17. Ka Makana Ali'i Borrow Pit (view to southwest).

Figure 18. Stockpile 1, east side, backhoe for scale (view to west).

Figure 19. Stockpile 2, west side, backhoe for scale (note ORV jumps, view to north).

Figure 20. Stockpile 3, north end (view to southeast).

Figure 21. Access road between OR&L tracks and Borrow Pit (view to west).

Figure 22. West side of property, relatively flat and open (view to southwest).

Figure 23. Interior of Excavation Area A, backhoe for scale (view to southwest).

Figure 24. Northern edge of Excavation Area A (view to southwest).

8.0 SUBSURFACE TESTING RESULTS

According to the Revised Testing Proposal, construction plans for the development assumed that removing approximately 8 inches of top soil would expose the limestone karst deposits, which is the proposed grade that the majority of the structures will be built upon. As the estimated depth of alluvial overburden was ca. 8 inches, the initial plan to test for the presence or absence of sinkholes was to remove the alluvium by grading down to the limestone *karst* with a backhoe, exposing the tops of sinkholes visible in the base of the excavation as reddish brown circular stains contrasting to the white *karst* plain. This alluvium removal process, referred to in this investigation as a "test scrape," was performed by scraping the inner blade of a backhoe loader bucket against the ground surface over a distance of 30 feet, removing the spoils repeatedly until the limestone karst, and potentially sinkholes, were revealed.

However, after four unsuccessful attempts in four different locations (TS-1, 3-5; Figures 25 and 37) to expose the *karst* layer (scraping down ≥19.7 inches or 0.5 meters) using the test scrape method, the strategy was modified. Backhoe trench excavations were then performed to locate the depths of the *karst* limestone in all areas of the property, including the proposed Keoneula Connector Road corridor (200 ft. east of HECO lines), but excluding the Borrow Pit and stock piles (Figure 25; Table 4).

A total of 62 test trenches were excavated, revealing varying strata throughout the project area. Trench depths ranged from ca. 20 inches (ca. 0.5 meters) to ca. 12 feet, 2 inches (ca. 3.7 meters), with 54 of the 62 trenches revealing the karst layer. During trench testing, a single trench appeared to reveal a sink hole in the base of excavation and was hand excavated down only 0.45 meters before reaching the karst layer. This depression was ruled out as being a sink hole due to its shallow nature. In another test trench, the *karst* surface was found to be < 0.3 meters deep and appeared to be undisturbed and encapsulated under the topsoil. A test scrape was subsequently performed in the vicinity, which revealed that the top surface of *karst* was not a flat horizon, but rather, an undulating and irregular surface with many natural depressions. This caused some confusion as to what may or may not be a sink hole. Two darkly colored depressions in the base of the test scrape that appeared to be sink holes were hand excavated, but were found to contain only a thin layer of alluvium (< 0.2 meters). Thus, no sink holes were encountered during the testing phase.

Subsurface testing results are arranged by quadrant (Figure 25; Table 4), to help organize the stratigraphy data for analysis and interpretation. This system allows anomalies and patterns in the data to be ordered into a more observable spatial context, as opposed to a collection of individual points with associated data scattered throughout a relatively large subject area. A complete database for Test Trenches is provided in Appendix B.

Neither sinkholes nor cultural materials were encountered during the subsurface testing. Nonetheless, the current stratigraphy of the project area has been comprehensively recorded to provide a better understand the land's varying topography and past land use as well as providing information on which to generate an accurate monitoring plan.

Table 4. Test Trenches and Test Scrapes by Quadrant

Northwest Quad	Northeast Quad	Southeast Quad	Southwest Quad
TT-17	TT-1	TT-9	TT-25
TT-18	TT-2	TT-10	TT-26
TT-19	TT-3	TT-11	TT-27
TT-20	TT-4	TT-12	TT-48
TT-21	TT-5	TT-13	TT-49
TT-22	TT-6	TT-38	TT-50
TT-23	TT-7	TT-39	
TT-24	TT-8	TT-40	
TT-28	TT-14	TT-41	
TT-29	TT-15	TT-43	
TT-30	TT-16	TT-51	
TT-31	TT-34	TT-55	
TT-32	TT-35	TT-56	
TT-33	TT-36	TT-57	
TT-46	TT-37	TS-2	
TT-52	TT-42	TS-6	
TT-53	TT-44		
TT-54	TT-45		
TT-58	TT-60		
TT-59	TT-47		
TT-61	TS-1		
TT-62	TS-3		
	TS-4		
	TS-5		

Note:

TT = Test Trench
TS = Test Scrape

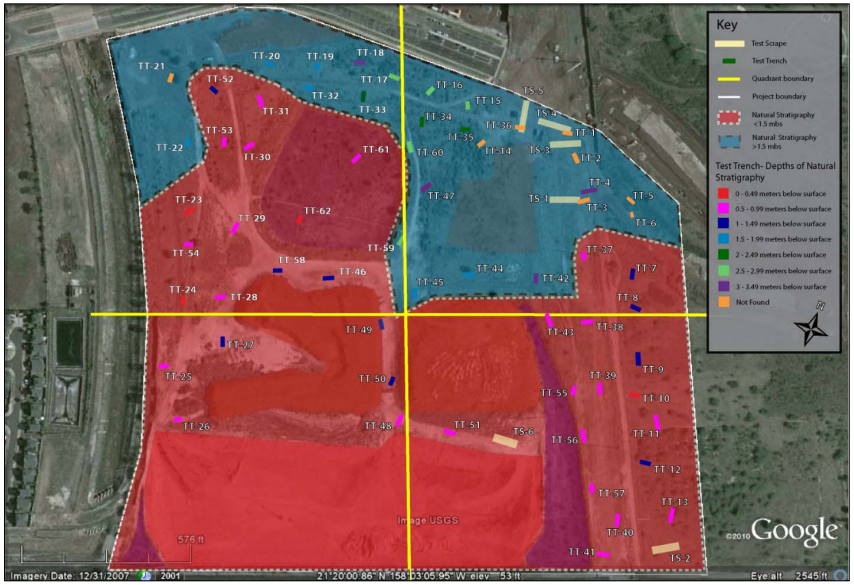

Figure 25. Project area with all Test Trenches and Scrapes (adapted from Google Earth image).

8.1 Northwest Quadrant

A total of 22 test trenches were excavated in the Northwest Quadrant (Figure 26), with depths ranging from ca. 0.5 meters below surface to ca. 3.7 meters below surface. This quadrant was found to have relatively deep sediment, consisting of construction fill and possibly plantation era red clay soil above the natural strata in its northern margin (Figures 27 and 28). The southern portion of this quadrant, omitting the previously excavated areas and modern stockpiles, appeared to have relatively thin layers of construction fill and/or red clay soils. Neither true sinkholes nor archaeological deposits were encountered during these test excavations.

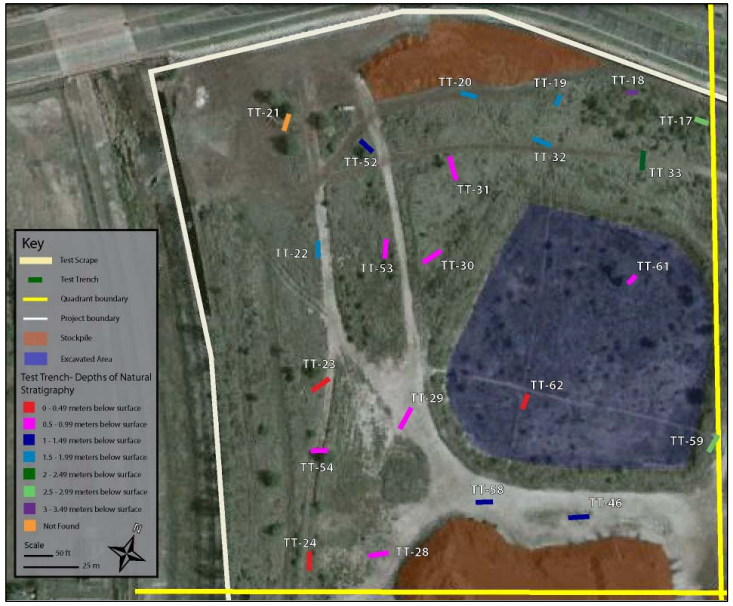

Figure 26. Northwest Quadrant (adapted from Google Earth image).

In most cases, natural strata was situated above the *karst* bedrock, which was represented by either a thin layer of natural alluvium, sometimes followed by an underlying layer of decomposing limestone. In general, these natural layers followed the contours of the *karst* bedrock. However, where natural depressions in the *karst* were encountered, the natural alluvium tended to be deeper. The boundaries between these two layers were usually irregular and gradual. The average depth of natural strata below surface was 1.36 meters.

With the exception of Test Trench 21, *karst* bedrock was encountered at depths varying from 0.3 meters below surface to 3.1 meters below surface. It is interpreted that substrate in the area of Test Trench 21, which was excavated to 3.7 meters below surface without encountering bedrock, has been disturbed by modern construction activities related to the drainage ditch located about 100 ft. west of the trench. While *karst* was encountered in Test Trenches 61 and 62, the excavated area in which they are located appears to have been disturbed deeper than the natural strata, as the fill layers appeared to rest directly on the *karst* with a smooth and abrupt boundary.

The soil profiles, photographs, and soil descriptions of four Test Trenches (numbers 20, 28, 30, and 46), were chosen to illustrate the diversity of layers and stratigraphies in this quadrant (Figures 29-36; Tables 5-8).

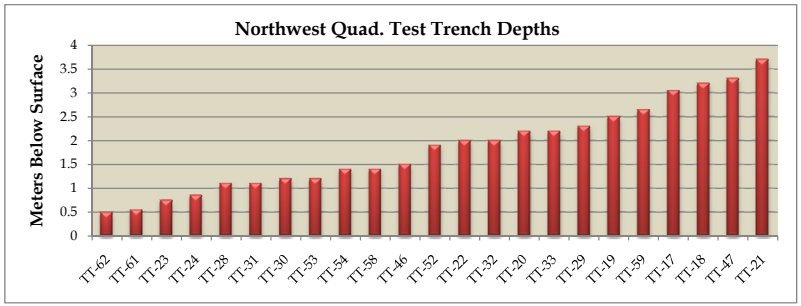

Figure 27. Overall trench depths for Northwest Quadrant.

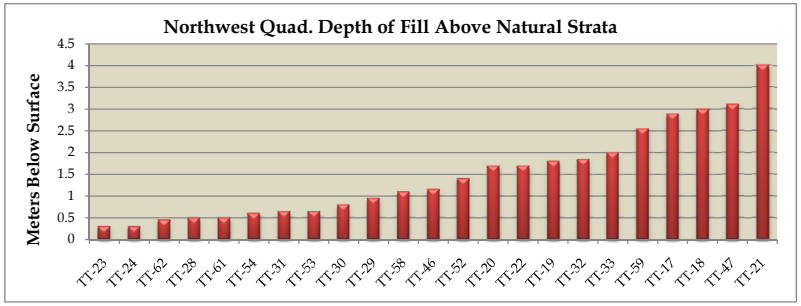

Figure 28. Depth of natural strata in Northwest Quadrant trenches.

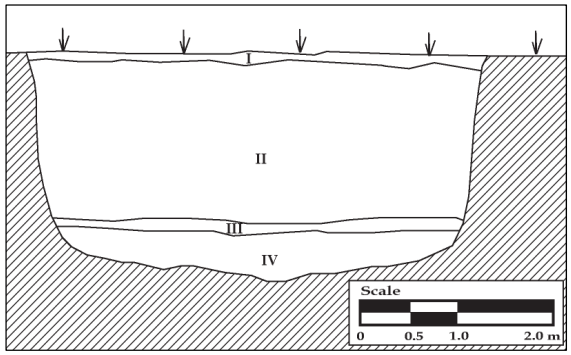

Figure 29. Test Trench 20 soil profile (south wall).

Figure 30. South wall of Test Trench 20 (view to southeast).

Table 5. Test Trench 20 Soil Descriptions

Layer	Depth (cmbs)	Description
I	0-20	Dark brown (7.5YR 3/3) silty clay; weak, medium subangular blocky; loose, slightly sticky and moderately plastic; gradual boundary; topsoil
II	10-175	Dark reddish brown (5YR 3/3) clay, medium angular blocky; slightly-sticky, moderately-plastic; clear boundary; agricultural layer (some plastic and metal)
III	165-185	Reddish brown (5YR 5/4) gravelly clay; weak, fine subangular blocky, non- sticky, and moderately plastic;
IV	180-245 (BOE)	White (2.5YR 8/1) decomposing limestone bedrock

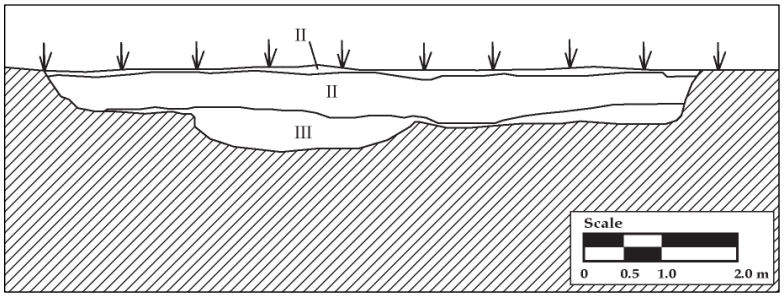

Figure 31. Test Trench 28 soil profile (south wall).

Figure 32. Test Trench 28 overview (view to east).

Table 6. Test Trench 28 Soil Descriptions

Layer	Depth (cmbs)	Description
I	0-18	Light gray (10 YR 7/1) silty loam; weak, medium subangular blocky; loose, non sticky and non plastic; clear boundary; topsoil/overburden
II	15-75	Weak red (10YR 4/2) silty clay, medium angular blocky; hard , slightly sticky and moderately plastic; contains construction debris
III	40-130(BOE)	White (2.5YR 8/1) decomposing limestone bedrock

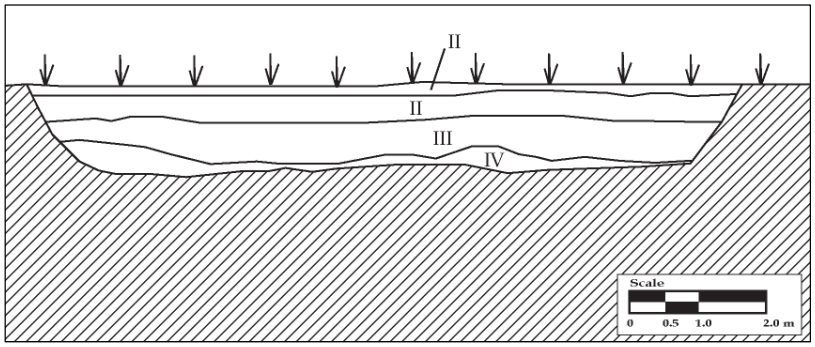

Figure 33. Test Trench 30 soil profile (south wall).

Figure 34. Test Trench 30, south wall, east end (showing coral bedrock).

Table 7. Test Trench 30 Soil Descriptions

Layer	Depth (cmbs)	Description
I	0-20	Dark reddish brown (5RY 3/3) gravelly clay; weak, medium subangular blocky; loose, slightly sticky and moderately plastic; clear boundary; topsoil/organics
II	10-50	Light gray (10YR 7/2) silt with coral gravel, fine to medium angular; hard , non-sticky, non-plastic; gradual irregular boundary; construction fill
III	45-110	Very dark grayish brown (10 YR 3/2) silty clay; weak, fine to medium subangular blocky; soft, slightly sticky, and moderately plastic; likely agricultural soil
IV	95-135 (BOE)	Pale red (10 YR 7/2) decomposing limestone bedrock, staining from clay

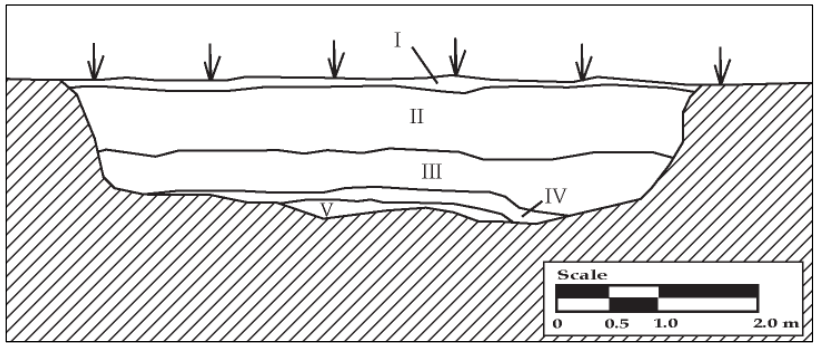

Figure 35. Test Trench 46 soil profile (north wall).

Figure 36. Test Trench 46 north wall, mid trench.

Table 8. Test Trench 46 Soil Descriptions

Layer	Depth (cmbs)	Description
I	0-23	Light gray (10YR 7/2) silt with coral gravel, fine to medium angular; hard , non-sticky, non-plastic; gradual boundary; some roots
II	15-110	White (10YR 8/1) silty coral gravel, medium angular blocky; hard , non-sticky, non-plastic; gradual boundary; construction fill
III	90-168	Reddish brown (2.5YR 5/3) clay loam; weak, fine to medium subangular blocky; soft, slightly sticky, and moderately plastic; mixed fills, gravel, and coral pebbles
IV	165-185	Reddish black (10YR 2.5/1) silty clay; fine angular; hard; sticky, and moderately plastic; possible agricultural sediment
V	181-190 (BOE)	White (2.5YR 8/1) decomposing limestone bedrock

8.2 Northeast Quadrant

A total of four test scrapes were performed, followed by 20 test trenches in the Northeast Quadrant (Figure 27). The grand majority of test scrapes for the investigation were performed in this quadrant. However, not one of these scrapes encountered the *karst* bedrock or any natural strata. After performing four test scrapes without encountering these natural layers, the mode of testing was changed to trench excavating to reveal how deep the natural layers were below the modern construction fills and agricultural soils. Test trenches in this quadrant revealed that this portion of the project area contained the deepest layers of soil above the natural strata, with the exception of Test Trench 21, located in the extreme northwest corner of the Northwest Quadrant (Figure 26).

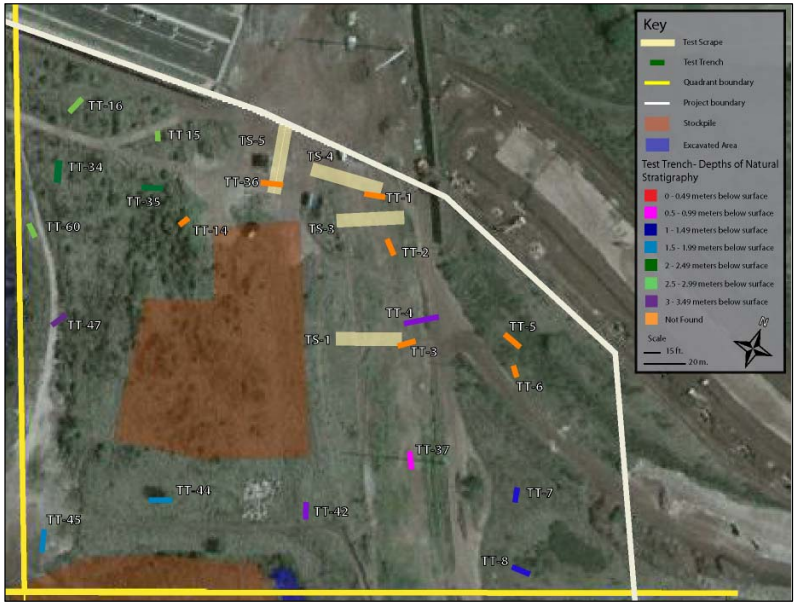

Figure 37. Northeast Quadrant (adapted from Google Earth image).

Test trench excavation depths ranged from ca. 1.15 meters below surface to ca. 3.4 meters below surface. This quadrant was found to have relatively deep sediment in its northern margin, similar to the Northwest Quadrant, consisting of construction fill and agricultural soil above the natural strata. Excavations revealed that the majority of trenches in the northern half of this quadrant encountered natural strata under sediment greater than 2.5 meters deep (Figure 38). The southern portion of this quadrant appeared to have relatively thin layers of

construction fill and/or red clay soils. Neither true sinkholes nor archaeological deposits were encountered during these test excavations. Test trenches 4 and 5 cross-cut modern trenches that appeared to contain existing, live utilities.

The natural stratigraphy was encountered in twelve out of nineteen test trenches, with depths ranging from 0.9 meters below surface to 3.5 meters below surface (Figure 39). Typically, natural sediment layers were situated above the *karst* bedrock, which was represented by either a thin layer of natural alluvium, followed by an underlying layer of decomposing limestone (Figures 44 and45; Table 12). As in the Northwest Quadrant, these natural layers followed the contours of the bedrock. The boundaries between these two layers were also irregular and gradual. The average depth of natural strata was 2.8 meters below surface. Soil profiles and soil descriptions are provided for Test Trench 4, 7, 35, and 44 (Figures 40, 42-44; Tables 9-12) and photographs for Test Trench 4 and 44 are visible in Figures 41 and 45.

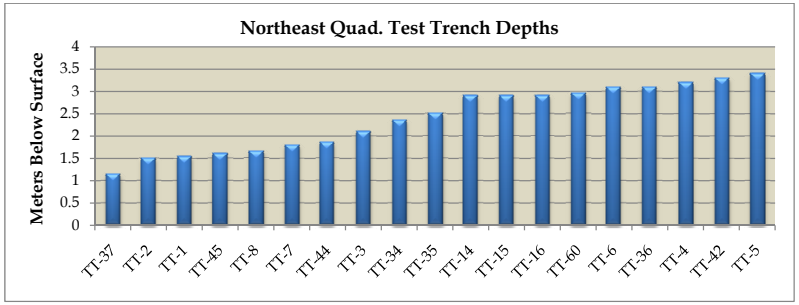

Figure 38. Overall trench depths for Northeast Quadrant.

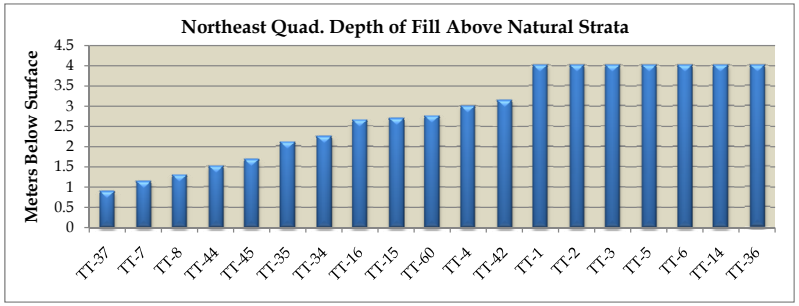

Figure 39. Depth of natural strata in Northeast Quadrant trenches.

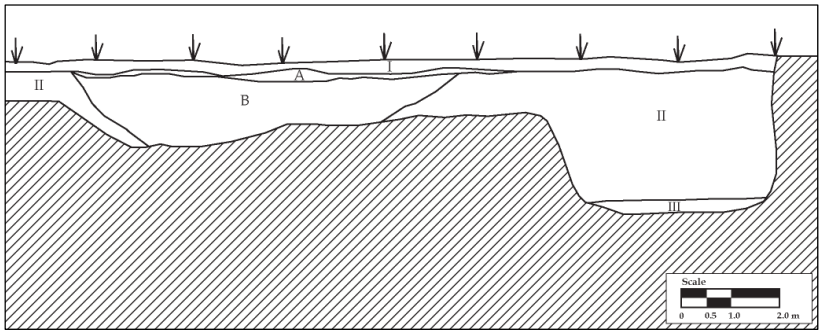

Figure 40. Test Trench 4 soil profile (east end, north wall).

Figure 41. Test Trench 4, north wall, east end (note construction fabric in cross-cut trench).

Table 9. Test Trench 4 Soil Descriptions

Layer	Depth (cmbs)	Description
I	0-23	Pale red (10YR7/3) silt with coral gravel, fine to medium angular; hard , non-sticky, non-plastic; gradual boundary; some roots
II	20-235	Dark reddish brown (5YR 3/3) clay, medium angular blocky; slightly-sticky, moderately-plastic; clear boundary; agricultural layer (with some plastic irrigation tubing)
III	300-320 (BOE)	White (2.5YR 8/1) decomposing limestone bedrock
A	15-35	**Cross-cut utility trench**: Light gray (5YR 7/1) silty gravel, medium subangular blocky; hard , non-sticky, non-plastic; clear boundary; coral fill
B	25-165 (BOE)	**Cross-cut utility trench**: White (5YR 8/1) silty gravel, medium subangular blocky; hard , non-sticky, non-plastic; clear boundary; coral fill

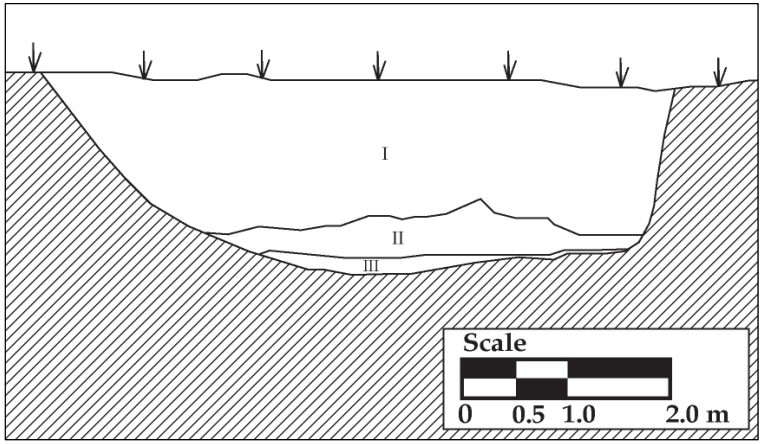

Figure 42. Test Trench 7 soil profile (east wall).

Table 10. Test Trench 7 Soil Description

Layer	Depth(cmbs)	Description
I	0-148	Dark reddish gray (5RY 4/2) loamy clay; weak, medium subangular blocky; loose, slightly sticky and moderately plastic; clear boundary; disturbed fill layer
II	125-175	Pinkish gray (5YR 7/2) silty clay with coral chunks, medium subangular blocky; soft, slightly sticky, non-plastic; clear irregular boundary; natural layer
III	170-200 (BOE)	White (2.5YR 8/1) solid limestone bedrock

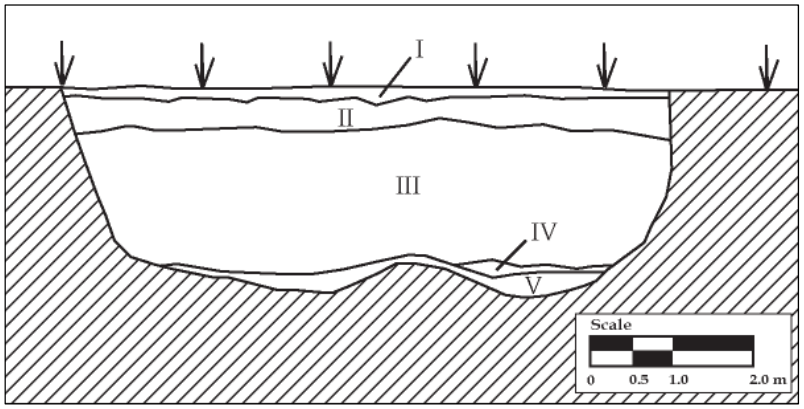

Figure 43. Test Trench 35 soil profile (north wall).

Table 11. Test Trench 35 Soil Description

Layer	Depth (cmbs)	Description
I	0-20	Light gray (10YR 7/2) silt with coral gravel, fine to medium angular; hard , non-sticky, non-plastic; clear boundary; some roots; topsoil
II	10-65	White (5YR 8/1) silty gravel, medium subangular blocky; hard , non-sticky, non-plastic; clear boundary; coral fill
III	45-270	Very dark grayish brown (10 YR 3/2) loamy clay; weak, fine subangular blocky; hard, slightly sticky, and moderately plastic; possible agricultural soil
IV	220-230	Pale red (10YR 6/4) gravelly clay; weak, fine with subangular coral gravel blocky, non-sticky, and moderately plastic;
V	205-250(BOE)	White (2.5YR 8/1) solid limestone bedrock

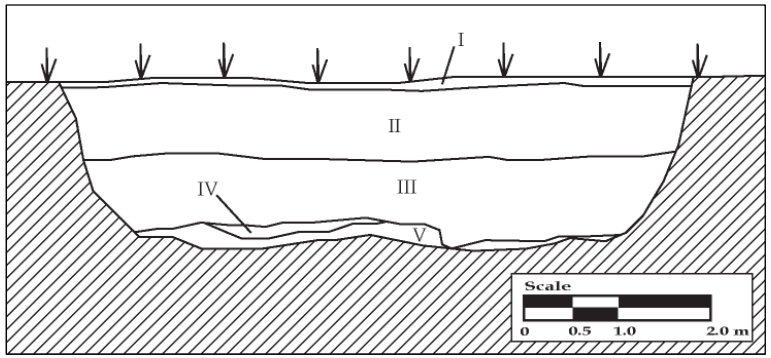

Figure 44. Test Trench 44 soil profile (south wall).

Figure 45. Test Trench 44 south wall.

Table 12. Test Trench 44 Soil Description

Layer	Depth (cmbs)	Description
I	0-12	Pale red (10YR7/3) silt with coral gravel, fine to medium angular; hard , non-sticky, non-plastic; clear boundary; some roots; topsoil
II	10-105	Light gray (10YR 7/2) coral gravel, medium angular blocky; hard , non-sticky, non-plastic; gradual irregular boundary; coral fill
III	90-175	Dark reddish brown (5YR 3/3) clay, medium angular blocky; slightly-sticky, moderately-plastic; clear boundary; agricultural layer (some plastic tubing)
IV	170-180	Pale red (10YR 6/4) gravelly clay; weak, fine with subangular coral gravel blocky, non-sticky, and moderately plastic;
V	180-185(BOE)	White (2.5YR 8/1) solid limestone bedrock

8.3 Southeast Quadrant

A total of two test scrapes and 14 test trenches were excavated in the Southeast Quadrant (Figure 46). Both of the test scrapes (numbers 2 and 6) encountered the *karst* bedrock. However, only Test Scrape 2 was interpreted as undisturbed natural strata. Test Scrape 6 appeared to have already been disturbed past the original upper horizon of the layer, likely due to bulldozing or excavations related to the Borrow Pit. Test trenches in this quadrant revealed that this portion of the project area contained the thinnest layers of fill and/or agricultural soil above the natural strata.

Figure 46. Southeast Quadrant (adapted from Google Earth image).

Test trench excavation depths ranged from ca. 0.65 meters below surface to ca. 1.8 meters below surface (Figure 47). This quadrant was found to have relatively shallow sediment in all areas not previously disturbed by construction. Generally the further south the trench, the thinner the fill or agricultural layer, except for Test Trench 10. Neither true sinkholes nor archaeological deposits were encountered during these test excavations. However, several perceived sinkholes were hand excavated in the base of Test Scrape 2, which turned out to only be depressions (≤20 cm deep) in the naturally undulating karst surface.

The natural stratigraphy was encountered in all test trenches, with depths ranging from 0.45 meters below surface to 1.1 meters below surface (Figure 48). Typically, natural sediment layers were situated above the *karst* bedrock, which was represented by either a thin layer of natural alluvium, followed by an underlying layer of decomposing limestone (Figure 49). As in the rest of the site, these natural layers followed the contours of the bedrock. The boundaries between these two layers were also irregular and gradual. The average depth of natural strata was 1.14 meters below surface.

Figures 49, 50, 52, and 53 illustrate the soil profiles of Test Trench 9, 10, 13, and 56. Tables 13-16 describe the soil observed in those profiles and Figure 51 is a photograph of the typical stratigraphy for the Southwest Quadrant as seen in Test Trench 10.

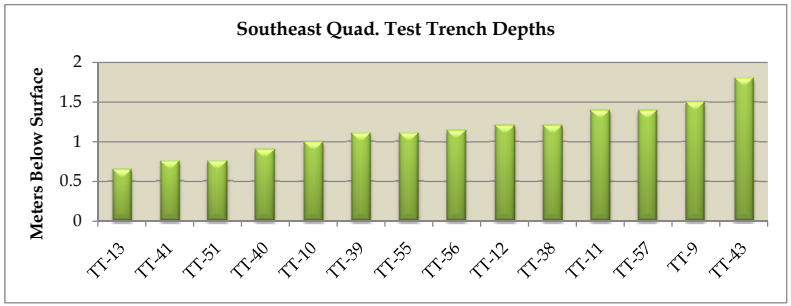

Figure 47. Overall Trench Depths for Southeast Quadrant.

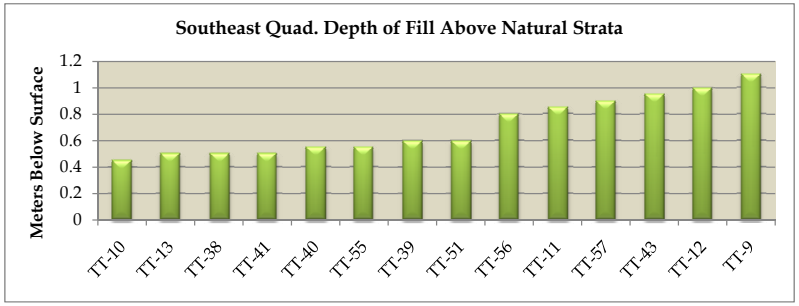

Figure 48. Depth of Natural Strata in Southeast Quadrant trenches.

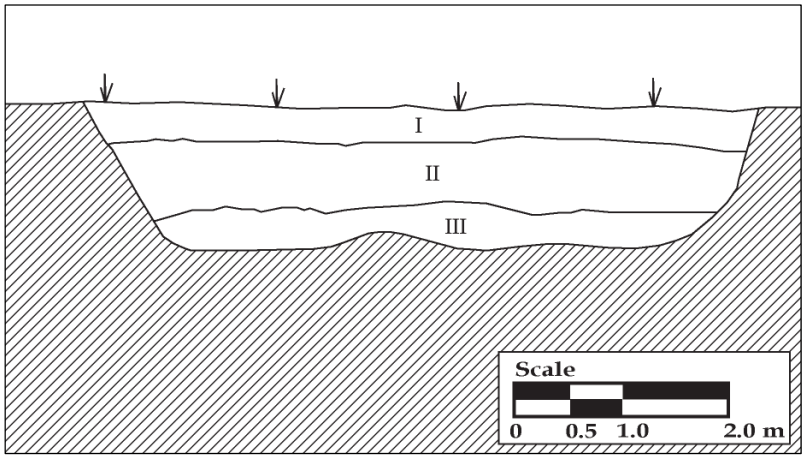

Figure 49. Test Trench 9 soil profile (east wall).

Table 13. Test Trench 9 soil descriptions

Layer	Depth (cmbs)	Description
I	0-45	Dark reddish gray (10RY 4/1) gravelly clay loam; weak, medium subangular blocky; loose, slightly sticky and moderately plastic; gradual boundary; fill layer with asphalt, gravel, plastic; organics scraped off
II	40-115	Dusky red (10YR 3/2) clay, medium angular blocky; slightly-sticky, moderately-plastic; clear boundary; agricultural layer (some plastic tubing)
III	110-150(BOE)	Pale red (10 YR 7/2) decomposing limestone bedrock, staining from clay

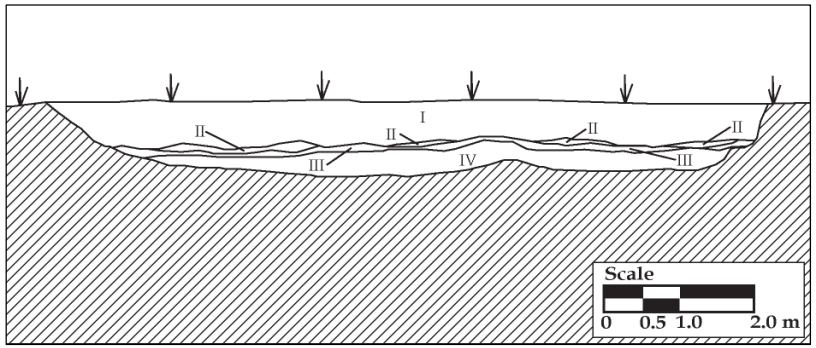

Figure 50. Test Trench 10 soil profile (south wall).

Figure 51. Test Trench 10, south wall.

Table 14. Test Trench 10 Soil Descriptions

Layer	Depth (cmbs)	Description
I	0-80	Very dusky red (10YR 2.5/2) gravelly clay; weak, medium subangular blocky; loose, slightly sticky, moderately plastic; gradual boundary; mixed fill and agricultural soil
II	77-85	Light gray (10YR 7/2) gravel, medium angular blocky; hard , non-sticky, non-plastic; clear boundary; coral fill with concrete and nails
III	80-90	Dusky red (10 YR ¾) silty gravel; weak, fine to medium subangular blocky; soft, slightly sticky, moderately plastic; possible interface of clay and decomposing bedrock
IV	70-100(BOE)	White (2.5YR 8/1) solid limestone bedrock

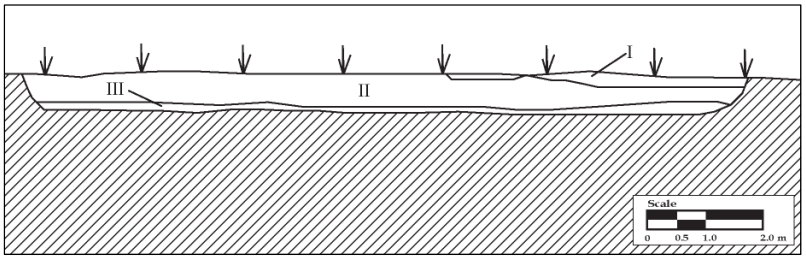

Figure 52. Test Trench 13 soil profile (east wall).

Table 15. Test Trench 13 Soil Descriptions

Layer	Depth (cmbs)	Description
I	0-30	Pale red (10YR7/3) silt with coral gravel, fine to medium angular; hard , non-sticky, non-plastic; gradual boundary; some roots
II	0-50	Light gray (10YR 7/2) gravel, medium angular blocky; soft , non-sticky, non-plastic; clear boundary; decomposing coral
III	55-65(BOE)	White (2.5YR 8/1) solid limestone bedrock

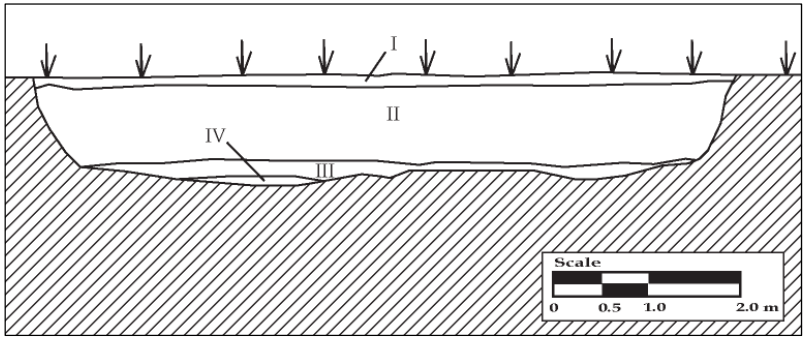

Figure 53. Test Trench 56 soil profile (east wall).

Table 16. Test Trench 56 soil description

Layer	Depth (cmbs)	Description
I	0-20	Weak red (10YR 4/2) silty clay, medium angular blocky; hard , slightly sticky and moderately plastic; contains construction debris
II	17-105	Light gray (10YR 7/2) gravel, medium angular blocky; hard , non-sticky, non-plastic; clear boundary; coral fill
III	90-115(BOE)	White (2.5YR 8/1) hard limestone bedrock

8.4 Southwest Quadrant

The least amount of testing was carried out in the Southwest Quadrant, due to the fact that the area was dominated by modern construction features, including the Borrow Pit and Stockpile 2 (Figure 54). A total of 6 Test Trenches were excavated, with all six encountering the natural strata.

Figure 54. Southwest Quadrant (adapted from Google Earth image).

Test trench excavation depths ranged from ca. 1.1 meters below surface to ca. 1.6 meters below surface (Figure 55). This quadrant was found to have relatively thin layers of sediment and very similar stratigraphy and soils as southern portion of the Northwest Quadrant. This suggests that the stratigraphy is continuous on the west side of the property between the modern construction features and the western edge.

The natural stratigraphy was encountered between 0.65 meters below surface to 1.3 meters below surface (Figure 56). In Test Trench 27, a soft deposit in the base of exaction, which was the upper horizon of the karst bedrock was hand excavated to test the notion that it may be a sinkhole. However, the soft natural alluvium was less than 40 cm deep and the depression did not exhibit the hallmarks of a sinkhole (Figure 58). Thus, neither true sinkholes nor

archaeological deposits were encountered during test excavations in the Southwest Quadrant. Soil profiles and soil descriptions are provided for Test Trench 27 and 48 (Figures 57 and 59; Tables 17 and 18) and a photograph for the hand excavate area in Test Trench 27 is provided in Figure 58.

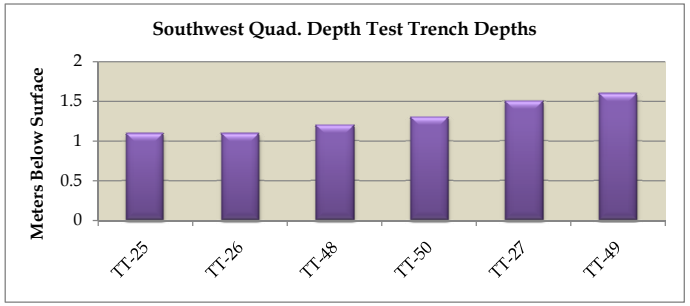

Figure 55. Overall Trench Depths for Southwest Quadrant.

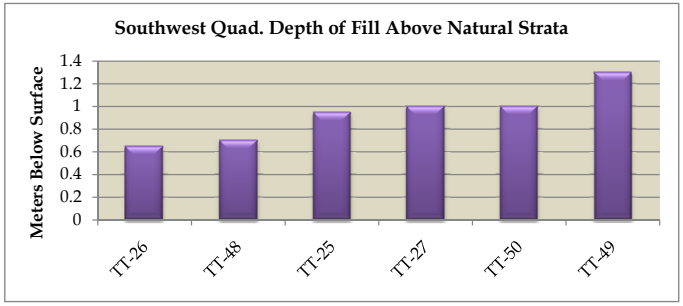

Figure 56. Depth of Natural Strata in Southwest Quadrant trenches.

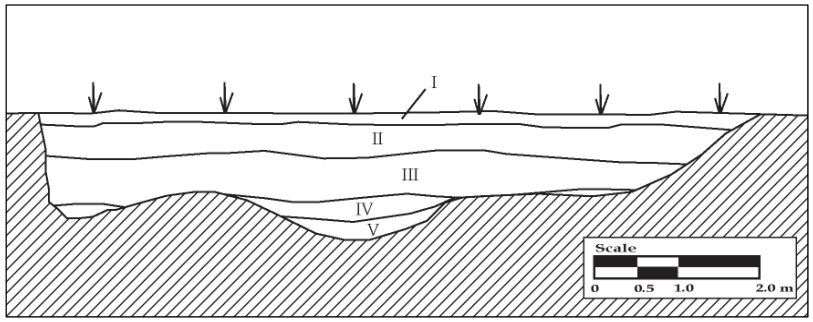

Figure 57. Test Trench 27 soil profile (west wall).

Figure 58. West wall of Test Trench 27 at hand excavated depression in bedrock.

Table 17. Test Trench 27 Soil Descriptions

Layer	Depth (cmbs)	Description
I	0-18	Light gray (10YR 7/2) silty gravel, medium angular blocky; hard , non-sticky, non-plastic; gradual boundary
II	17-65	Light gray (10YR 7/2) gravel, medium angular blocky; hard , non-sticky, non-plastic; clear boundary; coral fill
III	50-130	Dark reddish brown (5RY 3/3) clay; compacted, medium subangular blocky; loose, slightly sticky and moderately plastic; clear boundary; poss. Agricultural
IV	100-120	Pale red (10 YR 7/2) decomposing limestone bedrock, soft, staining from clay
V	115-150(BOE)	White (2.5YR 8/1) solid limestone bedrock

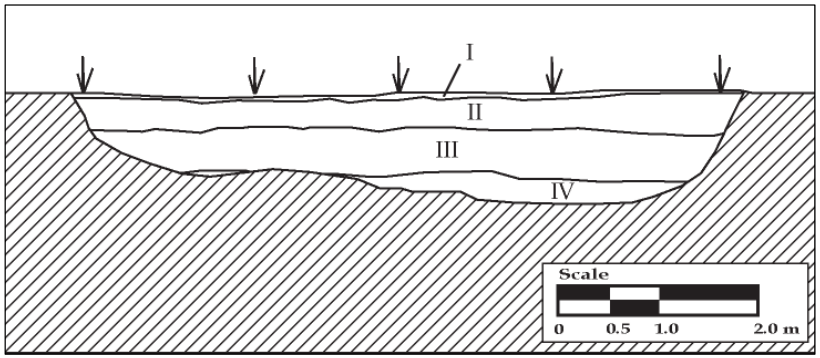

Figure 59. Test Trench 48 soil profile (west wall).

Table 18. Test Trench 48 Soil Description

Layer	Depth (cmbs)	Description
I	0-10	Pale red (10YR 6/2) silty gravel, medium angular blocky; hard , non-sticky, non-plastic; clear boundary; loose gravel mixed with Aeolian clay
II	7-55	Light gray (10YR 7/2) gravel, medium angular blocky; hard , non-sticky, non-plastic; clear boundary; coral fill
III	45-110	Very dark grayish brown (10 YR 3/2) gravelly clay; weak, fine subangular blocky; soft, slightly sticky, and moderately plastic; fill layer
V	100-120(BOE)	White (2.5YR 8/1) hard limestone bedrock

9.0 SUMMARY AND RECOMMENDATIONS

The ‘Ewa Plain of Honouliuli Ahupua‘a has a long and complex history, which is apparent from archival research and archaeological investigations carried out in the last 30 years. Archival research has allowed a glimpse of the varied lifeways on the plain. Peripheral areas, especially those bordering Pearl Harbor, offered rich natural resources for fishing and gathering and the perfect matrix for fruitful agriculture in pre-Contact times. Yet, central plain areas presented scant resources needed for survival. Traditional accounts echo this disparity in ‘Ewa Plain resources. Local mythology and lore suggest that the entire region is has been the stage for legendary tales and the home of many mystical beings as well as *ali‘i*. Archaeological investigations have shown that much of the area’s cultural resources have been disturbed by sugar plantation activities. However, the most common features in this area are agricultural features and sinkholes containing archaeological and paleontological resources. Due to historic sugar cane and sisal cultivation activities as well as plantation related infrastructure development, features such as these have likely been covered with sediment, encapsulating them and obscuring their locations. The area’s more recent past is also significant in understanding the region’s economic evolution as well as local cultural dynamics and identities.

The surface survey yielded no archaeological sites. Rather, the project area exhibited signs of continuous disturbances in the form of construction excavations, bulldozing, and dumping. Further, there appeared to be a significant amount of modifications to the land in the form of jumps, tracks, roads, and berms, to help facilitate modern off-roading for off-road vehicles (ORV) and all-terrain bicycles, which are likely non-authorized activities.

While no archaeological sites nor true sinkholes were encountered during this investigation , test excavations revealed that the project area, omitting the borrow pit and other previously excavated areas, is overlain with 0.45 to more than 3.7 meters of sediment relating to modern construction and/or sugar cane cultivation. This is contrary to the previous assumption that the current substrate was all ready graded down to the *karst* bedrock, or within 8 inches of the karst. Further, the study was able to discern areas that appear to have relatively deep layers of modern fill, and conversely, areas where the natural strata is relatively shallow.

Given the lack of finding any archaeological resources or even finding evidence of sinkholes within the project area, we conclude that no further archaeological work is necessary within this area. However, in the event that limestone bedrock (*karst*) is encountered during construction activities, work in this area should halt and a qualified archaeologist should be summoned to the site to monitor excavations in the limestone areas. If any filled and buried sinkholes are encountered during these construction excavations, they should be archaeologically investigated to determine if they contain potentially significant archaeological deposits, including human burials. If at any time during construction potentially significant archaeological remains are encountered, work in the immediate vicinity should halt and the State Historic Preservation Division should be contacted (808-692-8015).

10.0 REFERENCES

Ahlo, Hamilton M Jr. and Robert J. Hommon
1983 *An Archaeological Reconnaissance Survey of the Site of the Proposed Solid Waste Processing and Resource Recovery Facility, Honouliuli, Ewa, O'ahu*. Report on File at the Historic Preservation Division Library, Kapolei.

1984 *Archaeological Test Excavations at the Site of the Proposed Solid Waste Processing and Resource Recovery Facility, Honouliuli, Ewa, O'ahu*. Report on File at the Historic Preservation Division Library, Kapolei.

Allen, Jane
1990 Geology, Soils, and Sediment at Barbers Point, O'ahu. In Paul L. Cleghorn and Bertell D. Davis (editors), *Archaeological Paleontological Investigation at Kalaeloa (Barber's Point), Honouliuli, 'Ewa, O'ahu*. Public Archaeology Section, Applied Research Group, Bishop Museum, Honolulu.

Armstrong, Warwick (ed.)
1973 *Atlas of Hawai'i*. University of Hawai'i Press, Honolulu.

Barrera, William Jr.
1975 *A Report on the Archaeological Reconnaissance Survey of the Proposed Barber's Point Harbor Area*. Report on File at the Historic Preservation Division Library, Kapolei.

Bath, Joyce
1989 *Burial of Hō'ae'ae Point in West Loch Project Area, Honouliuli, 'Ewa, O'ahu*. Department of Land and Natural Resources, State Historic Preservation Division, Kapolei, Hawai'i.

Beckwith, Martha
1970 *Hawaiian Mythology*. University of Hawaii Press, Honolulu, Hawai'i.

Belt Collins
2006 Kalaeloa Master Plan. Prepared for the Hawai'i Community Development Authority (HCDA) and U.S. Economic Development Administration (EDA).

Bishop, S.E.
1835 "Ewa 1835." *O'ahu Station Reports – 'Ewa to Wai'anae, from 1835-1863*. On File at the Hawaiian Historical Society Library.

1841 "Report of the Station of Ewa and Waianae for the year ending April 30th 1841" *O'ahu Station Reports –'Ewa to Wai'anae, from 1835-1863*. On File at the Hawaiian Historical Society Library.

1846 "Report of the Station of Ewa and Wai'anae for the 2 years Ending May 1, 1846" *O'ahu Station Reports –'Ewa to Wai'anae, from 1835-1863*. On File at the Hawaiian Historical Society Library.

1901 'Ewa, O'ahu– Old Memories. *The Friend*: May 1901: 87.

Bordner, Richard M.
1977 *Archaeological Reconnaissance of the Proposed Makaiwa Gulch Landfill Site, 'Ewa, O'ahu*. Archaeological Research Center Hawai'i, Inc., Honolulu.

Campbell, Archibald
1819 *Voyage Round the World from 1806-1812*, New York.

Campbell, S. M.
1994 "Ewa Plantation Company History," Hawaiian Sugar Planters Association. University of Hawaii, Manoa Website. Viewed on January 22, 2002. http://www2.hawaii.edu/~speccoll/p_ewa.html

Chamberlain, Levi
Ms. Journals of Levi Chamberlain, 1822-1849, in Bishop Museum.

Chervet-Pond, A. and B. D. Davis
1992 *West Beach Data Recovery Program, Phase 4, Archaeology and Paleontological Excavations, 2 vols. Report for West Beach Estates*. Paul H. Rosendahl, Ph. D., Inc., Hilo.

Cline, M.G.
1955 Soil Survey of the Territory of Hawai'i. *Soil Survey Series 1939*, No. 25. United States Department of Agriculture.

Collins, S. and Muffet Jourdane
2005 *Recovery of Inadvertent Discovered Skeletal Remains Adjacent to 91-2168 Old Ft. Weaver Road (Site: 50-80-04-06665; SHPD Case #2004-1-0003-001) Honouliuli, 'Ewa, O'ahu TMK: (1) 9-1-017:061; (9-1-019:001 Tanaka Residence)*. Report on File at the Historic Preservation Division Library, Kapolei.

Cordy, Ross
1996 The Rise and Fall of the O'ahu Kingdom: A Brief Overview of O'ahu's History. In J.M. Davidson, G. Irwin, B.F. Leach, A. Pawley, and D. Brown (editors) *Oceanic Culture History: Essays in Honour of Roger Green*. New Zealand Journal of Archaeology Special Publication, pp. 591-613.

Cuddihy, L. W. and C.P. Stone
1990 *Alteration of Native Hawaiian Vegetation, Effects of Humans, Their Activities and Introductions*. Honolulu: University of Hawaii Cooperative National Park Resources Studies Unit.

Davis, Bertell D.
1988 *Final Report Archaeological Subsurface Survey of the Proposed ʻEwa Gentry Project Area, Honouliuli, ʻEwa, Oʻahu.* Bernice P. Bishop Museum: Honolulu.

1979 *Report on Archaeological Survey of the Proposed Ewa-Marina Community Development, Ewa Beach, Oʻahu Island, Hawaii.* Report on File at the Historic Preservation Division Library, Kapolei.

1990 Summary and Conclusion of the 1981-1983 Barber's Point Research. In *Archaeological and Paleontological Investigations at the Barber's Point Deep Draft Harbor, ʻEwa, Oʻahu.* B.P. Bishop Museum. (P. Cleghorn and B. Davis, eds.)

1995 *Archaeological and Paleontological Investigations at the Barber's Point Deep Draft Harbor, ʻEwa District, Honouliuli Ahupuaʻa Oʻahu Island, Hawaiʻi, Volume I.* Report on File at the Historic Preservation Division Library, Kapolei.

Dicks, Merrill A., Alan E. Haun, and Paul H. Rosendahl
1987 *Archaeological Reconnaissance Survey for EIS, West Loch Estates – Golf Course and Parks, Honouliuli, Ewa, Oʻahu.* Report on File at the Historic Preservation Division Library, Kapolei.

Emerson, N. D.
1978 *Pele and Hiiaka: a Myth from Hawaii.* Originally published 1915. Charles E. Tuttle, Rutland.

Emory, Kenneth
1933 *Field Notes from Honouliuli Archaeological Survey.* Department of Anthropology, Bishop Museum, Honolulu.

Foote, D. E., E. L. Hill, S. Nakamura, and F. Stephens
1972 *Soil Survey of the Islands of Kauai, Oʻahu, Maui, Molokai, and Lanai, State of Hawaii.* U.S. Dept. Agriculture-Soil Conservation Service and University of Hawaiʻi Agriculture. Experiment Station. Government Printing Office, Washington, D.C.

Fornander, Abraham
1880 *An account of the Polynesian Race: Its Origin and Migrations and the Ancient History of the Hawaiian People to the Times of Kamehameha I.* Volume II. Trubner, London.

1919 *Fornander Collection of Hawaiian Antiquities and Folklore…from Original Sources.* Thomas G. Thrum (ed.), B.P. Bishop Museum Memoirs. Vols. IV, V. Honolulu, Hawai'i.

Fung Associates, Inc.
2009 Inventory and Condition Assessments of Historic Structures in 'Ewa Villages Historic District, Island of Oʻahu. Prepared for State of Hawaii Department for Land and Natural Resources State Historic Preservation Division.

Gabbard, Mike
2007 *In Memory of WWII Honouliuli Internees.* In Senate Majority Caucus Blog Archive online. 9 December 2007. Accessed on 9 July 2008. http://www.hawaiisenatemajority.com/2007/12/09/in-memory-of-wwii-honouliuli-internees/.

Geolabs – Hawaiʻi
1987 *Geotechnical Engineering Reconnaissance, West Loch Estates Development, Honouliuli, Oʻahu, Hawaiʻi.* C.W. Associates Inc. dba Geolabs – Hawaiʻi, Honolulu. Prepared for R.M. Towill Corporation.

Goodman, W.L. and P. Cleghorn
1991 *Historical Documents and Literature Search, and Archaeological Surface Survey of the Proposed Laulani City Housing Project at Puʻuloa, ʻEwa, Oʻahu Island.* Prepared for William E. Wanket, Inc. Applied Research Group, Bishop Museum, Honolulu.

Hall, Edwin Oscar
1839 *Notes of a Tour Around Oʻahu.* Hawaiian Spectator, Vol. 2: 94-112. Honolulu.

Hammatt, Hallett H.
1984 *Reconnaissance and Evaluation of Archaeological Sites in the Proposed Ewa Marina Community, Ewa, Oʻahu, Hawaii.* Report on File at the Historic Preservation Division Library, Kapolei.

Hammatt, Hallett H. and David W. Shideler
1991 *Archaeological Inventory Survey for a Proposed Expansion of Saint Francis Medical Center West (TMK 9-7-17: por. 56), Honouliuli, ʻEwa, Oʻahu.* Report on File at the Historic Preservation Division Library, Kapolei.

Hammatt, Hallett H. and Rodney Chiogioji
1997 *Archaeological Reconnaissance Survey of a 4.5-Kilometer (14,730-ft.) Long Land Corridor Within Honouliuli Ahupua'a, 'Ewa District, Oʻahu Island.* Cultural Surveys Hawaiʻi, Kailua. Report on File at the Historic Preservation Division Library, Kapolei.

Hammatt, Hallett H. and William H. Folk, II
1981 *Archaeological and Paleontological Investigation at Kalaeloa (Barber's Point), Honouliuli, ʻEwa, Oʻahu: Federal Study Areas 1a and 1b and State of Hawaii Optional Area 1.* Report on File at the Historic Preservation Division Library, Kapolei.

Hammatt, Hallett H., David W. Shideler, and William Folk
1990 *Archaeological Reconnaissance of the ʻEwa Villages Project Site, Honouliuli, ʻEwa, Oʻahu.* Cultural Surveys Hawaiʻi, Kailua, Hawaiʻi.

Hammatt, Hallet H., Jennifer Robbins, Mark Stride, and Matthew McDermott
1991 *An Archaeological Inventory Survey for the Makaiwa Hills Project Site, Honouliuli, ʻEwa, Oʻahu.* Cultural Surveys Hawai'i, Kailua.

Handy, E.S.C.
1940 *The Hawaiian Planter*, Vol. I: B.P. Bishop Museum Bulletin 161.

Haun, Allen E.
1991 *An Archaeological Survey of the Naval Air Station Barber's Point, O'ahu, Hawai'i*. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Hawai'i Aviation
2011 "Ewa Field Auxiliary Base, July 29, 1941" and "Ewa Plantation Locomotive #6, 1926" photographs from the Hawaiian Aviation website. Accessed August 2011. State of Hawai'i Department of Transportation, Airports Division. http://hawaii.gov/hawaiiaviation/aviation

Hommon, R.J., and H.M. Ahlo, Jr.
1983 *Archaeological Survey and Subsurface Testing in Selected Areas of the Proposed Ewa Marina Community Development*. Science Management Inc.

Jensen, Peter M., Alan E. Haun, and Paul Rosendahl.
1988 *Phase I – Mitigation Plan for Archaeological Data Recovery Excavations: West Loch Estates Mitigation Program Residential Increment I and Golf Course and Shoreline Park, Land of Honouliuli, Ewa District, Island of O'ahu*. Report on File at the Historic Preservation Division Library, Kapolei.

Jensen, P.M. and J.A. Head
1995 *Pre-final Report: Phase I Archaeological Reconnaissance Survey, Naval Magazine Lualualei, NAVMAG – West Loch, Lands of Pu'uloa, Honouliuli, Waikele, and Waipi'o, 'Ewa District, Island of O'ahu*. PHRI Report 1547-041995. Prepared for Department of the Navy, Commander, Pacific Division, Naval Facilities Engineering Command.

Jourdane, E.
1979 *Archaeological Reconnaissance Survey of Proposed Ewa Marina Cove. Campbell Estate Properties, Oneula, Honouliuli, O'ahu, Hawai'i*. Report 03-0979. B.P. Bishop Museum.

Juvik, Sonia P. and James O. Juvik (ed.)
1998 *Rainfall Atlas of Hawai'i*. Third Edition. University of Hawai'i Press, Honolulu.

Kamakau, S.M.
1961 *Ruling Chiefs of Hawaii*. Revised Edition. Originally published 1868-1870. The Kamehameha Schools Press, Honolulu, Hawai'i.

1964 *Ka Po'e Kahiko: the People of Old*. Bishop Museum Special Publication d1. Originally published 1866-1871. Bishop Museum Press, Honolulu, Hawai'i.

1991 *Tales and Traditions of the People of Old: Na Mo'olelo Ka Po'e Kahiko*. Originally published 1865-1869. Bishop Museum Press, Honolulu, Hawai'i.

Kelly, Marion
1991 Notes on the History of Honouliuli. Appendix A In *An Archaeological Survey of the Naval Airstation, Barber's Point, O'ahu, Hawai'i*. By Alan E. Haun. Applied Research Group. Bishop Museum, Honolulu.

Kennedy, Joseph
1988 *Archaeological Reconnaissance Report Concerning the Proposed 'Ewa Gentry Project in Honouliuli, O'ahu*. Archaeological Consultants of Hawai'i.

Kennedy, J. and T. Denham.
1992 *Archaeological Data recovery Report for the Puuloa Golf Course located at 'Ewa, Island of O'ahu, TMK: 9-1-01:27 and 6*. Revised May 1992. Archaeological Consultants of Hawaii, Inc., Hawaii.

Kennedy, J., J. Berlin and T. Denham.
1991 *Archaeological Inventory Survey Report for the Puuloa Golf Course Site, TMK: 9-1-01: 27 and 6, located at 'Ewa, Island of O'ahu*. Archaeological Consultants of Hawai'i, Inc., Hawaii.

Kikuchi, William K.
1959 *Standard Oil Refinery Site Letter Report*. Bernice P. Bishop Museum, Honolulu.

Kuykendall, Ralph S.
1967 *The Hawaiian Kingdom, Volume III, 1874-1893: The Kalākaua Dynasty*. University of Hawai'i Press, Honolulu.

Landrum, J., S. Williams, and A.J. Schilz
1993 *Archaeological Reconnaissance and Limited Subsurface Testing at the Proposed Family Housing Construction Area Project No. 34863, Barbers Point Naval Air Station, Honouliuli Ahupua'a, 'Ewa District, O'ahu, Island*. Ogden Environmental and Energy Services, Honolulu.

Lewis, Ernest
1970 *The Campbell Project: a Preliminary Report*. Report on file in the State Historic Preservation Division Library, Kapolei.

MacDonald, G.A. and A.T. Abbott
1970 *Volcanoes in the Sea*. University of Hawai'i Press, Honolulu.

Manhoff, M. and M. Uyehara
1976 *Rockhounding in Hawai'i: Our Rocks, Minerals, and Semi-precious Stones*. Honolulu: Hawaiian Almanac Publishing Co.

Maly, Kepā
1992 Historical Documentary Research. In *Archaeological Reconnaissance Survey, Naval Magazine Lualualei, NAVMAG – West Loch, Lands of Pu'uloa, Honouliuli, Waikele, and Waipio, District of 'Ewa, Island of O'ahu.* By Peter M Jensen and James Head, pg. 7-59. Paul Rosendahl, Ph.D., Inc., Hilo, Hawai'i.

1997 Historical Documentary Research. In *Archaeological Reconnaissance Survey, Naval Magazine Lualualei, NAVMAG – West Loch, Lands of Pu'uloa, Honouliuli, Waikele, and Waipi'o, 'Ewa District, Island of O'ahu.* PHRI Report 1547-041995. Prepared for Department of the Navy, Commander, Pacific Division, Naval Facilities Engineering Command.

1999 *Phase III – Archaeological Site Preservation Plan Phased Mitigation Program 'Ewa Marina Community Project Land of Honouliuli, 'Ewa District, Island of O'ahu.* Prepared for HASEKO ('Ewa), Inc., Honolulu, Hawai'i. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawaii.

McAllister, J.G.
1933 *Archaeology of O'ahu.* B.P. Bishop Museum Bulletin 104. Bishop Museum Press: Honolulu.

McCoy, Patrick
1972 *Archaeological Survey of the Proposed Pu'uloa Elementary School Site, 'Ewa Beach, O'ahu.* Bernice P. Bishop Museum, Dept. of Anthropology, Honolulu.

McIntosh, James and Paul L. Cleghorn
2003 *Archaeological Survey for the Proposed 'Ewa Gentry Makai Development 'Ewa District, Ahupua'a of Honouliuli, Island of O'ahu (TMK 9-1-10:7 and 9-1-69-5).* Pacific Legacy, Inc., Kailua, Hawai'i.

Miller, Lynn
1993 *Archaeological Data Recovery of State Sites 50-80-12-2710 and 50-80-12-2711 at Barber's Point, Honouliuli Ahupua'a 'Ewa district, O'ahu Island.* Prepared for R.H.S. Lee, Inc. Report on File at the Historic Preservation Division Library, Kapolei.

Mitchell, Auli'i and Hallett H. Hammatt
2004 *A Cultural Impact Assessment of Approximately 595 Acres at Kapolei, Honouliuli Ahupua'a, 'Ewa District of O'ahu.* Prepared for Helber Hastert and Fee Planners, Inc. Report on file at the Historic Preservation Division Library, Kapolei.

Mooney, Kimberly M. and Paul L. Cleghorn
2007a *Archaeological Assessment for the Proposed Imperium Renewable Bio-Diesel Plant at Barber's Point, Honouliuli, 'Ewa, O'ahu [TMK (1) 9-1-14:24].* Pacific Legacy, Inc., Kailua. Report on file at the Historic Preservation Division Library, Kapolei.

2007b *Cultural Impact Assessment for the Proposed Imperium Renewable Bio-Diesel Plant at Barber's Point, Honouliuli, 'Ewa, O'ahu [TMK (1) 9-1-14:24].* Pacific Legacy, Inc., Kailua.

2008a *Archaeological Assessment for the Proposed Makakilo Quarry Expansion, Kapolei, Honouliuli Ahupua'a, 'Ewa O'ahu[TMK (1) 9-2-3:18].* Pacific Legacy, Inc., Kailua. Report on file at the Historic Preservation Division Library, Kapolei.

2008b *Cultural Impact Assessment for the Proposed Makakilo Quarry Expansion, Kapolei, Honouliuli Ahupua'a, 'Ewa O'ahu[TMK (1) 9-2-3:18].* Pacific Legacy, Inc., Kailua.

2008c *Archaeological Assessment for the Proposed Development of two parcels between Fort Weaver Road and Old Fort Weaver Road, Honouliuli Ahupua'a, 'Ewa, O'ahu TMK: (1) 9-1-17: 010 and 041.* Pacific Legacy, Inc., Kailua. Report on file at the Historic Preservation Division Library, Kapolei

2008d *Cultural Impact Assessment for the Proposed Development of two parcels between Fort Weaver Road and Old Fort Weaver Road, Honouliuli Ahupua'a, 'Ewa, O'ahu TMK: (1) 9-1-17: 010 and 041.* Pacific Legacy, Inc., Kailua.

2008e *Cultural Impact Assessment for the Proposed Development of Kroc Center in East Kapolei, Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu [TMK: 9-1-17: 71].* Pacific Legacy, Inc., Kailua.

2008f *Archaeological Monitoring Report for the Ke Kama Pono Facility at York Town Road, Kalaeloa, Honouliuli Ahupua'a, O'ahu, Hawai'i [Tmk (1) 9-1-13:24].* Pacific Legacy, Inc., Kailua. Report on file at the Historic Preservation Division Library, Kapolei.

2011 *Revised Archaeological Inventory Survey of Varona Village, Honouliuli Ahupua'a, 'Ewa District, Island Of O'ahu [Tmk: (1) 9-1-17:069].* Pacific Legacy, Inc., Kailua. Report submitted for review to the Historic Preservation Division Library, Kapolei.

Moore, James R. and Joseph Kennedy
2002 *An Archaeological Archival Research Report for the 'Ewa Nonpotable Water System, Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu.* Archaeological Consultants of the Pacific, Inc., Haleiwa, Hawai'i.

Moy, Tonia
1995 'Ewa Sugar Plantation Villages Registration Forms (OMB No. 1024-001). United States Department of the Interior, National Park Service, National Register of Historic Places. On file at the Historic Preservation Department.

Nakamura, Barry S., Jeffrey Pantaleo, and Aki Sinoto
1993 *Archaeological Inventory Survey of Proposed Development Parcels D and D-1 Makakilo, Honouliuli ahupua'a 'Ewa District, O'ahu Island (TMK 9-2-3:18 POR.; 75 POR.; 81 POR.).* Prepared for LandPlan Associates, Kailua, Hawai'i . Aki Sinoto Consulting, Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

National Park Service
1990 'Ewa Plantation Historic District Registration Forms (OMB No. 10024-0018; October 1990). United States Department of the Interior, National Park Service, National Register of Historic Places. On file at the Historic Preservation Department.

O'Hare, Constance R., David W. Shideler, and Hallett H. Hammett
2006 *An Archaeological Inventory Survey for the Ho'opili Project, Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu. TMK: (1) 9-1-010:002, 9-1-017:004, 059, 072; 9-1-018:001, 004; 9-2-002:004, 005.* Cultural Surveys Hawaii. Prepared for D. R. Horton – Schuler Division. Report on File at the Historic Preservation Division Library, Kapolei.

2007 *Archaeological Assessment of the 'Ewa Industrial Park Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu Island. TMK: (1) 9-1-069:003.* Cultural Surveys Hawai'i. Prepared for Mr. Valentine Peroff, Jr. Report on File at the Historic Preservation Division Library, Kapolei.

Pagliaro, Penny
1987 Ewa Plantaion: An Historical Survey, 1890 to 1940. Report on File at the Historic Preservation Division Library, Kapolei.

Pukui, Mary Kawena
1943 *Ke Awa Lau o Pu'uloa: The Many-Harbored Sea of Pu'uloa.* Hawaiian Historical Society Report 52: 56-62.

1983 *'Olelo No'eau: Hawaiian Proverbs and Poetical Sayings.* Bernice P. Bishop Museum Special Publication No. 71, Bishop Museum Press, Honolulu.

Pukui, Mary K., Samuel H. Elbert, and Esther Mookini
1974 *Place Names of Hawai'i.* University of Hawai'i Press, Honolulu.

Rasmussen, Coral
2006 Archaeological *Assessment for Makakilo, Honouliuli Ahupua'a, Island of O'ahu, TMK (portions) 9-2-003:081, (1) 9-2-019:003, 072, 081, 084, 085.* Prepared for D.R. Horton-Schuler Division. International Archaeological Research Institute, Inc. Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

Rosendahl, P.H.
1987 *Archaeological Reconnaissance Survey for Environmental Impact Statement, West Loch Estates – Residential Increments I and II.* PHRI Report 322-040787. Prepared for the City and County of Honolulu. (September).

Schoofs, Robert
1978 *Pioneers of the Faith: History of the Catholic Mission in Hawai'i (1827-1940).* Revised by Fay Wren Midkiff. Second Printing. Sturgis Printing Co. Inc., Hawai'i.

Silva, Carol
1987 Historical Documentary Research – West Loch Estates Project Area. In *Archaeological Reconnaissance Survey for Environmental Impact Statement, West Loch Estates Golf Course and Parks, Honouliuli, 'Ewa, O'ahu.* By Merrill A. Dicks, Alan E. Haun, and Paul H. Rosendahl, Appendix A. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai'i.

Sinoto, Aki
1976 *A Report on Cultural Resources Survey at Barber's Point, Island of O'ahu. Manuscript 122476.* Department of Anthropology, B.P. Bishop Museum, Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

1978a *Archaeological and Paleontological Salvage at Barber's Point, O'ahu. Manuscript 030278.* Department of Anthropology, B.P. Bishop Museum, Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

1978b *Archaeological Reconnaissance Survey and Salvage of Burial at NAVMAG Lualualei, West Loch Branch, O'ahu Island.* Cultural Surveys Hawai'i, Inc. Kailua, Hawai'i.

1979 *Cultural Resources Survey of New Dredged Material Disposal Sites at Barbers Point, O'ahu, Hawai'i. Manuscript 050179.* Department of Anthropology, B.P. Bishop Museum, Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

1988 *Surface Survey of the Proposed Makakilo Golf Course, 'Ewa, O'ahu.* TMK 9-2-03:18. Bernice P. Bishop Museum, Department of Anthropology, Honolulu.

Smith, L.
1835 "Ewa 1835." *O'ahu Station Reports – 'Ewa to Waianae, from 1835-1863.* On File at the Hawaiian Historical Society Library.

Soehren, Lloyd
1962 *Burial Recording, Secondary Internment in Sinkhole.* In O'ahu Sites folder , Department of Anthropology and Education, B.P. Bishop Museum, Honolulu.

1966 *Recording and Excavation at Possible Fishing Shrine.* (Site 50-Oa-B6-13) In O'ahu Sites folder , Department of Anthropology and Education, B.P. Bishop Museum, Honolulu.

Stearns, H.T.
1946 *Geology of the Hawaiian Islands.* Division of Hydrography Bulletin 8. Territory of Hawai'i.

1978 *Quaternary Shorelines in the Hawaiian Islands.* Bernice P. Bishop Museum Bulletin 237. Bishop Museum Press, Honolulu.

Stearns, H.T. and K.N. Vaksvik
1935 *Geology and Groundwater Resources of the Island of O'ahu, Hawai'i.* Bulletin 1, Division of Hydrology, Territory of Hawai'i, Honolulu.

Sterling, E.P. and C.C. Summers
1978 *Sites of O'ahu*. Bishop Museum Press, Honolulu, Hawai'i.

Stokes, John F.
1909 *Walled Fish Traps of Pearl Harbor.* Occasional Papers of the Bishop Museum. 4(3): 199-212.

Thrum, T.
1906 Heiaus and Heiau Sites Throughout the Hawaiian Islands. *Hawaiian Almanac and Annual for 1907.* T.G. Thrum, Honolulu.

1907 Heiaus and Heiau Sites Throughout the Hawaiian Islands. *The Hawaiian Almanac and Annual for 1908*. Honolulu.

1917 List of Heiaus and Sites. *Hawaiian Almanac and Annual or 1918.* Pacific Commercial Advertiser, Honolulu.

1923 *More Hawaiian Folk Tales.* , Chicago.

Tuggle, David H. and M.J. Tomonari-Tuggle
1997 *Synthesis of Cultural Resource Studies of the 'Ewa Plain. Task 1a: Archaeological Research Services for the Proposed Cleanup, Disposal and Reuse of Naval Air Station Barbers Point, O'ahu, Hawai'i.* International Archaeological Research Institute, Inc. Prepared for Belt Collins Hawaii.

U. S. Department of Agriculture (USDA)/Natural Resources Conservation Service (NRCS)
2011 *Custom Soil Resource Report for Island of Oahu, Hawaii: Ka Makana Alii Project Area.* A Publication of Web Soil Survey. Produced 6/30/2011online at http://websoilsurvey.nrcs.usda.gov/. Copy available upon request.

Vancouver, G.
1798 *A Voyage of Discovery to the North Pacific Ocean, and Round the World*. 3 Volumes. Robinson and Edwards, London, England.

Welch, David J.
1987 *Archaeological Reconnaissance of Former Ewa Marine Corps Air Station, Barbers Point Naval Air Station, O'ahu, Hawai'i.* International Archaeological Research Institute, Inc., Honolulu.

Westervelt, William D.
1963 *Legends of Old Honolulu.* Collected and Translated from the Hawaiian by W.D. Westervelt. Press of George H. Ellis Co., Boston.

Wilson, Christie
2008 "Clues Sought to Honouliuli's Dark Past." The Honolulu Advertiser. 17 February 2008: A1.

Wolforth, Thomas R. and Warren Wulzen
1998 *Archaeological Data Recovery at West Loch Estates Residential Increment I, and Golf Course and Shoreline Park, Land of Honouliuli, 'Ewa District, Island of O'ahu.* Paul Rosendahl, Ph.D., Inc. Prepared for City and County of Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

Zeigler, Alan C.
2002 *Hawaiian Natural History, Ecology, and Evolution.* University of Hawai'i Press. Honolulu.

11.1 HISTORIC MAPS

Alexander, W. D.
1873 "Map of Honouliuli, O'ahu" Reg. No. 618, Hawai'i State Survey Office.

Malden, Leroy C.R.
1825 "Sandwich Islands, South Coast of Woahoo" Reg. No. 640, Hawai'i State Survey Office.

Monsarrat, M.D.
1878 "Map of Honouliuli Taro Land, Ewa, O'ahu" Reg. No. 630, Hawai'i State Survey Office.

APPENDIX A

Archaeological Surface Survey and Testing Photographs

North end of project area and Stockpile 3, with car for scale (view to southeast).

East side of project area with HECO power lines and telephone lines in background (view to north).

East side of project area, taken from old plantation dirt road, Stockpile 3 in background (view to northwest).

Old plantation access or cane haul road with HECO power lines flanking it on the west and old telephone lines flanking it on the east (view to south).

Pile of rubbish including appliance hardware, bedding, bottles, and car tires.

Existing utility manhole (Reclaimed water) located ca. 10 m west of the old plantation dirt road in NE Quad. (runs roughly parallel to dirt road), purple bollards in background (view to west).

Existing utility manhole (Sewer) located ca. 10 meters west of plantation dirt road in NE Quad. (view to southwest).

Another reclaimed water manhole near northeast corner of project area (view to northwest).

Test Trench 18, excavating from west to east (note cars in background are on Kapolei Pkwy. (view to northeast).

Test Trench 18, looking at coral limestone bedrock in BOE (3.2 mbs)(view to east).

Test Trench 21located in northwest extreme of property (view to northwest).

Test Trench 21, west wall showing 3.7 meters of tape (*karst* bedrock not found).

Excavating Test Trench 49 between Stockpiles 1 and 2, on edge of Stockpile 2 (view to south).

Test Trench 49 east wall and high spot in *karst* bedrock in the BOE (view to north).

Test Trench 51 at south end of Stockpile 1, showing previously disturbed *karst* bedrock (view to east).

Test Trench 56, east wall showing decomposing *karst* bedrock and solid *karst* bedrock in layers III and IV.

APPENDIX B

Ka Makana Aliʻi Test Trench – Master Database

KAPOLEI TESTING (KA MAKANA ALI`I) TEST TRENCHES - MASTER DATABASE											
*Unit No. KMA-	Location (Quad)	Trench Direction	GPS Coordinates			Dimensions (meters)			No. of Layers	Top Depth of Natural Strata (mbs)	Date
			Northing	Easting	Point Loc.	Length	Width	Depth			
TT-1	NE	E-W	598421	2359572	E end	2.5	0.4	1.55	3	not found	7/11/11
TT-2	NE	NW-SE	598432	2359555	NW end	2.5	0.4	1.5	3	not found	7/12/11
TT-3	NE	NE-SW	598460	2359511	NE end	7.3	0.4	2.1	4	not found	7/12/11
TT-4	NE	NE-SW	598467	2359526	NE end	15.2	0.4	3.2	5	3	7/12/11
TT-5	NE	E-W	598509	2359527	E end	9.7	0.4	3.4	2	not found	7/12/11
TT-6	NE	N-S	598509	2359527	N end	6	0.4	3.1	2	not found	7/12/11
TT-7	NE	N-S	598532	2359463	N end	6.15	0.4	1.8	3	1.15	7/13/11
TT-8	NE	E-W	598544	2359427	W end	7.7	0.4	1.65	3	1.3	7/13/11
TT-9	SE	N-S	598571	2359386	N end	6.8	0.4	1.5	3	1.1	7/13/11
TT-10	SE	E-W	598575	2359342	W end	9.5	0.4	1	4	0.45	7/13/11
TT-11	SE	NW-SE	598615	2359320	SE end	13	0.4	1.4	5	0.85	7/13/11
TT-12	SE	E-W	598618	2359283	E end	8.9	0.4	1.2	3	1	7/13/11
TT-13	SE	N-S	598658	2359248	N end	13.8	0.4	0.65	3	0.5	7/13/11
TT-14	NE	NE-SW	598336	2359525	SW end	4.5	0.75	2.9	2	not found	7/14/11
TT-15	NE	N-S	598311	2359559	S end	4	1.25	2.9	5	2.7	7/14/11
TT-16	NE	N-S	598368	2359563	N end	5	1	2.9	4	2.65	7/14/11
TT-17	NW	E-W	598231	2359557	W end	4.5	1	3.05	5	2.9	7/14/11
TT-18	NW	E-W	598189	2359556	W end	5	1	3.2	4	3	7/14/11
TT-19	NW	N-S	598152	2359536	S end	4.5	1	2.5	4	1.8	7/14/11
TT-20	NW	E-W	598098	2359522	W end	4.5	1	2.2	4	1.7	7/14/11
TT-21	NW	N-S	598008	2359471	S end	4.3	1	3.7	6	not found	7/14/11
TT-22	NW	N-S	598046	2359421	N end	4.2	1	2	3	1.7	7/15/11
TT-23	NW	NE-SW	598071	2359351	SW end	6.1	1	0.75	4	0.3	7/15/11
TT-24	NW	N-S	598098	2359264	S end	5.9	1	0.85	4	0.3	7/15/11
TT-25	SW	E-W	598109	2359198	E end	6.8	1	1.1	6	0.95	7/15/11
TT-26	SW	E-W	598143	2359152	E end	6	1	1.1	4	0.65	7/15/11
TT-27	SW	N-S	598162	2359240	S end	8.8	1	1.5	5	1	7/15/11
TT-28	NW	E-W	598131	2359282	W end	8.7	0.7	1.1	3	0.5	7/18/11
TT-29	NW	N-S	598125	2359351	S end	8.8	0.7	2.3	4	0.95	7/18/11
TT-30	NW	NE-SW	598107	2359434	SW end	9.5	0.7	1.2	4	0.8	7/18/11
TT-31	NW	NW-SE	598110	2359481	SE end	9	0.7	1.1	4	0.65	7/18/11
TT-32	NW	E-W	598146	2359515	E end	10.5	0.7	2	3	1.85	7/18/11
TT-33	NW	N-S	598209	2359522	S end	9.6	0.7	2.2	3	2	7/18/11
TT-34	NE	N-S	598272	2359525	S end	8.1	0.7	2.35	4	2.25	7/18/11
TT-35	NE	E-W	598314	2359535	W end	8.6	0.7	2.5	4	2.1	7/18/11
TT-36	NE	E-W	598366	2359558	W end	6.3	0.7	3.1	4	not found	7/19/11
TT-37	NE	N-S	598481	2359454	S end	8.2	0.7	1.15	5	0.9	7/19/11
TT-38	SE	E-W	598511	2359398	E end	8.3	0.7	1.2	5	0.5	7/19/11
TT-39	SE	N-S	598541	2359340	S end	9	0.7	1.1	5	0.6	7/19/11

KAPOLEI TESTING (KA MAKANA ALI`I) TEST TRENCHES - MASTER DATABASE											
*Unit No. KMA-	Location (Quad)	Trench Direction	GPS Coordinates			Dimensions (meters)			No. of Layers	Top Depth of Natural Strata (mbs)	Date
			Northing	Easting	Point Loc.	Length	Width	Depth			
TT-40	SE	N-S	598609	2359213	S end	7.5	0.7	0.9	3	0.55	7/19/11
TT-41	SE	E-W	598603	2359178	W end	6.3	0.7	0.75	3	0.5	7/19/11
TT-42	NE	N-S	598440	2359420	N end	5	0.7	3.3	4	3.15	7/19/11
TT-43	SE	N-S	598465	2359388	N end	5.7	0.7	1.8	3	0.95	7/19/11
TT-44	NE	E-W	598368	2359396	W end	6.9	0.7	1.85	5	1.5	7/20/11
TT-45	NE	N-S	598329	2359356	S end	5.3	0.7	1.6	4	1.7	7/20/11
TT-46	NW	E-W	598231	2359340	W end	6	0.7	1.5	5	1.15	7/20/11
TT-47	NW	NE-SW	598296	2359459	SW end	5	0.7	3.3	4	3.1	7/20/11
TT-48	SW	N-S	598361	2359228	S end	5.6	0.7	1.2	4	0.7	7/20/11
TT-49	SW	NW-SE	598311	2359314	S end	8	0.7	1.6	4	1.3	7/21/11
TT-50	SW	N-S	598339	2359263	W end	7.6	0.7	1.3	4	1	7/21/11
TT-51	SE	E-W	598409	2359240	W end	5.3	0.7	0.75	2	0.6	7/21/11
TT-52	NW	NW-SE	598053	2359479	NW end	9	0.7	1.9	4	1.4	7/21/11
TT-53	NW	N-S	598085	2359429	N end	6.75	0.7	1.2	5	0.65	7/21/11
TT-54	NW	E-W	598081	2359321	W end	7	0.7	1.4	4	0.6	7/21/11
TT-55	SE	N-S	598591	2359322	S end	6.8	0.7	1.1	3	0.55	7/22/11
TT-56	SE	N-S	598547	2359281	S end	7.6	0.7	1.15	4	0.8	7/22/11
TT-57	SE	N-S	598570	2359242	N end	7	0.7	1.4	3	0.9	7/22/11
TT-58	NW	E-W	598329	2359329	W end	6.9	0.7	1.4	4	1.1	7/22/11
TT-59	NW	N-S	598296	2359401	S end	5.9	0.7	2.65	3	2.55	7/22/11
TT-60	NE	NW-SE	598273	2359496	SE end	4.6	0.7	2.95	3	2.75	7/22/11
TT-61	NW	NE-SW	598223	2359466	SW end	3.5	0.7	0.55	2	0.5	7/22/11
TT-62	NW	NE-SW	598187	2359385	SW end	3.6	0.7	0.5	3	0.45	7/22/11

* TT stands for Test Trench, **but** in log book notes and profiles all Test Trenches were referred to as Test Probes (TP) and Test Scrapes were referred as Test Trenches (TT). So, when referring to log book notes or profiles, substitute TT for TP and TS for TT. Photo log has already been amended, so do not substitute.

APPENDIX C

'Ewa Plain: A Hawaiian Settlement Model
In *Synthesis of Cultural Resource Studies of the 'Ewa Plain.*
By David Tuggle and M.J. Tomonari-Tuggle
(1997: Section VIII, pp.115-119)

VIII. 'EWA PLAIN: A HAWAIIAN SETTLEMENT MODEL

At its maximum development during Hawaiian occupation, the main portion of the 'Ewa Plain was a dryland agricultural landscape, comparable in broad terms to leeward Kohala on the island of Hawai'i, the Kaunakakai region of Moloka'i, or upper Mākaha Valley on O'ahu (although certainly with a much lower overall yield than these other regions). The distinctive characteristic of the 'Ewa Plain is that the agricultural system was developed on a karst landform. Adapted to this, the 'Ewa cultivation system emphasized mounds and sinkholes (and possibly the use of wetlands such as swamps), rather than dry terraces. Variation in 'Ewa Plain cultivation occurred on the Honouliuli floodplain and at the base of the Waianae slopes.

'Ewa Plain Settlement Model

With this perspective, the following is proposed as a general model for pre-contact 'Ewa Plain settlement (the primary numbers in the following list refer to corresponding numbers in Figure 22):

1. The population center of the region was the irrigation complex of lower Honouliuli (or Makali'i) Stream, lying at the northeastern edge of the Plain. Although lower Honouliuli is not part of the physiographic region of the Plain, its proximity and cultural history define it as crucial to the settlement of the Plain itself.

   This is based on the archival data for the area, with the assumption that similar conditions existed in pre-contact times, partly corroborated by traditions that refer to the many place names recorded for this area (e.g., Po'ohilo).

   Some evaluation of this proposition may be testable through archaeological research, depending on the nature and extent of buried deposits.

1a. Honouliuli floodplain is an area that included chiefly residential complexes.

   This is based on general models of Hawaiian settlement. It may not be testable because of site destruction.

1b. Honouliuli floodplain was one of the areas of earliest settlement of 'Ewa and one of the earliest settlements in Hawai'i.

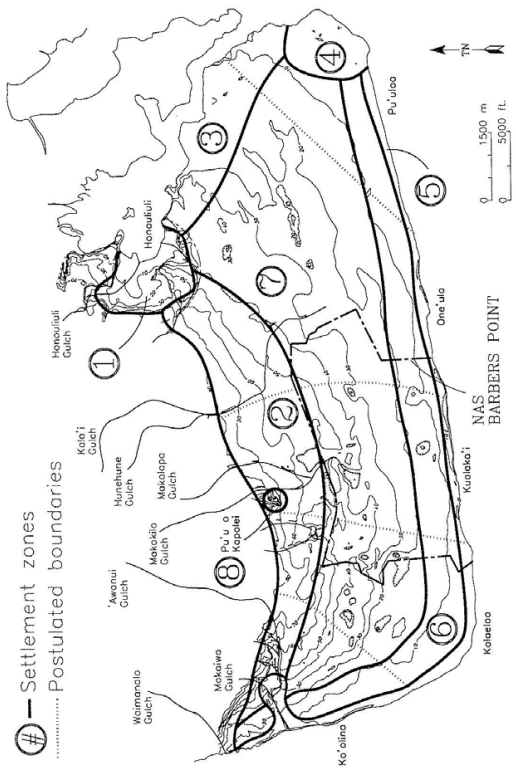

Figure 22. 'Ewa settlement model.

This is based on the richness of the resource catchment area, and is testable depending on the preservation of buried deposits.

2. Permanent agricultural settlements developed along the upper 'Ewa Plain, associated with the alluvial fans and soil of the upper Plain. Most of the cultivation was dryland, but included some runoff cultivation and some irrigation in a few of the spring-fed gully mouths.

   This is based on the environmental conditions of the area and archival data regarding water potential. It is probably not testable, except for the possibility of site discovery in small undeveloped gulches.

2a. This area was the first area of agricultural expansion outside the Honouliuli floodplain region, and probably consisted of small settlements at the mouths of the gullies.

   This proposition is based on the agricultural potential, but may not be testable because of site destruction.

3. The West Loch coast of the 'Ewa Plain had fishponds and fishtraps, with an adjacent strip of dense population including elite residence. The density of population would have been greater than that along the seaward coasts.

   The fishponds and traps are recorded from archival and archaeological data. The settlement argument is based on general Hawaiian models. It is probably not testable because of site destruction.

4. The area of Pu'uloa was a place of royal residence.

   This proposition rests in part on the documentary evidence of the existence of a residence of Kamehameha II, and in part on a general Hawaiian settlement model of royal residence associated with rich resources areas, surfing, and canoe landing (cf. Kahalu'u, Waikīkī, and Kaunakakai). In the absence of traditional records noting this for royal habitation, the residence was probably a secondary one and not a royal center. The area in question has been destroyed by development, and thus the nature of this settlement can be evaluated only by means of archival research.

5. The coastline of the 'Ewa Plain was intensively occupied, primarily with temporary camps associated with resource collection. The temporary camps were tied to permanent settlements in zones 1, 3 and 6.

   This rests on the archaeological data sample.

5a. Early settlement in this area emphasized marine exploitation and bird collection, based on temporary habitation associated with permanent habitation along the West Loch coast and the Honouliuli floodplain.

5b. Later settlement emphasized marine exploitation, with continued temporary habitation, but in association with permanent inland settlements (see Fig. 22, zones 6 and 7).

These propositions are based in part on archaeological data and in part on general Hawaiian settlement models. They are partially testable with additional archaeological research. Some of the cultural resources of NAS Barbers Point are appropriate for this testing.

6. The zone inland of the coast line was a region of permanent habitation based on cultivation and marine exploitation. The settlements were focused on sinkhole clusters, which were a source of water and could be developed for cultivation.

Because of disturbance, there are few archaeological areas left in this region but several sites suggest a permanent and long-term occupation (e.g., complexes at 2700 and 2702). This model component is testable with the extensive remains at NAS Barbers Point in this topographic zone.

6a. The permanent occupation of the area was initiated in the A.D. 1200 to 1400 range and developed within the A.D. 1400 to 1850 range, and is associated with the construction of rectangular stone-walled houses.

This is based on radiocarbon dating and evidence of occupation into the post-contact period. Additional testing of this proposition is possible, and resources at NAS Barbers Point are ideal for this.

6b. Early occupation occurred in the form of temporary camps related primarily to resource collection (primarily bird hunting) and was not related to development of cultivation.

This is based on archaeological information combined with settlement modeling. It is argued, for example, that there is no evidence for permanent "home settlement" from which to establish temporary agricultural camps. Additional testing is possible, but dependent on site preservation.

7. The central area of the ʻEwa Plain was occupied with permanent settlements dependent on cultivation. However, unlike the settlement in zone 6, this occurred late in the pre-contact period and with the permanence based on adaptation to long-term rainfall variation.

This proposition is based on archaeological data, and is additionally testable, particularly at NAS Barbers Point.

8. Puʻuokapolei is the sacred center of the ʻEwa Plain.

This is based on traditional information. There are probably no physical remains of Hawaiian sites left on Puʻuokapolei to determine the nature of the religious activities that may have taken place there. The proposition can be evaluated through additional archival research.

9. Land division boundaries. One possible generalized land division model for the ʻEwa Plain is shown on Figure 22. If any such divisions existed, they would have been further subdivided, probably in *lele* fashion, so that parcels would have been held along the coast as well as in agricultural areas inland, possibly including lots for stream irrigation in the Honouliuli lowlands.

This is based on the known local names of the ʻEwa Plain and a general Hawaiian settlement model. Testing may be possible with additional archival research, although the searches of land records have not provided any information outside the Honouliuli floodplain. Some limited testing may be possible with archaeological remains, including in areas of NAS Barbers Point.

10. (not on Figure 22). Scattered Hawaiian occupation existed on the Plain into the mid-19th century. This was a time of low population. Families occupied a number of scattered residences and use areas, including coastal fishing camps and inland houselots and walled cultivation areas.

This is based in part on archival data and in part on preliminary archaeological data. It is testable by detailed analyses of existing archaeological information and through additional archaeological research. NAS Barbers Point has resources suitable for testing this proposition.

ʻEwa Plain Settlement and the Cordy Oʻahu Model

In order to place the ʻEwa settlement in context, the Cordy model (1996) of the development of Oʻahu (with some modifications) is summarized in graphic and schematic form (Figs. 23-26). This is also shown with a model of population growth for Hawaiʻi as a whole (Dye and Komori 1992a), and the comparative development of ʻEwa Plain settlement based on radiocarbon dates.

APPENDIX D

Historical Features of the ‘Ewa Plain from 1825 to World War II (Figure 5, Map and Key)
In *Synthesis of Cultural Resource Studies of the ‘Ewa Plain.*
By David Tuggle and M.J. Tomonari-Tuggle
(1997: Section II, pp.32-33)

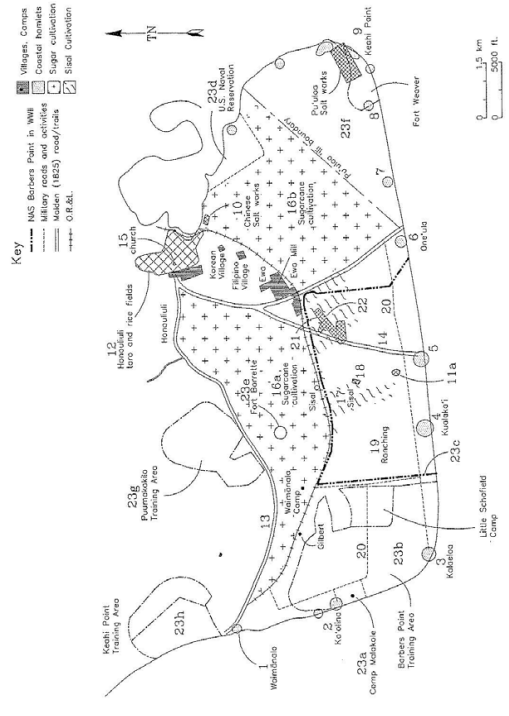

Figure 5. Historical features of the ‘Ewa Plain from 1825 to World War II.

Key to Figure 5. Historical features of the 'Ewa Plain from 1825 to World War II.

1-8. Coastal hamlets in the 1800s (Malden 1825; Alexander 1873; tax records).
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23g. Puu Makakilo Training Area.
23h. Keahi Point Training Area.

Appendix H

Cultural Impact Assessment

Pacific Legacy

Historic Preservation

FINAL
CULTURAL IMPACT ASSESSMENT
OF THE PROPOSED
KA MAKANA ALI‘I
MIXED-USE COMPLEX
KAPOLEI, HONOULIULI AHUPUA‘A
‘EWA DISTRICT, O‘AHU ISLAND
TMK 9-1-016:142

Pacific Legacy: Exploring the past, informing the present, enriching the future.

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ABSTRACT

As part of the Environmental Impact Statement process, Hawai‘i DeBartolo, LLC, has requested a Cultural Impact Assessment (CIA) for the proposed Ka Makana Ali‘i mixed-use complex and *mauka* half of Keoneula Road, which is slated for a parcel in central ‘Ewa Plain, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu [TMK: 9-1-016:142]. This assessment is based upon archival research as well as ethnographic interviews. Under Act 50, the Hawaii State Department of Health "Guidelines for Cultural Impact Assessments" mandate that the subject property be studied as well as surrounding areas where construction or development have impact potential. These guidelines also recommend personal interviews with traditional cultural practitioners and knowledgeable informants on cultural practices.

The results of archival research indicate that this general area of ‘Ewa Plain has a long and rich cultural history. From the archaeological record, traditional stories and myths, and Historic documents attributed to the vast plain, it is evident that these lands have been the backdrop to many significant acts in the long drama of O‘ahu's pre- and post Contact history. However, no archaeological research has been conducted on the project area. Archival research has pointed out that a major feature of pre-Contact and early Contact Honouliuli, the Kualaka‘i Trail, cut across or passed near to the project area. Though the trail no longer exists, cultural resources, such as archaeological features attributed to this trail, may exist beneath the plantation era soil. Additionally, the project area boarders the Historic OR&L Railroad to the south. This Historic railway, in operations from 1889 to 1947, was accepted into the National Register of Historic Places in 1975. Hawai‘i DeBartolo, LLC is not proposing to disturb any portion of the OR&L Railroad for Ka Makana Ali‘i or Keoneula Road at this time.

For this study, seven interviews were performed and information from previous interviews of one cultural informant was authorized to be used for this report. Based on these consultations, two cultural resources were identified as being potentially impacted by the proposed development: *‘uha loa* (*Waltheria indica*) used for traditional Hawaiian medicine and *‘alae* (red clay) used for coloring salt, medicine, dye, and spiritual purification. A total of three cultural practitioners were documented as gatherers of these cultural resources. This particular location is purportedly desired for its easy access, abundance of the resources, and the lack of pesticide spray in its interior. However, these cultural resources exist in localities outside of this project area. Hence, the proposed Ka Makana Ali‘i and Keoneula Road development will undoubtedly impact these activities, but not prevent the cultural practitioners from collecting these resources. There is also the concern about water usage by the planned development as preventing cultural practices, such as traditional forms of horticulture, agriculture, and aquaculture.

In addition, ethnographical evidence supports the possibility of a variety of cultural practices that occurred on the property prior to the large scale cultivation of sugar cane, the remnants of which may encapsulated under plantation era and modern sediment. Several informants voiced concerns about potential damage to subsurface archaeological sites. Unsettled spirits are also a concern, where unwanted paranormal activities could plague the new development or, conversely, haunt surrounding localities due to displacement.

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Frontispiece: Artistic rendering of proposed Ka Makana Aliʻi (courtesy of Hawaiʻi DeBartolo, LLC.).

1.0 INTRODUCTION

Pacific Legacy Inc., under contract to Hawaiʻi DeBartolo, LLC, conducted a Cultural Impact Assessment (CIA) for the proposed Ka Makana Aliʻi mixed-use complex (Figure 1) and *mauka* half of Keoneula Road (Figure 2), in East Kapolei, Honouliuli Ahupuaʻa, ʻEwa District, Oʻahu, Hawaiʻi [TMK 9-1-016:142]. Ka Makana Aliʻi is slated to be built on ca. 67 acres directly southwest of the intersection of North-South Road and Kapolei Parkway. The 6 acre Keoneula Road add-on will provide access to the eastern side of Ka Makana Aliʻi. At the present time, this proposed roadway is not to continue south of the central east driveway of Ka Makana Aliʻi. The function of this assessment is to determine if any traditional practices will be displaced or disrupted by the proposed development of the mixed-use complex and roadway.

Preparation for this document was conducted in compliance with rules outlined in Chapter 343 (HRS) and Act 50, and Hawaiʻi State Department of Health (DOH), Office of Environmental Quality Control (OEQC) Guidelines for Cultural Impact Assessments, adopted by the State of Hawaiʻi Environmental Council in 1997 and amended in 2000 (OEQC 2011). These guidelines mandate that archival research be performed on and around the subject property as well as cultural consultations to provide pertinent information on cultural practices that may be impacted by the proposed development. A copy of the OEQC guidelines is provided in Appendix A.

Community consultations and archival research was performed by Kimberly M. Mooney, B.A. under the general guidance of Paul L. Cleghorn, Ph.D. For this study, eight community consultations were performed. While numerous contacts were pursued, concerted attempts to interview additional informants were unsuccessful. A complete list of contacted members of the community, with project affiliation and communication log is provided in Appendix B.

Figure 1. Location of project area (courtesy of National Geographic).

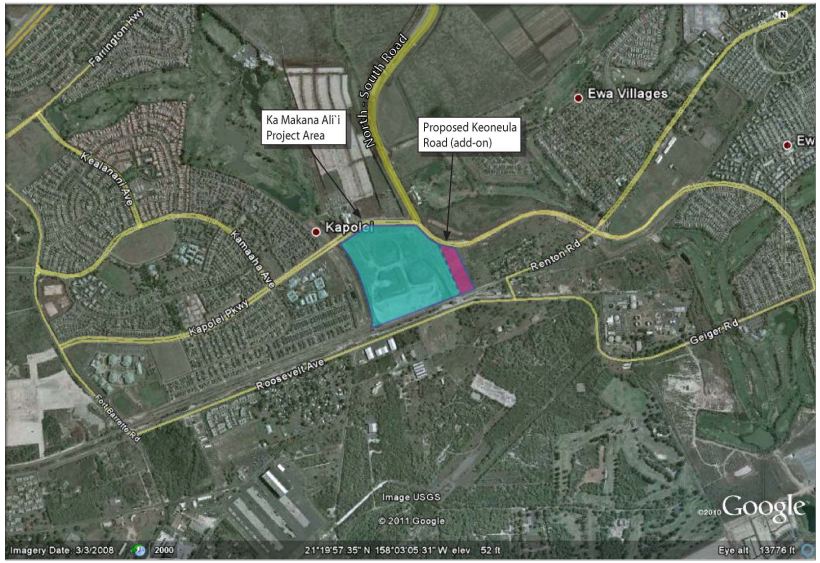

Figure 2. Location of project area (courtesy of Google Earth).

1.1 PURPOSE

Essentially, a CIA is designed to promote and protect cultural beliefs, practices, and resources of native Hawaiians, other ethnic groups, as well as other collective groups associated with the subject area. In the State of Hawai‘i, under Chapter 343 HRS, and Act 50, SLH 2000, a CIA is required as part of the EIS process, and has the stated purpose to:

1) require that environmental impact statements include the disclosure of the effects of a proposed action on the cultural practices of the community and State; and

2) amend the definition of "significant effect" to include adverse effects on cultural practices.

According to the OEQC guidelines, types of cultural practices and beliefs may include those relating to subsistence, commercial, residential, agricultural, access-related, recreational, as well as religion and spirituality. Further, the CIA was designed to promote and protect cultural beliefs, practices, and resources of native Hawaiians, other ethnic groups, as well as other collective groups (OEQC 2011: 3-4). To determine the effects of the proposed development on cultural practices and beliefs, the following tasks are undertaken:

1) identify and consult with individuals and organizations knowledgeable about cultural practices that may have taken place in the area;

2) conduct archival research about traditional practices that may have been conducted in the area;

3) describe the cultural practices that took place within the potentially affected area;

4) assess the impact of the proposed development on the cultural practices that may have taken place within the potentially affected area; and;

5) prepare a report on the findings resulting from the above investigations.

1.2 METHODS

According to the Office of Environmental Quality Control (OEQC) Guidelines for Assessing Cultural Impacts (OEQC 2011), it is recommended that preparers of CIA implement the following protocol:

1. identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or *ahupua‘a*;

2. identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;

3. receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;

4. conduct ethnographic, historical, anthropological, sociological, and other culturally related documentary research;

5. identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

6. assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

Archival documents as well as archaeological reports and CIAs focusing on the general locality of the ‘Ewa Plain were consulted to supplement the interviews. Research for background information as well as finding ethnographic interviewees was performed at the following repositories:

- State of Hawai‘i Historic Preservation Office (SHPD)
- State of Hawai‘i Office of Environmental Quality Control (OEQC)
- State of Hawai‘i Public Library

A list of *kūpuna*, cultural practitioners, and cultural informants viewed as potential interviewees was developed by contacting elected officials, members of civic clubs, and local *hula halau* as well as visiting nearby Varona Village to find willing informants. In addition, the Cultural Assessment Provider List available in the OEQC website (http://video.doh.hawaii.gov) and CIAs on file for the area were referred to. A full list of potential cultural informants and communication log for the preparation of this assessment is provided in Appendix B and the Ethnographic Interview Questionnaire used as a framework for the interview is provided in Appendix C. Informal interviews were conducted between 7 July and 14 August 2011. A total of seven individuals representing a variety of cultural practices and resources were interviewed for this CIA. Transcripts of interviews were not attempted in this assessment; however, audio recordings of four of the interviews were obtained and are kept on file at Pacific Legacy office in Kailua, Hawai‘i. Audio recordings of the other three interviews were not attempted due to background noises. In all but two cases, due to time constraints, summaries of the interviews were sent to the informant for review and feedback. When the informant was satisfied with the summary, written permission to the information was given by signing an Oral History Study Personal Release of Interview Records form. Copies of release forms completed by interviewees are provided in Appendix D.

2.0 PROJECT AREA DESCRIPTIONS

2.1 ENVIRONMENTAL SETTING

A number of reports have been written on the geological formations and environmental conditions of the ʻEwa Plain (Allen 1990; Cline 1955; Foote et al. 1972; MacDonald & Abbott 1970; Stearns 1946, 1978; Stearns & Vaksvik 1935; Zeigler 2002), which address broad characteristics of the ʻEwa Plain.

2.1.1 Geology, Hydrology, and Sediments

Based on terrain and availability of water, the ʻEwa Plain can be separated into three main geographical regions that are described by Tuggle & Tomonori-Tuggle (1997:9) as: "lowland limestone exposure, the upland alluvial terrain, and a locale of floodplain and alluvial fans." Fresh water on the barren coral plain has often been reported as being insufficient to support a permanent or substantial Hawaiian settlement during pre-contact years. However, Tuggle and Tomonari-Tuggle (1997:18-21) summarize various research projects on the availability of water in ʻEwa Plain asserting that there may have been permanent Hawaiian settlements in a number of locales, if not generally across the entire area. Water sources were identified in several locations on the plain, including: sink holes that reach the water-table, wetlands, sheet runoff, spring and creek water from gulches, natural limestone water traps, Honouliuli Stream, and other water features in Honouliuli Ahupuaʻa (Malden 1825). The proposed Ka Makana Aliʻi project area is located on the lowland limestone just southwest of Kaloʻi Gulch at roughly 50-60 ft above mean sea level (AMSL).

Generally, the ʻEwa Plain is an expansive limestone shelf that begins 3-5 miles (5 to 8 km) south of the Waianae Mountain range to the southern coast of Oʻahu, stretching from the western coast of Koʻolina east to Pearl Harbor. This elevated coralline reef was formed during an interglacial period approximately from 120,000 to 38,000 years ago, when sea levels in Hawaiʻi were some 6-8m above the present sea level, which has been termed the Waimānalo Sea Stand. During this period, coral reefs developed upwards with the gradually rising sea levels. During the next period of glaciation, sea levels dropped leaving exposed coral reefs that were then eroded by marine level fluctuation, wave/sediment abrasion, as well as weathering by rain, run-off, and wind after sea levels dropped to their present level. Further, rain water naturally absorbs carbon dioxide in the air to form a weak carbonic acid, which dissolves portions of the limestone with prolonged exposure, subsequently forming karst topography. Hallmark features of karst topography are caverns and sinkholes, which are formed as acids build up and dissolve soluble portions and natural voids in the limestone. Several miles east of the project area is an escarpment approximately 15 meters high, often referred to as "fossil cliffs" and/or "fossil bluffs," where the alluvial clay layer has been eroded away, exposing Pleistocene limestone that is laden with fossils.

Sinkholes of the ʻEwa Plain are typically bell-shaped in cross-section with openings commonly 3.28 feet (1 m) in diameter with base diameters increasing to 6.56 to 9.84 feet (2 – 3 m) (MacDonald & Abbott 1970; Stearns 1946, 1978; Stearns & Vaksvik 1935; Zeigler 2002:96-97).

These sinkholes became important resources for avian populations prior to human settlement in Hawaiʻi. Later, sinkholes became significant resource locales, temporary shelters, agricultural features, as well as burial locations for early Hawaiian populations on the ʻEwa Plain (Barrera 1975; Davis 1995; Lewis 1970; Miller 1993; Sinoto 1976, 1978a, 1978b, 1979). Sinkholes containing archaeological and/or paleontological remains encapsulated under alluvial soils or construction fills can be encountered anywhere within the ʻEwa Plain.

The ʻEwa Plain gently slopes *mauka* or towards the mountains, due to the deposition of alluvial clays and silts that are derived from weathered basalt from upslope. The alluvial substrate forms a wedge that lies atop the limestone bench, itself positioned above the basalt foundation (Geolabs-Hawaii 1987; Stearns & Vaksvik 1935). This limestone shelf contains artesian basal aquifers that are the source of potable water found in springs and wells in several locations across the plains; two of the most prominent locations, Honouliuli Gulch "Watering Place" and Waihuna in Kaloʻi Gulch, are within two miles of the project area (Malden 1825; Sterling & Summers 1978; Mooney & Cleghorn 2008c).

Soils in the project area are currently described as Honouliuli clay with 0-2% slopes (HxA) and Mamala stony silty clay loam with 0 to 12 percent slopes (MnC) according to the Department of Agriculture Natural Resources Conservation Service (USDA/NRCS 2011; Figure 3; Table 1). The soil types roughly bisect the project area (*mauka-makai*), where the *mauka* portion is Honouliuli clay and the *makai* portion is Mamala stony silty clay. This is greatly due to agricultural practices of the early 1800's, where natural forests of the Waianae Range were extensively harvested, causing severe erosion of the mountain sides. Erosion was further advanced unintentionally by the over-grazing of livestock in the uplands and then intentionally by the intensive plowing of these soils to encourage fertile sediment deposition onto the lower plains for farming (Lewis 1970; Tuggle & Tomonari-Tuggle 1997; Wolforth & Wulzen 1998). Hence, the deposition of sediments onto the ʻEwa Plain was unnaturally increased from the early 1800's to the present time.

Also worthy of note, are the three volcanic cones lying on the northern margin of the ʻEwa Plain: Puʻu Pālailai, Puʻu Kapolei, & Puʻu Makakilo. Puʻu Pālailai, which lies ca. 2.5 miles (4 km) west of the project area, is one of only three known volcanic glass quarries on Oʻahu (Manhoff & Uyehara 1976:46; Wolforth & Wulzen 1998). As volcanic glass was a choice material for stone tool manufacture, Puʻu Pālailai would have been an important locality in pre-contact times.

2.1.2 Climate

Honouliuli, the largest *ahupuaʻa* of Oʻahu, is situated on the leeward side of Oʻahu. ʻEwa Plain covers the lower half of the *ahupuaʻa* . This is one of the driest regions of Oʻahu, having an average of 18 inches of annual rainfall (Juvik & Juvik 1998). The proposed Ka Makana Aliʻi Center is situated on the northern border of Kalaeloa (former NAS Barbers Point), whose temperatures range between 72°F (40°C) in January to 78.5°F (43°C) in August, with a variance of 13°F (7°C) throughout the day (Orr 2008:3-1). The hottest days of the year typically fall between August and September (Armstrong 1973).

2.1.3 Vegetation

Generally, the most common types of plants in the ʻEwa Plain are xeric and hardy exotics, with the exception of relatively undisturbed coastal marshlands. Previous to human settlement in the area, Cuddihy and Stone (1990) claim that the region would have been more like a savannah: a plain of grasses with sparse groves trees and shrubs. Pre-contact plant species would have included, but not limited to: *wiliwili* (*Erythrina sandwicensis*), *lama* (*Diospyros ferrea*), *pili* grass (*Heteropogon contortus*), *ʻaʻaliʻi* (*Dodonea ericarpa*), scrub *ʻōhiʻa* (*Metrosideros collina*), and possibly sandalwood or *ʻiliʻahi* (*Santalum* sp.). Ground cover may have included cayenne vervain (*Stachytarpheta urticaefolia*), *ʻilima ku kula* (Sida cordifola), morning glory (*Ipomoea indica*), *koʻokoʻolau* (*Bidens pilosa*) according to Moore and Kennedy (2002:3).

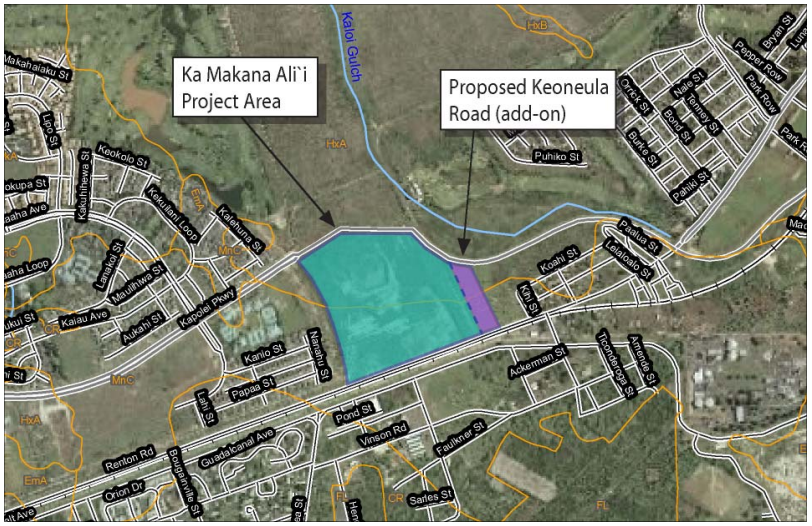

Figure 3. Ka Makana Aliʻi Soil Map (courtesy of NRCS/USDA Soil Survey 2011).

Table 1. Ka Makana Aliʻi Project Area– Custom Soil Report (USDA/NRCS Soil Survey 2011)

Map Unit Symbol	Map Unit Name	Acres in Project Area	Percent of Project Area
HxA	Honouliuli clay, 0 to 2 percent slopes	38	56.8%
MnC	Mamala stony silty clay loam, 0 to 12 percent slopes	29	43.2%
	Totals for Area of Interest	67	100.0%

2.2 Current State of Project Area

An archaeological survey and backhoe testing was performed by Kimberly M. Mooney, B.A., under the general guidance of Paul L. Cleghorn, Ph.D., from 11 July to 22 July 2011 on the 70-plus acres of land slated for the Ka Makana Aliʻi mixed-use complex and the proposed Keoneula Road (Mooney and Cleghorn 2011a). The pedestrian survey yielded no new archaeological sites visible on the ground surface. Rather, the project area appeared to have evidence of multiple ground disturbing activities from the time of sugarcane cultivation until recent years. Ground disturbing activities include extremely deep and vast excavations resulting in a ca. 1345 foot by 390 foot borrow pit at the south end of the property. Further, a number of soil stockpiles cover much of the interior of the lot (Figure 4). The remaining areas have evidence of recent construction and rubbish dumping, major modifications for unofficial off-road vehicle riding (i.e. built up berms, jumps, and trails), as well as dense feral growth of grasses, weeds, shrubs, and trees. However, during a site visit 7 July 2001 with Kupuna Eaton and Makua Kalani to reintroduce them to the project area, both informants were able to spot *ʻilima*, *ʻuha loa*, and *mauna loa*, which are used in traditional medicine and crafts.

Figure 4. Current state of Ka Makana Aliʻi Project Area and proposed Keoneula Road corridor (courtesy of Google Earth).

3.0 TRADITIONAL & MYTHOLOGICAL ACCOUNTS

A number of oral traditions have been recorded that help describe the physical, mystical, and cultural landscapes of Honouliuli Ahupuaʻa. Although Ka Makana Aliʻi is located in an area that has diminutive mythological significance, it is situated amidst several areas within Honouliuli Ahupuaʻa that are well known in Hawaiian legends and history.

3.1 THE NAMING OF ʻEWA & HONOULIULI

Honouliuli is the westernmost *ahupuaʻa* of ʻEwa District, or *moku*, which stretches from Red Hill on the west edge of Kona District to Pili O Kahe just north of Koʻolina and Waimanalo (Figure 5). Sterling and Summers (1978) state that the Gods Kane and Kaneloa gave ʻEwa District its name, which translates as, "the stone that strayed," since the stone used to determine district boundaries had landed a great distance away from where it was thrown (Sterling & Summers 1978: 1). Pukui et al. (1974:28) maintain that ʻEwa literally translates as 'crooked' and comes from the same story of Kane and Kaneloa determining ʻEwa's *moku* boundaries at the landing place of their divinely thrown stone.

The name, Honouliuli, applies to the entire *ahupuaʻa* as well as a village within the *ahupuaʻa*, which is located less than two miles northeast of Ka Makana Aliʻi. Noted as the largest *ahupuaʻa* on the island of Oʻahu, Honouliuli stretches from the West Loch of Pearl Harbor to what is now called Koʻolina to the west and north all the way to Wahiawa. Honouliuli is literally translated as 'dark bay' by Pukui et al. (1974:50). Yet, Thrum (1923) and Westervelt (1963) offer a different origin for the name Honouliuli, which comes from the "Legend of Lepeamoa." According to this legend, Honouliuli is the name of Lepeamoa's grandfather and Chiefess Kapalama's husband who gave his name "to a land district west of Honolulu" (Thrum 1923: 170).

3.2 MYTHOLOGICAL TALES OF ʻEWA & HONOULIULI

Honouliuli Ahupuaʻa is the setting for a number of legendary accounts concerning the activities of Gods, Goddesses, demi-gods, and head Oʻahu chiefs or *mōʻī* , as well as supernatural beings such as *moʻo,* mystical creatures, and wandering spirits. Compilations of Honouliuli's mythology have been created by Sterling and Summers (1978), Hammatt and Folk (1981), Kelly (1991), Charvet-Pond and Davis (1992), Maly (1992), Tuggle and Tomonori-Tuggle (1997), Mitchell and Hammatt (2004), and O'Hare et al. (2006).

Some tales paint the plains of ʻEwa as a mystical and somewhat foreboding place, where gods and goddesses frequent. For example, Sterling and Summers (1978) report a story from a January 13, 1900 *Ka Loea Kālaiʻāina* newspaper article, "The Old Women Who Turned to Stone" which reads:

> If a traveler should go by the government road to Waianae, after leaving the village of gold, Honouliuli, he will first come to the plain of Puu-ainako and when that is passed, Ke-one-ae. Then there is a straight climb up to Puu-o-Kapolei and there look seaward from the government road to a small hill. That is Puu-o-Kapolei…You go down some small inclines, then to a plain. This plain is Pukaua and on the mauka side of the road, you will see a large rock standing on the plain. This stone has a legend that made this plain noted…There were two supernatural old women or rather peculiar women with strange powers and Puukaua belonged to them. While they were down fishing at Kualakai in the evening, they caught these things[:] aama crabs, pipipi shell fish and whatever they could get with their hands. As they were returning home to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run, running, leaping, falling[,] sprawling, rising up and running on, without a thought to the aama crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, "Let us hide lest people see us," and so they hid. Their bodies turned to stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women…(*Ka Loea Kālaiʻāina,* 13 January 1900 as cited in Sterling & Summers 1978: 39).

Another version of this tale is offered in an article found in the *Ka Hōkū o Hawaiʻi*, February 15, 1927 (translated by Maly 1997: 19), where the women were *moʻo* and changed into lizard form as they crossed the goddess Hiʻiaka on her journey to the ʻEwa coast, for they feared she would kill them. The *moʻo* hid near the trail and Hiʻiaka greeted them and passed without harm (Maly 1997 as cited by O'Hare et al. 2006: 20). This story not only illustrates the enchantment of ʻEwa Plain in lore, but also the wealth (in one form or another) of nearby Honouliuli Village, deemed the "village of gold," which is upheld by early maps of the region where it is depicted as the largest permanent settlement of the ʻEwa District in pre-plantation times. Additionally, it accounts significant foot traffic from Honouliuli Village to Waianae in pre-Contact times.

The legend of Namakaokapaoo originates in Honouliuli Village area. This is a story of a young 2 ½ foot tall boy, named Namakaokapaoo, who killed his stepfather and threw his head five miles away before conquering Oʻahu's king and his warriors, and subsequently replaced the king with his mother as ruler (Beckwith 1970). Honouliuli Village is also the place that Ka ihu o Palaʻai, the sister of mythological figure, Maikoha, fell in love and settled (Sterling & Summers 1978:53).

Pearl Harbor, just east of Honouliuli Village, is the source of many legends. Sterling and Summers (1978) offer several stories about the shark goddess, Kaʻahupahau (translated as Cloak-well-cared-for), her origin having several interpretations. In one interpretation, Kaʻahupahau was thought to have been a miscarriage by her mother and left in the waters of Pearl Harbor, but still alive, she transformed into a shark. In another version, Kaʻahupahau and her brother were born as human, but were later transformed into sharks by a shark god. The two remained in Pearl Harbor, where they were fed *ʻawa* by their human relatives. In return, Kaʻahupahau protected her human kin from other sharks. Another major figure in Pearl Harbor mythology is Papio, the beautiful surfing chiefess, who had several conflicts with the shark goddess, Kaʻahupahau, and is often said to have eventually been devoured by her

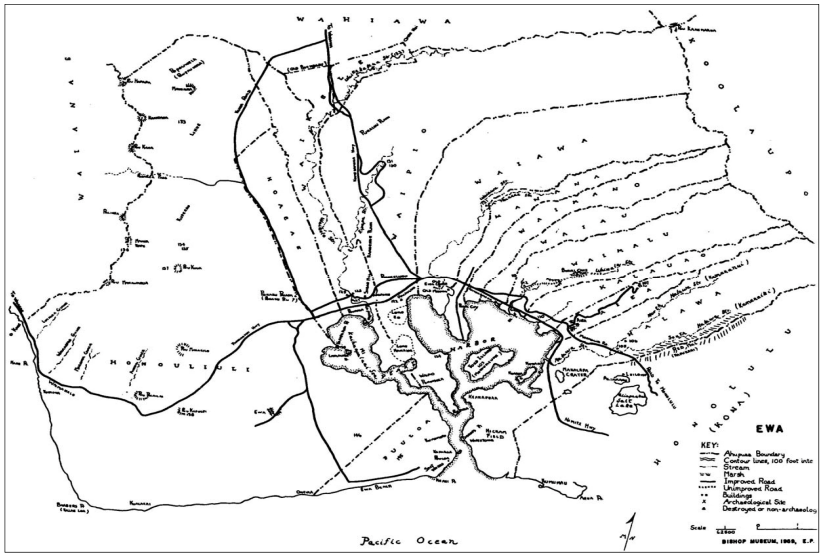

Figure 5. Ahupuaʻa of ʻEwa District (from Sterling & Summers 1978).

(Sterling & Summers 1978: 54-56). Kapakule is the tennis racket shaped fishpond located at the entrance to Pearl Harbor, which is the setting of many tales. One of which is of the *menehune*, or little people, building the fishpond in one night at the command of the gods, Kane and Kanaloa (Sterling & Summers 1978: 42-43).

Located approximately 1.8 miles (1.9 km) west of Ka Makana Aliʻi, Puʻu Kapolei, was subject of numerous local ancient myths and chronicles. Sterling and Summers (1978) mention Puʻu Kapolei as being one of the most famous hills in the olden days and a major point of reference for travelers going east or west through Honouliuli. Additionally, Puʻu Kapolei was the landmark (juxtaposed to the setting sun) used to mark the end of Makaliʻi, or the Kau season, and the beginning of the Hoʻoilo season, when young sprouts emerged from the ground (Kamakau as cited in Sterling and Summers 1978).

The very name Kapolei translates as "beloved Kapo," who was the sister of the Goddess Pele (Pukui et al. 1974:89). Colorful tales further link the *puʻu* to Hawaiʻi's pantheon of gods and goddesses, including dramatic conflicts between them. One such tale involves Kamapuaʻa, the Goddess Pele, and her sister Kapo, where the amorous pig-god Kamapuaʻa assaults Pele at Puʻu Kapolei and is subsequently lured away from her as he pursues Kapo's detached "flying vagina"(*kohe lele*) that she placed on Puʻu Kuua (Pukui et al. 1974:200; Beckwith 1970). Additionally, the deity Kamaunuaniho was supplanted at Puʻu Kapolei by her grandson, Kamapuaʻa, to exact tribute from the commoners of the area (Nukuina as cited by Sterling and Summers 1978). Sterling and Summers (1978) list several accounts of a dwelling or heiau in Puʻu Kapolei belonging to the grandmother of Kamapuaʻa. As nearby Puʻu Kapolei has been home to deities, the setting for legends, as well as the landmark for the seasons, the nearby lands have likely been significant to Hawaiians in pre-Contact times.

Further to the west and south are a number of additional myths. Kamakau described western ʻEwa as the "rough country (*wiliwili*) of Kaupeʻa" and "the home of wandering spirits with no holdings, who ate spiders and moths for sustenance" (Kamakau 1964:83). Kamakau adds that the wandering souls of Kaupeʻa are often helped by *ʻaumakua* to escape from this domain (Kamakau 1991: 49). The description of west ʻEwa as being the "realm of wandering spirits" is supported by Pukui's chant on the subject (Pukui 1983: #1666 as cited by O'Hare et al. 2006) and Fornander's lament for Kahahana (Fornander 1919, Vol. 6, Part 2: 297 as cited by O'Hare et al. 2006).

3.3 Chronicles and Conflicts in Honouliuli Ahupuaʻa

Some tales portray Honouliuli Ahupuaʻa as being a place of "firsts," such as the origin of humans on Oʻahu and breadfruit in Hawaiʻi. The *ahupuaʻa* of Honouliuli was also noted for being the origin, home, refuge, and vacationing place for some of Oahu's earlier *mōʻī*, or ruling chiefs (Kamakau 1961, 1991; Lewis 1970). Yet, *kauwā* (slaves) lived in the ʻEwa District's as well. In addition, the *ahupuaʻa* was the location of key battles and treaties in Oʻahu's pre-Contact annals.

Some tales suggest that the first Hawaiians had settled in Honouliuli. In the legend, Ka-Lua-Ōlohe, Pearl Harbor was said to be the place where human beings first came to Oʻahu. This

area is said to have many caves, which belong to the *ōlohe*, who were "born in the day" (Beckwith 1970).

The first planting of breadfruit in Hawaiʻi is said to have occurred at Puʻuloa, located about 4 miles (6.4 km) southeast of Ka Makana Aliʻi. According to tradition, Kahai, son of Moikeha, transported the species from Upolu, an island in Samoa, on his return trip home from Tahiti (Thrum 1907; McAllister 1933). Fornander (1919, Vol IV, Part I: 392) and Kamakau (1964) confirms that Puʻuloa is the location of Hawaiʻi's first breadfruit.

The story of Maʻili-kukahi, one of the chiefs who was celebrated for leading Oahu out of chaos and into a period of prosperity, confirms Honouliuli Ahupuaʻa as being the homeland of some Oʻahu *mōʻī*. Kamakau refers to Māʻili-kūkahi as a 'kind' chief and not culpable for abandoning Hawaiian taboos although he is said to have "relinquished [his] position as ruling chief and gave it to the commoners; and took the firstborn children of the commoners to rear and care for" (Kamakau 1961: 223). Māʻili-kūkahi's sovereign realm was eventually challenged by chiefs from Maui and Hawaiʻi Island, one of which was named Hilo. The Oʻahu chief came out victorious after a bloody battle and placed the heads of his foes for all to see at a major trail junction just outside of Honouliuli Village, which was thereafter called Poʻo-hilo (head of Hilo), after the decapitated chief from the island of Hawaiʻi (Kamakau 1991: 56).

According to the 1883 Dictionary of Hawaiian Localities, ʻEwa was a "…favorite residence of Oahu kings of olden times…" (Sterling & Summers 1978:1). Kamakau mentions that ʻEwa, from Puʻu Kuua to Maunauna at the northern extreme of the *ahupuaʻa*, was quite populous where Oʻahu *mōʻī* reigned before they ruled from Waikiki (Kamakau 1991: 54). Fornander tells the story of Keaunui, "the head of the powerful and celebrated Ewa chiefs" who is credited with cutting a navigable channel into the estuary of Pearl River near the Puʻuloa saltworks (Fornander 1880: 48 as cited in Sterling & Summers 1978:46).

Coastal Honouliuli was sought as a refuge and vacation area on Oʻahu, as is clear in several texts. For instance, the beach area now called Koʻolina, was noted as the favored vacationing place of Chief Kakuhihewa, a *mōʻī* of ancient times (Fornander as quoted by Lewis 1970). In addition, when Kahekili conquered Oʻahu, Kahahana, his wife, and 'friend' fled together to various locations in ʻEwa. One location was Poʻo-hilo in Honouliuli where they went into hiding before giving themselves up to the commoners, as they were "weary with life in the forest"(Sterling & Summers 1978: 6).

However, some traditional accounts paint a rather disparaging picture of central Honouliuli *ahupuaʻa* inhabitants. According to an 1899 newspaper, "the very dirty ones" lived in the large hollow above Puʻu Kuua, which is approximately 4.6 miles (7.4 km) northwest of Ka Makana Aliʻi ("*Na Wahi Pana o Ewa*" 1899 as cited by Sterling and Summers 1978: 32). Another tradition explains the origin of stigmas placed on the peoples of Puʻu Kuua:

> The Chiefs of old, who lived at that time, were of divine descent. The two gods looked down on the hollow and saw how thickly populated it was. The mode of living here was so that the chiefs and commoners mixed freely and they were so

> like the lowest of people (*Kauwā*). That was what these gods said and that was the time when the term *kauwā* [an outcast or slave] was first used, and was used for many years afterwards.
>
> After the first generations of chiefs had passed away and their descendants succeeded them, a chiefess became the ruler. It was customary for the chiefs of Oahu to visit this place to see the local chiefs. They did this always. When the time came in which a new chiefess ruled, an armless chiefess, she ran away to hide when other chiefs came to visit as usual because she was ashamed of the lack of an arm. Because she was always running away because of being ashamed the chiefs that visited called her the low-born (*kauwā*). Thus the term remained in the thoughts down to this enlightened period. She was not truly a kauwa but was called that because she behaved like one. This was how they were made to be kauwas. When the ruling chief wished to go to Waikiki for sea bathing he asked the chief just below him in rank, "how are my planting places at Puu-Kuua, have they not produced young suckers?" The chief next to him answered, "There are some suckers," and sent someone for them. When the men, women and children least expected it, the messenger came to get some of the children. The father stood up and took his sons to Waikiki. Then when the ruling chief went sea bathing, he sent an attendant to get the boys and take them to a shallow place where the ruling chief would come. Then the ruler placed a hand on each of the boys, holding them by the necks. The words he uttered were, "My height has not been reached (by the sea)! My height has not been reached!" (*Aole i pau kuu loa, aole pau kuu loa*). He advanced and held on to the boys until the sea was up to his chest. The boys floated on the water face down. The father on shore called out, "Lie still in the sea of your Lord," and so on.
>
> The sea of Waikiki is said to have been used to kill men in and the other place is Kualoa. The inhabitants of Puu-Kuua were so mixed, like taro beside an imu. There were two important things concerning this place. (1) This place is entirely deserted and left uninhabited and it seems that this happened before the coming of righteousness to Hawaii Nei. Not an inhabitant is left. (2) The descendants of the people of this place were so mixed that they were all of one class. Here the gods became tired of working and returned to Kahiki. ("Na Wahi Pana o Ewa" 1899 as cited by Sterling and Summers 1978:32-33).

The peoples of Puʻu Kuua became viewed as pariahs for not abiding by social codes, and as a result, they were persecuted to near extinction. This story also suggests that the pre-Contact population of central upland Honouliuli Ahupuaʻa may have thrived previous to this campaign of extermination.

Warfare was another constant theme in the ʻEwa District. Fornander (1919, Vol IV, part II: 364) wrote about the "battle" of Keahumoa Plain, which was supposed to be the final battle of celebrated chief, Kualiʻi. In this account, two warrior brothers sought higher positions in life, so they arranged for 12,000 of Kualiʻi's men to meet with 1,200 Koʻolau warriors to battle at Keahumoa, ʻEwa. However, they did not plan to fight, but to unite both sides. The youngest brother, Kamakaaulani, presented a *mele*, or chant, to Kualiʻi while the older brother, Kapaahulani, led the opposing side to the battleground. When the two sides met, the *mele* was successful and the battle was prevented. After the treaty, the island of Oʻahu was united.

When chiefs of other islands found out about the unity, they joined forces to unite under Kualiʻi. Sterling and Summers (1978: 38) list several versions of this battle. Another battle referred to as "Battle of Kipapa" was part of the story of Maʻili-kukahi, where Big Island's chief, Hilo, attempted to take over Oʻahu unsuccessfully in a particularly bloody battle. His head was placed at a crossroads just above Honouliuli Village, which was since called Poʻohilo (Kamakau 1991: 56). A later conflict was the Battle of ʻEwa, which took place in several places within ʻEwa in the mid-1790's. In this battle, Ka-ʻeo and Kalani-ka-pule fought, and with the aid of European weaponry, Kalani-ku-pule overcame Ka-ʻeo (Kamakau 1961; as cited in Sterling & Summers 1978: 12).

3.4 Traditional Accounts of Natural Resources in ʻEwa Plains

Although historic accounts of water in west ʻEwa are rare, fresh water is documented at the spring Hoaka lei at Kualakaʻi on the ʻEwa coastline, in the oral history chant, He Moʻolelo Kaʻao No Hiʻiaka I Ka Poli O Pele, translated by Pukui et al. (1974:119) and by Kepā Maly (1999:31).

According to ancient myths, the ʻEwa Plain was home to a variety of wild plants and birds. The legend, He Moʻolelo Kaʻao No Hiʻiaka I Ka Poli O Pele, is the goddess Hiʻiaka's account of her journey across ʻEwa. In this legend, first published in Hawaiian in the newspaper *Ka Hoku o Hawaiʻi* (September 18, 1924 -July 17, 1928), important geographical locales as well as many trees, plants, and flowers were mentioned. Flora mentioned in the tale included: *nene* grasses, *kupukupu* ferns, *noni* trees, *maʻo*, varieties of *lehua*, *koaiʻa*, *ʻilima*, *ʻohai*, *kukui*, *kaunoʻa*, *ʻuala*, *pilipili-ʻula*, *wiliwili*, and *noho*. Emerson (1978:167) translated parts of this legend, and more recently Kepā Maly (1999:31) translated parts relating to ʻEwa. Maly (1999) paraphrases a portion of his translations of the Hiʻiaka legend chant:

> Descending to the flat lands of Honouliuli, Hiʻiaka then turned and looked at Puʻuokapolei and Nawahineokamaʻomaʻo who dwelt there in the shelter of the growth of the ʻohai (*Sesbania tomentosa*), upon the hill…When Hiʻiaka finished her chant, PuʻuoKapolei said…So it is that you pass by without visiting the two of us. Lo, we have no food with which to host you. Indeed, the eyes roll dizzily with hunger. So you do not visit us two elderly women who have cultivated the barren and desolate plain. We have planted the *ʻuwala* (sweet potato) shoots, that have sprouted and grown, and have been dedicated to you, our lord. Thus as you travel by, pull the potatoes and make a fire in the *imu*, so there will be relief from the hunger. For we have no food, we have no fish and no blanket to keep us warm. We have but one Kapa (covering)…in the time when the grasses dry, and none is left on the plain, we two are left to live without clothing. (Maly 1999:35)

Traditional *mele,* or chants, refer to and other localities on lands stretching from Puʻu o Kapolei to Kalaeloa as well. The nature of these lands in ancient times is suggested through these *mele*. Kamakau, in the mid- to late-1800's wrote articles in newspapers titled, *Kuʻokoʻa* and *Ke Au ʻOkaʻa,* which shed light on ancient Hawaiian life, customs, and oral traditions. These articles were translated into English and compiled in several manuscripts in the 1960's then reprinted several times. For instance, Samuel Mānaiakalani Kamakau published numerous *mele* in

Nupepa Kuokoa during the late 19th Century. One of which describes the people, terrain, vegetation, and climates of various locations within the ʻEwa Plain:

> *Me he kanaka la ka ohai o Kaupea,*
> People are like the *ohai* blossoms of Kaupeʻa
>
> *Ka wiliwili haoe kaune i ka la,*
> The *wiliwili* appear to stagger in the sun
>
> *Kulolia i ke kaha i Kanehili,*
> Stricken on the plain of Kānehili
>
> *I ke kaha kahakai o Kaolina – e,*
> At the shore of Ka-ʻolina (Koʻolina),
>
> *He wahi olina na ka la i Puuloa…*
> There is a place of joy from the sun at Puʻuloa
>
> (Kamakau, in *Nupepa Kuakoa*, August 10, 1867:3; Translated by Maly, in Belt Collins 2006:2-15)

Kamakau also published several proverbs about the area in the Hawaiian newspaper, two of which are translated as:

> *A o kona oliliko ana e ulili haamalule ana i Puuokapolei,*
> And Puʻuokapolei which shimmers in the daylight;
>
> *A ua kolilii koliliko kona wailiula i ke kaha o Kanehili ka hele o ka wiliwili me ka lau o ka maomao*
> It is on the arid flat lands, of Kānehili,
> with the mirage forming waters,
> that the *wiliwili* and *maomao* grow,
> with their leaves scattered in the wind
>
> (Kamakau, in *Nupepa Kuakoa*, August 10, 1867:3; Translated by Maly, in Belt Collins 2006:2-14)

Another *mele* published in Nupepa Ka Oiaio in 1895 by Moses Manu, helps to reveal the lands of Kaupeʻa as the ancient Hawaiians viewed it. The *mele* is as follows:

> *O-u o lea ka manu o Kaupea,*
> The ʻŌʻū is the joyful bird of Kaupeʻa,
>
> *Ka O-o manu leo lea o Puuloa,*
> The joyful voiced `Ō`ō is of Puʻuloa,
>
> *E hoonaele ana i ka pua o ka Wiliwili,*
> Softening the blossoms of the Wiliwili,

Inu iaola i ke koena wai lau noni
Drinking the drops of nectar from the noni,

Inu ka manu ano kunewa…
The birds drink and pass time…

(M. Manu in *Nupepa Ka Oiaio*, May 10, 1895:1; Translated by Maly, in Belt Collins 2006:2-15)

Marine resources were also plentiful along the coasts of the ʻEwa Plain. Kamakau (1991) in Ka Poʻe Kahiko: The People of Old, speaks of one ʻEwa guardian ancestor deity, Kanekuaʻana, also interpreted as a *moʻo,* or guardian water lizard, who was revered for providing her faithful descendants and *kamaʻāina* with an abundance of *iʻa* or marine resources from Halawa to Honouliuli. Further, Mary Kawena Pukui (1943), states that Kanekuaʻana was responsible for bringing the *pipi,* or pearl oyster, from Tahiti in ancient times (Pukui 1943 as cited in Sterling & Summers 1978:49-51). During times of scarcity, her devotees erected *waihau* and *heiau* to Kanekuaʻana where pigs, bananas, and coconuts were sacrificed, rather than people. Kamakau (1991) reports on the outcome of one such sacrifice:

> What blessings did they obtain? *Iʻa.* What kinds of *iʻa*? The *pipi* (pearl oyster) – strong along from Namakaohalawa to the cliffs of Honouliuli, from the *kuapā* [walled] fishponds of inland ʻEwa clear out to Kapakule. That was the oyster that came in from the deep water to the mussel beds near shore, from the channel entrance of Puʻuloa to the rocks along the edges of the fishponds. They grew right on the *nahawele* mussels, and thus was this *iʻa* obtained…the *pipi* were found in abundance – enough for all ʻEwa – and fat with flesh. Within the oyster was a jewel (*daimana*) called a pearl (*momi*)…They were great bargaining value (*he waiwai kumukuʻai nui*) in the ancient days, but were just "rubbish" (ʻ*opala*) in ʻEwa (Kamakau 1991: 83)

Though the project area is located beyond the margins of the areas touted as abundant in natural resources, it appears central and nearly equidistant to these important areas. Thus, pre-Contact cultural activities may have taken place in this area, such as travelling to and from Honouliuli Village to other locales in the *ahupuaʻa,* with the possibility of trails, trail markers, temporary encampments, or other activity areas. Conversely, this area was comparatively void of resources, yet abundant in sinkholes, making it ideal for human interments.

4.0 HISTORIC ACCOUNTS

Since the time of European Contact, ʻEwa District has had an intriguing history and has been the backdrop for several significant milestones of the island's history.

4.1 ʻEWA DISTRICT AND HONOULIULI AHUPUAʻA AT CONTACT

The written account of ʻEwa begins with the arrival of Captain George Vancouver in 1793. Apparently, the lands of ʻEwa garnered little comment in early written history, save for those of derogatory nature. According to Vancouver (1798), the conditions of the area between Waianae and Koʻolau Mountains were not pleasant, stating:

> This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of natural fertility; although we were told that a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced (Vancouver 1798 as cited by Sterling and Summers 1978: 31).

Vancouver's crewmen commented further on the condition of the few canoes that came out to greet them from west ʻEwa, calling them "small and indifferent" and "furnished with little for barter" (Vancouver 1798 as cited by Lewis 1970: 6). Later, Vancouver wrote of the relatively dismal condition of west Honouliuli coast, stating:

> From these shores we were visited by some of the natives, in the most wretched canoes I had ever yet seen amongst the South-sea islanders; they corresponded however with the appearance of the country, which from the commencement of the high land to the westward of Opooroah (Puuloa), was composed of one barren rocky waste, nearly destitute of verdure, cultivation or inhabitants, with little variation all the way to the west point of the island (Vancouver 1798 as cited by Lewis 1970: 6).

The political center of ʻEwa during the Contact period is still disputed. McAllister (1933: 106) describes a place named Lepau, which sits on the Waipiʻo Peninsula, less than 4 miles (6.35 km) east of Ka Makana Aliʻi, as a "dwelling place of the alii." Silva (1987) suggests that a place called Halaulani on the same peninsula was home to chiefs. Conversely, some argue that the political center was much further north at Lihue between Puʻu Kuua and Maunauna (Cordy 1996).

The Battle of ʻEwa is stated by Kamakau (1961) to have occurred in 1794, shortly after European Contact. This battle is said to have several phases, taking place in ʻEwa District and utilizing European weaponry. It is said that Kalanikupule, high chief of Oʻahu, overcame Kaeokulani, who ruled Kauai and Maui at the time.

4.2 HONOULIULI AHUPUAʻA IN THE EARLY TO MID-1800'S

The ʻEwa Plain was described as a near uninhabitable place in early accounts, however, Honouliuli Village was viewed more as an oasis with a sizable population, aquatic abundance,

and burgeoning agricultural system. As seen in the Land Commission Award's Native Testimonies and early maps of Honouliuli, land adjacent to West Loch was intensively farmed with a variety of traditional agricultural methods from early Contact times into the late 1800's (Dicks et al. 1987, Appendix A; Malden 1825; Monsarrat 1878; Figures 6 & 7). The coastal areas were also famous for their marine resources and inland fishponds, as evident in oral and written history. Connecting Honouliuli Village and the trail leading from Honolulu to Waianae was a trail, often referred to as Kualakaʻi Trail, which appears in the Malden 1825 map of the south coast of Oʻahu to pass through or adjacent to the Ka Makana Aliʻi project area (Figure 6). The ancient trail leads from Honouliuli Village to Keoneula (Hau Bush) with a leg leading to Kualakaʻi (Figures 6, 10, & 12).

Edwin Hall, Hawaiian Minister of Finance, described west ʻEwa as a "barren, desolate plain" in the early 1800s after traversing much of the island of Oʻahu (Hall 1839 as quoted in Lewis 1970: 8). Yet, according to maps of the early to late 1800s (Malden 1825; Monsarrat 1878; Figures 6 & 7), Honouliuli was labeled as the "Watering Place" and depicted as a relatively large agricultural community.

Honouliuli Village, which is located approximately 2.4 miles (3.9 km) northeast of Ka Makana Aliʻi, had an abundance of natural resources, such as rich soil, marine life, and fresh water since pre-Contact times as depicted by early maps (Malden 1825; Monsarrat 1878; Figures 6 & 7) and written accounts (A. Campbell 1819; Chamberlain Ms.; Kamakau 1991). These vital elements permitted the development of an extensive system of irrigated taro patches or *loʻi* as well as landlocked and shoreline fishponds previous to the drilling of the first artesian well commissioned by James Campbell in 1879. Captain George Vancouver described the ʻEwa plain as deficient in people and fertility, but said he was informed that inland "…a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced…" (Vancouver 1798, Vol 3: 361-363). Archibald Campbell later writes of his experience travelling through ʻEwa in his 1809 essay, "Voyage Round the World," by stating:

> We passed by foot-paths winding through an extensive and fertile plain, the whole of which is in the highest state of cultivation. Every stream was carefully embanked to supply water for the taro beds. Where there was no water, the land was under crops of yams and sweet potatoes. The roads and the sides of the mountains were covered with wood to a great height. We halted two or three times, and were treated by the natives with the utmost hospitality (A. Campbell 1819: 145).

Maps from early to mid-1800's depict Honouliuli as having extensive agricultural fields and fishponds (Malden 1825, Monsarrat 1878; Figures 6 & 7). Additionally, Native Testimony given at the time of the Mahele ʻĀina in 1848, list scores of taro patches (*loʻi kalo*), vegetable plots (*māla*), fishponds (*loko iʻa*), pig pens (*pā puaʻa*), pastures (*kula*), hala groves (*ulu hala*), and house sites within Honouliuli Valley (Dicks et al. 1987: Appendix A&B), attesting to intensive agricultural activities and habitation density in the area. Furthermore, several well-known varieties of taro are associated with the area, one being the *kaikoi* taro that comes from the "land of the silent fish," which is another name for Pearl Harbor (Sterling & Summers 1978: 8).

However, after the arrival of Europeans, areas of natural abundance were severely impacted by exotic species and agricultural practices. S.E. Bishop wrote in 1836 that *mauka* areas were of denuded of vegetation due to intensive cattle ranching to the extent that "vast quantities of earth" were washed down into the lagoons, filling them with sediment, causing a near extinction of oysters and clams (Bishop 1901: 87 as cited in Sterling & Summers 1978). The reduction of marine resources and choking of wetland agriculture with upland sediments may have hastened the exodus of surviving Honouliuli villagers to seek employment and western comforts of the ʻEwa Plantation and villages.

Additionally, Honouliuli Ahupuaʻa was host to one of the earliest Roman Catholic Churches in Hawaiʻi (Figure 8), which helped indoctrinate Honouliuli inhabitants into a western lifestyle and values. By the mid-1800s, Honouliuli Village's population experienced a serious decline in Native Hawaiians, primarily due to disease. Following the development of ʻEwa Plantation in the late 1800's, parishioners of Honouliuli's Catholic Church moved their homes and subsequently their house of worship closer to the mill, which became ʻEwa Villages - the center of Honouliuli Ahupuaʻa's economy and its densest population center until the modern era.

Honouliuli Ahupuaʻa experienced a severe population decline in the early 1800s, despite the fecundity of the land. Levi Chamberlain, who circled Oʻahu in 1828 to inspect missions and schools, held a small assembly for scholars in Waimanalo, west ʻEwa. The assembly took place in the house of a "head man" and was attended by people who lived in the area (Lewis 1970:7). Thus, during the early 1800's ʻEwa still had a modest population of Native Hawaiians who were receptive to Christianity and European-style schools.

In 1832, missionaries carried out a census in Honouliuli, recording 1,026 people with 25% of ʻEwa living in Honouliuli. L. Smith wrote of Honouliuli Village's population in 1830's, stating that within the village was a "populous neighborhood" (Smith 1835: 4). Kamakau (1961) stated that east ʻEwa experienced a spike in Native Hawaiian population growth in the mid 1800's, followed by a severe drop, to near extinction, as a result of European diseases. Further, Kamakau stated "Honouliuli had over ten school houses with their teachers" and after the acute population decrease, "whole villages have vanished, leaving not a man" (Kamakau 1961: 424-425). L. Smith, who was the first missionary to build a house and church in ʻEwa, said in the 1830's that, "the people of Ewa are a dying people" and for each birth were at least eight to ten deaths (Smith 1835: 8 as quoted by Lewis 1970: 8). Artemis Bishop, Smith's successor, listed small-pox, cholera, and measles as responsible for decimating Native Hawaiians of ʻEwa.

Additionally, Bishop stated that after several years of population decline, about half of Honouliuli's remaining population died within a few months in 1854 despite his attempt to vaccinate them (Bishop 1835: 1). Unfortunately, the people of Honouliuli, like other Hawaiians, had little chance of survival from these foreign diseases.

L. Smith, also noted in 1835 that the people of ʻEwa were generally of ill health and over-taxed by Oʻahu's chiefs (Smith 1835 as cited by Lewis 1970). Smith expanded, by saying that the people of Honouliuli were "almost constantly employed for the chiefs – making salt – getting timber-wood & money for their annual tax" (Smith 1835:1).

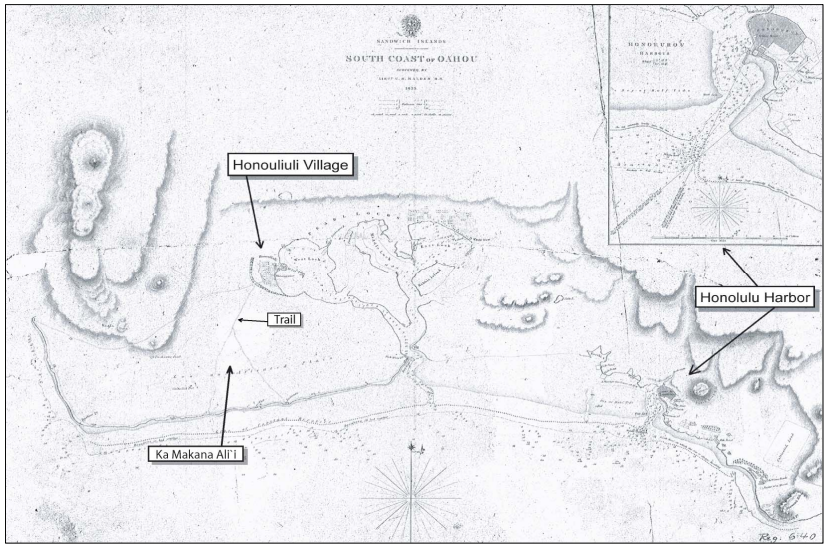

Figure 6. Malden (1825) map, South Coast of O'ahu with Honouliuli & Honolulu depicted as well as the approximate location of Ka Makana Ali'i project area.

Christianity was met with mixed reception by Native Hawaiians of Honouliuli in the early 1800's. However, some of the earliest detailed accounts of 'Ewa are from mission station reports. These reports doubled as a commentary on Honouliuli's demographics and as a progress report of conversions. Smith mentioned the presence of a school and provided a count of students tested in 'Ewa District in his "Oahu Station Reports - 'Ewa to Waianae, from 1835-1863," stating:

> There have been but two other Schools at Ewa during the year [be]sides those taught at the station.
>
> Two young men residing at Honouliuli have taught one School of children & one of adults. These Schools have made considerable improvement. Samuel has been reading book[s] of the adults. They had also an exercise in the Almanac; & it appeared at our examination or "hoike" recently held, that they could answer almost any question that could be asked from that book.
>
> We have had but one hoike during the year, & that took place on the 20th of May, & was composed of persons who had attended School & no others. Others would have gladly joined us as Scholars on that occasion, but I told them they had no part nor lot in the matter except as Spectators.
>
> The following is a list of the Scholars as they were examined.

No. of children from Honouliuli	31
*Do of adults	19
Total	50
No. of adult females at the Station	51
*Do of males	73
*Do of children	54
Choir of Singers	122
Total taught at the Station	300
	50
Total taught at Ewa	350

(Smith 1835:6)

> *Do is a form of short-hand used by L. Smith that appears to imply number of types of individuals in Honouliuli.

Yet, while walking in 'Ewa's hinterland during the same year, Smith happened upon a mound of stones with a "heathen god" atop, described as a "small stone dressed in tapa" (Smith 1835:2 as quoted by Lewis 1970:8). Thus, it is likely that some Native Hawaiians still revered old gods in the early 1800's.

The conversion to Christianity proved to have some positive outcomes according to missionaries as seen in a later report from Artemis Bishop from the mid 1800's:

> Four protracted meetings have been held during the year, within the bounds of my field of labor, to wit, at Halawa, Waiawa, Honouliuli, and Waianae. They

> were all, with the exception of the one at Halawa, well attended, and solemn, and were followed by decidedly beneficial effects. The frequent repetition of these meetings however in the same place, does not appear to me to be attended with very striking effects, unless it be in a time of special seriousness among the people. Such meetings however continue to be popular, and prove beneficial or not in proportion to the spirit with which they are conducted. (Bishop 1841:1)

Another station report for ʻEwa was submitted in 1846 by Bishop, revealing the mixed reception of Christianity in Honouliuli during the mid-1800's. Bishop writes:

> The state of religious apathy continued as heretofore for several years past, down to the middle of last year, without anything remarkable to disturb the false security that pervaded the community. About the first of July last, I was visited by several inquirers from Honouliuli a settlement on the western part of the district, who appeared to be anxious about their salvation. This was the first indication of anything special among my people. Soon afterwards I was invited to spend a day at the place and meet the people in religious meetings. I went accordingly and we had a full house and attentive listeners. Several who attended from neighboring villages, requested that I would likewise spend a day in religious meetings with them. As I was desirous that the people should generally come out, I required that the invitation should come from them, and special effort be previously made to obtain their presence. As I had been so long discouraged with the slender attention paid to social religious meetings which I had appointed in the neighboring villages, I feared that without a special effort on the part of the *kamaainas*, the appointment might prove a failure. But as I was happily seconded by my elders and other *lunas*, my appointments were well attended, and the preaching was listened to with seriousness and solemnity. My first efforts were mainly directed to the slumbering [church] members. These however gradually began to awake to prayer and effort to arouse others. Daily prayer meetings were after a time established in every village in the district, and where suitable houses for meetings were not to be found, new ones were in the time of a few months erected, and two days meetings were appointed at their dedication. These houses that exist in all the principal villages are distinct from the school houses, and are consecrated exclusively to religious meetings. About the close of the year a general seriousness pervaded the minds of the people throughout the district, the church was filled on the sabbath, and religious were thronged. Many backsliding professers were awakened, and many apostates had publicly confessed their sins, and sought to be restored to the bosom of the church. The no. of inquiries from the ranks of the world now amounted to upwards of 200. But as there appeared so little excitement, and everything went on so still, I had not dared to call it a revival. Nor have I yet ventured to give it that name; or scarcely to write much about it to my brethren, lest it should prove in the end a false illusion to the greater part of the young converts. I have all along preached to them the terms of the law, as well as the invitations and hopes of the Gospel – to lead them to a sense of sinfulness as well as to faith in the blood of Jesus, but I fear that a great multitude of them, do not feel as deeply as they mouth their utter unworthiness, notwithstanding their full and ample confessions with the lips. But it is not easy for this people to feel without animal excitement, which I have from the first falling away for now nearly a year, my hopes are more confirmed that their repentance and faith are sincere. Still I

> would hope with trembling, knowing as I do the fickle character of this people (Bishop 1846:1).

Bishop's struggle with the Native Hawaiian conversion to Christianity was endured in vain, however, as the majority of Honouliuli peoples would be wiped out by disease.

4.3 HONOULIULI FROM THE MID- TO LATE 1800'S

Despite the severe population decline, Christianity and European ways persisted in Honouliuli Ahupuaʻa, as they did all over Hawaiʻi. Agriculture, however, would not only persist in the area - it would dominate in the form of sugarcane.

According to Tuggle and Tomonori-Tuggle (1997), tax records from 1855 to 1888 reveal that the principal communities of the *ahupuaʻa* were in or flanking Honouliuli Gulch, as well as Lihue, Puʻuloa, Kualakaʻi, and Waimānalo. Only a total of 44 individuals were taxed between these years, although this number likely represents head-of-households. Taxable assets included, but were not limited to, "fishnets, boats, and houses" (Tuggle and Tomonori-Tuggle 1997: 38). Hence, at this time, small pockets of Native Hawaiian communities persevered in Honouliuli.

Although Catholic missionaries under Father Alexis Bachelot arrived in Honolulu in 1827, Catholic missionaries did not find Hawaiʻi receptive until the Edict of Toleration was issued by King Kamehameha III in 1839, which allowed Catholics to set up their own church to convert Hawaiians (Schoofs 1978). Schoofs (1978) commented on the little known Roman Catholic Church of Honouliuli, which is also depicted on M.D Monsarrat (1878; Figure 8) and W.D. Alexander (1873) Honouliuli maps. According to Schoofs (1978), the Roman Catholic Church of Honouliuli was overseen by Father Raymond Delalande and the location where baptismal records of leeward Oʻahu were kept. O'Hare et al. (2006) refers to this church as "Kapalani Catholic Church," which is taken from the description of LCA No. 1720 by the claimant, Hilinae in the late 1840's (Dicks et al. 1987, Appendix A: 9; O'Hare et al. 2006: 38). Although no other sources were found referring to the church as "Kapalani," this is the earliest record of a church in this area. In addition to Hilinae's native testimony, another is given by Kaohai (LCA No. 5670B), stating that his house site adjoins "the Catholic Chapel yard" (Dicks et al. 1987, Appendix A: 10) further upholding the existence of Honouliuli's Roman Catholic Church.

O'Hare et al. (2006), in a very thorough report about a nearby property, mentions the relationship of the church to Kepelino (Zepherino) Keauokalani, which translates as 'to-be-the-chief-of-the-nine-districts', who was a descendant of Kamehameha I and the historian Namiki (on his mother's side). O'Hare et al. (2006) found that Kepolino was a Catholic School teacher in various areas and had acquired a bad reputation as a prankster. As a result of his reputation as a bad administrator and accusations of "dancing and thieving" during his tenure as a Honouliuli school teacher in 1851, Kepolino was given a letter by the Minister of Public Education and Catholic Priests of Honouliuli denying further teaching positions, which were published in Catholic newspapers (O'Hare et al. 2006: 39). Kepolino's colorful story further verifies the establishment of a Catholic Church as well as Catholic school house in the village of Honouliuli located less than 2.25 miles (3.62 km) east of the project area in the mid-1800s.

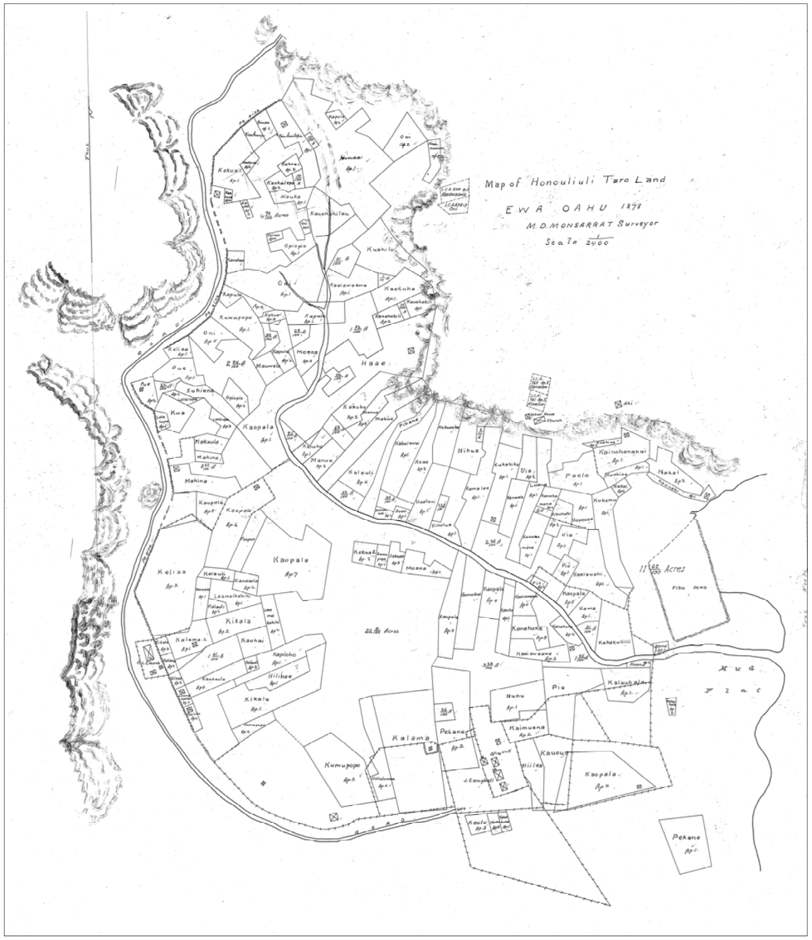

Figure 7. 1878 Monsarrat map of Honouliuli Taro Lands.

Figure 8. Portion of Monsarrat (1878) map showing old Roman Catholic Church.

'Ewa Plain's growth, stemming from the development of sugar cane plantations, and the decline of Honouliuli's Native Hawaiian population due to disease were key factors in the abandonment of Honouliuli's Roman Catholic Church. According to Schoofs (1978), "there was no point in having a chapel in both places…" and further states:

> The Honouliuli Church, located close to Pearl Harbor, had by the 1880's outlived its usefulness and become dilapidated. It was therefore abandoned and replaced by a simple structure erected close, too close, to the mill ['Ewa Plantation]. The location was unfortunate, but the little church had to accommodate the Catholic people of Ewa for 30 years.
>
> In the late 1920's, when the patchwork on the church had become impossible, plans were made for a new church in a better location. Fortunately the Catholic mission still owned the former church property in Honouliuli, and Bishop Alencastre was able to exchange it for a piece of land owned by the Campbell Estate and situated right in Ewa town, on the Renton Road, close to the Ewa public school (Schoofs 1978: 111-112).

Hence, the Roman Catholic Church of Honouliuli was not maintained and subsequently abandoned due to the exodus of Honouliuli Villagers, who survived European disease, into plantation centers such as 'Ewa Villages. Yet, Schoofs (1978) states that during the late 1800's, a Catholic cemetery existed in Honouliuli. Schoofs reported, "While most of the communities along the west coast of O'ahu disappeared in the course of time, Honouliuli remained on the

map until in its turn it was replaced by the growing plantation villages of ʻEwa. But, in 1891 Honouliuli was still important enough to acquire its own Catholic cemetery" (Schoofs 1978: 110). The location of the cemetery is still unknown.

As the drama of Honouliuli's Roman Catholic Church unfolded, another major event was occurring - the Great Mahele. The Land Commission granted approximately 43,250 acres of unclaimed lands in Honouliuli to chiefess Miriam Keʻahikuni Kekauʻōnohi in 1848. However, nearly 150 acres of Honouliuli Ahupuaʻa were designated as *kuleana* awards for commoners. Tuggle and Tomonori-Tuggle (1997) maintain that 72 awards were made, all of which appear to have been in or adjacent to Honouliuli Gulch (Tuggle & Tomonori-Tuggle 1997). Kekauʻōnohi's death in 1851 transferred her lands to her husband, Levi Haalelea. Most of Honouliuli was then sold to J.H. Coney for cattle ranching after Haalelea's death, who in turn sold 42,000 acres for $95,000 to James Campbell in 1877, an Irish born entrepreneur (Lewis 1970; Kelly 1991).

While the ʻEwa Plain had a sizeable cattle population by the mid-1800s, James Campbell consolidated great portions of Honouliuli for ranching, running over thirty-two thousand head of cattle. Honouliuli Village area became the nucleus of Campbell's prosperous ranch (Figure 7). In the summer of 1879, Campbell commissioned James Ashley to drill Hawaiʻi's first artesian well using a hand-operated rig near Campbell's ranch house in Honouliuli (Kuykendall 1967). The true location of the original well is disputed, but undoubtedly lies close to the intersection of Old Fort Weaver Road and Fort Weaver Road, which lies ca. 2.3 miles (3.7 km) northeast of the project area. In 1889, Campbell leased his lands, from Pearl Harbor to Waimanalo, to Mr. B.F. Dillingham of the Oʻahu Railway and Land Company for the next 50 years, who extended the railway from Pearl Harbor to Waianae (Lewis 1970; Figure 11). Dillingham then started the 11,000 acre ʻEwa Plantation Company in 1890 roughly to the west of West Loch and the Oʻahu Plantation in 1894 to the north of West Loch, initially planting sugarcane at Honouliuli and ʻEwa by irrigating with underground water (S. Campbell 1994; Figure 7). During that period, cattle were still ranched in the margins of the cane fields.

The rise of sugar plantations such as the ʻEwa and Oʻahu Plantations came with the increased demand for sugar in the United States, which was a result of the California gold rush in 1848 and the Civil War of 1861 as well as the 1875 Reciprocity Treaty that allowed Hawaiʻi sugar export rights to the U.S. (Hawaii's Plantation Village n.d.). The plantations were also, in part, the outcome of James Campbell and B. F. Dillingham's "Great Land Colonization Scheme" failure of 1886, where the entrepreneurs originally set out to sell Honouliuli land to homesteaders, but opted instead for large-scale cultivation after drilling the first artesian well (Oʻ Hare et al. 2006). These visionaries successfully transformed vast portions of the coral plains into fertile agricultural land by grubbing and deeply plowing upland areas and directing run-off sediments onto the plains. This feat allowed for both lucrative plantations, and subsequent merger of the two, to operate for nearly a century (S. Campbell 1994).

Part of the plantations' success came from the importation of cheap foreign labor to compensate for the severe Native Hawaiian population deficit due to European disease. At first, the Chinese were brought in to work the fields and mills for the length of their contracts. However, U.S. sugar demand mandated a rise in production, so the plantations began to recruit from Portugal, Japan, Puerto Rico, Okinawa, Korea, and the Philippines. The plantations were

initially all- inclusive, providing housing, food, medical and meager wages to all employees and their families. A 1927/1928 US Geological Survey Map shows segregated villages for different ethnic groups represented at ʻEwa Plantation, which was incorporated into a map of Historic features located in Honouliuli Ahupuaʻa by Tuggle & Tomonori-Tuggle (1997; Figure 10). A full size copy of this map as well as key is provided in Appendix F.

4.4 ʻEWA PLAINS IN THE EARLY 1900'S

By the turn-of-the-century, large-scale agriculture, primarily sugarcane and sisal, dominated the ʻEwa Plain, leaving only small pockets of traditional agriculture and family farms, primarily in Honouliuli Village area. As a result, plantation villages spread throughout the eastern ʻEwa Plain, including nearby Varona Village. Plantation sugar mills became the hub of activity and plantation life, attracting commerce and more settlers. By 1902, was able to produce over ten tons of sugar for every acre, outweighing its Hawaiian competitors by 6 tons an acre and Cuban competitors by 7.5 tons an acre. Another development would forever change the face of west ʻEwa – the leasing of land by the United States for military purposes (Lewis 1970; Kelly 1991; Tuggle & Tomonori-Tuggle 1997; Figures 9, 10, 12-14).

Agriculture was still the main focus of land use in Honouliuli Ahupuaʻa after the turn-of-the-century. Handy (1940) writes of agricultural terraces or vestigial agricultural structures being visible on the 1917 U.S. Geological Survey Map of Oʻahu, stating, "Large terrace areas are shown…bordering West Loch of Pearl Harbor, the indication being that these are still under cultivation. I am told that taro is still grown here. This is evidently what is referred to as "Ewa taro lands." "(Handy 1940 as cited by Sterling & Summers 1978: 31). Of course, sugar cane dominated most of the ʻEwa Plain, yet sisal proved to be a lucrative crop for Honouliuli in the early 1900s. Sisal had gone from being an experimental crop in mid-1890 to being farmed on over 2000 acres, producing up to 445 tons of fiber a year (Kelly 1991; Figure 9 & 10). In addition, there are several testimonies from local Kūpuna and longtime residents of the area that an area once existed just 0.6 miles northeast of Ka Makana Aliʻi where plants for *lāʻau lapaʻau*, Traditional Hawaiian herbal healing, were maintained, harvested, and administered (Mooney and Cleghorn 2008e).

By this time, Honouliuli Village, once considered the 'village of gold,' was no longer a destination, but a stopping point for those travelling on Old Ft. Weaver Road from Farrington Highway to Puʻuloa and plantation villages, and southeast ʻEwa Plain, now considered ʻEwa Beach. A handful of general and feed stores, a barber shop, a gas station, and mechanic shop had been erected sometime in the early 1900s to take advantage of this traffic. These were the western-most stores of the ʻEwa Plain. However, traffic along the old thoroughfare would sharply decline in later years with the coming of a new Ft. Weaver Road. As a result, Honouliuli Village would fall deeper into obscurity.

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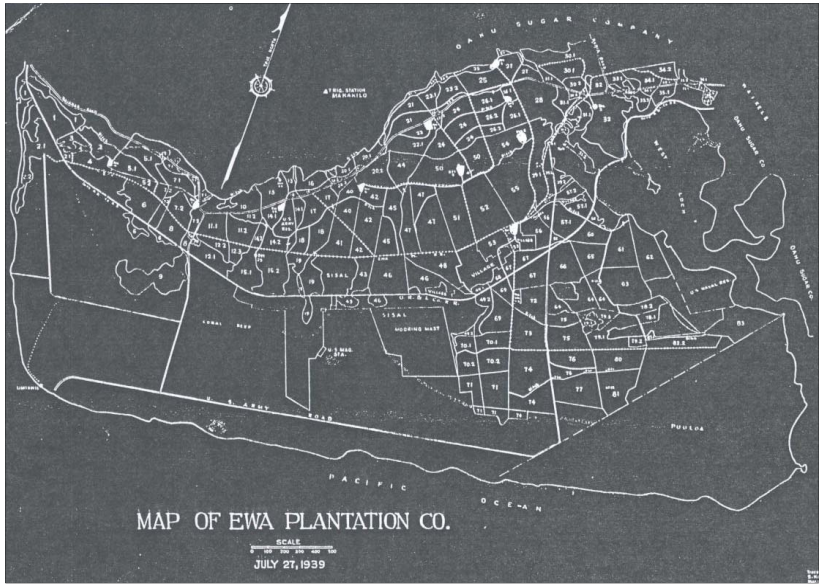

Figure 9. 1939 Ewa Plantation Map.

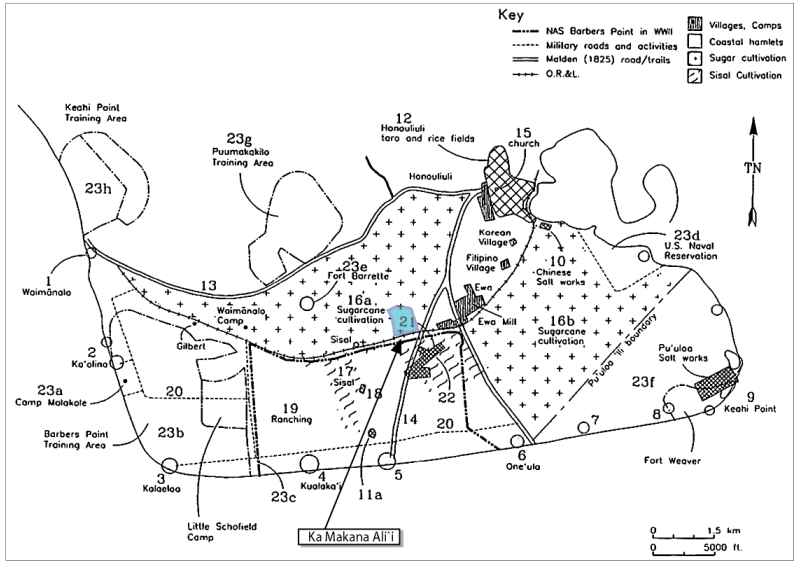

Figure 10. Historic features of Honouliuli (from Tuggle & Tomonori-Tuggle 1997, Figure 5; key provided in Appendix F of this report).

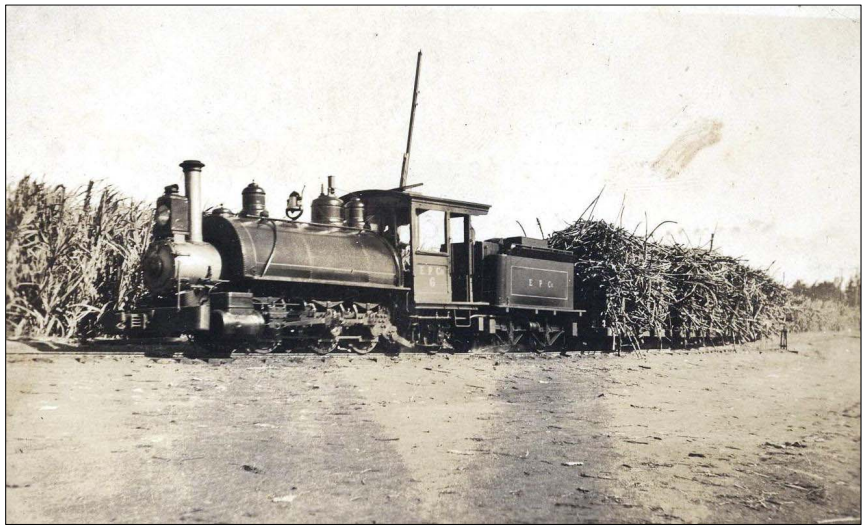

Figure 11. Ewa Plantation Locomotive #6, 1926 (courtesy of the Hawaiian Aviation website Accessed 2011, State of Hawaii Department of Transportation, Airports Division).

The United States would show increased interest in this area after the annexation of the islands to the U.S. in 1899. In 1901, dredging began to deepen and widen Pearl Harbor and repeated in 1908 and in the 1920s. During this time, the U.S. Navy built support and dry dock facilities in the Pearl Harbor area. In the early 1930's, the Navy constructed an ammunition depot on a 213 acre parcel at West Loch that was leased from the Campbell estate (O'Hare et al. 2006: 52). A Magnetic Observatory was built in Honouliuli near the U.S. Coast Guard Air Station Barber's Point in 1902 by the U.S. Coast and Geodetic Survey. This facility was designed to measure movements of the earth and its magnetic field. (Kelly 1991; Tuggle & Tomonori-Tuggle 1997).

In the 1925, the U.S. Navy leased a 3,000 square foot piece of land from the Campbell estate to build a mooring mast for the dirigible *Akron* (Figures 9 & 10; Appendix F). However, records dispute the description of the property, suggesting that the 'Ewa mooring mast was approximately 206 acres of grassy area that was used to land blimps. During this time, the Navy laid approximately 18 miles of roadway and built several camps and installations (O'Hare et al 2006: 52). By 1940, the U.S. Navy leased an additional 3,500 acres from Campbell estates to build the Marine Corps Air Station at 'Ewa, which subsequently became NAS Barber's Point (Kelly 1991: 166; Welch 1987).

In early 1941, the U.S. Marine Corps completed the airstrip, known as 'Ewa Field, for peacetime training and began an expansion of Naval Aviation facilities at Barber's Point. In October of the same year, construction of runways began at Barber's Point, using excavated local coral for paving (Kelly 1991: 166; Welch 1987). 'Ewa Field, now defunct, was constructed near to the old Mooring Mast and located across the train tracks and Roosevelt Road – less than 800 feet (300 meters) south of the project area (Figures 9, 10, 12; Appendix F). However, the Pearl Harbor attack on December 7, 1941, devastated much of the airstrip as well as its aircraft. As World War II commenced, the airstrip was swiftly completed by April 1942 – used as an active airstrip throughout its construction process. Upon completion, the main runway was over 8,000 feet long and 1,000 feet wide and the crossing runway 8,400 feet long and 750 feet wide.

The Marine and Naval Air Stations had some 12,000 enlisted personnel at its peak, but by 1947, the number went down to 1,645 (Kelly 1991: 168). To accommodate the military personnel, housing construction began for the men and their families at Barber's Point in 1951. In 1956, plans for a second military housing complex were initiated.

During World War II, accommodations of a different sort were prepared approximately 3.5 miles (5.6 km) north of the project area. The Honouliuli Internment Camp was built on March 1, 1943, on 160 acres of land in Honouliuli Gulch just north of what is now the H-1 Freeway, west of Kunia Road (Figure 13). The camp, which was comprised mostly of crude wooden barracks and tents within barbed wire fences, was designed to hold up to 3,000 people, although its occupancy never exceeded 320 people. Most internees were non-combatant local males of Japanese ancestry. Yet, German, Italian, and Japanese prisoners of war were also held at the internment camp (Gabbard 2007; Wilson 2008).

Figure 12. Ewa Field Auxiliary Base, July 29, 1941 (courtesy of the Hawaiian Aviation website Accessed 2011, State of Hawaii Department of Transportation, Airports Division).

Figure 13. Honouliuli Internment Camp 1940's (courtesy of Honolulu Advertiser, 17 December 2008).

5.0 PREVIOUS ARCHAEOLOGY

One of the earliest documentations of archaeological sites are the Boundary Commission survey records (1862-1935), which established boundaries and descriptions of features in properties slated for personal ownership according to new legislation under the Mahele ʻĀina of 1848. A list of noteworthy archaeological studies in the ʻEwa Plains of Honouliuli Ahupuaʻa is presented in Table 2. Initially, most research took place in west Honouliuli Ahupuaʻa, but in the early 1980's, the focus was turned to the east side of the *ahupuaʻa* as a result of increased residential and commercial development.

Table 2. Significant archaeological investigations of the ʻEwa Plains, Honouliuli Ahupuaʻa.

Author and Date	Investigation Type	Focus/Findings	Location
Thrum, T. G. 1906, 1917	Survey, *heiau* study	108 *heiau* on Oʻahu; 1 heiau in Puʻu Kapolei	All Oʻahu; Puʻu Kapolei
Stokes, J.F.G. 1909	Inventory Survey	Walled fish traps	Pearl Harbor
Emory, Kenneth 1933	Inventory Survey	House site, possible *heiau*	Puʻu Kapolei
McAllister, J. Gilbert 1933	Inventory Survey	General archaeology; 8+ sites in Honouliuli Ahupuaʻa	All Oʻahu; Honouliuli Ahupuaʻa
Kikuchi, William 1959	Site Letter Report	12-16 Burial removals from limestone sinkhole	Campbell Industrial
Soehren, Lloyd 1962, 1966	Site Letter Report	Burial removal from sinkhole, recording of house site, fishing shrine, & modified sinkhole	NAS Barber's Point; west ʻEwa Plain
Lewis, Ernest 1970	Summary of Historical Data, Reconnaissance Survey	Historical background of Honouliuli; west ʻEwa Plain: house sites and house compounds, cairns, mounds, *ahu*, modified sinkholes (n=17)	Campbell Industrial Park, Barber's Point Deep Draft Harbor, Kalaeloa
McCoy, Patrick 1972	Survey	Stone structures within *ʻili*	Puʻuloa
Barrera, William 1975	Reconnaissance Survey	24 sites related to temporary habitation or fishing, Midden, artifacts, possible horticultural features	Campbell Industrial Park, Barber's Point
Sinoto, Aki 1976, 1978a	Survey, testing	44 new sites (B6-58 through 137); re-recorded Lewis 1970 & Barrera 1975 sites; extinct avifaunal analysis	Campbell Industrial Park, Barber's Point
Sinoto, Aki 1978b	Reconnaissance Survey	10 burials, some historic burials found in sinkhole	NAVMAG - West Loch
Jourdane, E. 1979	Reconnaissance Survey	8 sites	ʻEwa Marina, Oneʻula Beach
Davis, B. D. 1979	Survey	107 features	Oneʻula
Ahlo & Hommon 1983, 1984	Reconnaissance Survey, testing	No sites found	Honouliuli Solid Waste Processing & Recovery Facility

Author and Date	Investigation Type	Focus/Findings	Location
Rosendahl, Paul 1987	Reconnaissance Survey	4 sites (no. 3314-3317) midden, cemetery complex, occupation site, artifact collection area	West Loch Estates – Residential Increments I and II
Dicks et al. 1987	Reconnaissance Survey	7 sites (habitation site 3321 has dates from 6th-9th century w/ later occupations in 1300-1600AD, and 1700-1800's AD); other sites: fishponds, pondfields, and cemetery.	West Loch Estates (Golf Course and Parks)
Welch, David J. 1987	Archaeological Reconnaissance	2 sites (50-80-12-3721 is a complex of 5 traditional structures and 50-80-12-3722 is likely a historic wall used to separate cattle from the sisal plantation	Former ʻEwa Marine Corps Air Station, sites are located ca. 0.5 miles southwest of Ka Makana Aliʻi
Davis, Bert 1988	Subsurface Survey	No sites Found	ʻEwa Gentry
Kennedy, Joseph 1988	Letter Report	No sites Found	ʻEwa Gentry
Bath, Joyce 1989	Site Letter Report	Burial removal	Hōʻaeʻae Point
Hammatt et al. 1990	Archaeological Reconnaissance	No prehistoric sites found; no pre-ʻEwa Plantation historic sites found; Recordation of existing & demolished features in the ʻEwa Villages Complex	ʻEwa Villages Complex, from Fernandez Village to Varona Village and from Tenney Village to "C" Village area
National Park Service 1990	NRHP Registration (NPS Form 10-900)	ʻEwa Plantation Historic District defined and evaluated for significance; typical house structures described	ʻEwa Plantation Co. Mill complex & villages
Haun, Allen 1991	Survey	42 sites with 385 features (indigenous: habitation, agriculture, burial, religious, storage, collection of water, boundary marking; non-indigenous: cattle ranch & military)	NAS Barber's Point
Hammatt & Shideler 1991	Inventory Survey	No sites found	St. Francis Medical Center West, ʻEwa
Goodman and Cleghorn 1991	Testing	No sites found	Laulani Fairways Housing project at Puʻuloa
Kennedy et al. 1991	Inventory Survey & Testing	25 sites (ranching, military, and mining)	NAVMAG – West Loch
Landrum et al. 1993	Survey	Reviewed 197 previously identified sites; re-recorded 400 reported features	USN facilities on Oʻahu; NAVMAG West Loch
Moy, Tonia 1995	National Register of Historic Places - Registration Form	Historic American Buildings Survey (HABS) Forms for many Tenney Village homes and several Renton Village homes, but no HABS forms for Varona Village homes	ʻEwa Sugar Plantation Villages

Author and Date	Investigation Type	Focus/Findings	Location
Jensen & Head 1995	Reconnaissance Survey	On base: 8 isolated feature sites (historic and military); off base: 254 sites (historic, military, & Native Hawaiian)	West Loch Branch
Tuggle & Tomonori-Tuggle 1997	Synthesis of Archaeological Studies	General history, mythology, and archaeology	Entirety of ʻEwa Plain
Hammatt & Chiogioji 1997	Archaeological Reconnaissance Survey	Plantation era infrastructural remains; area previously disturbed	Road Corridor for Proposed North-South Road, linking Kapolei to ʻEwa Beach, adjacent to Ka Makana Aliʻi (to east))
Wolforth & Wulzen 1998	Data Recovery (controlled excavation, backhoe trenching, & monitoring	Agricultural pondfields: chronology & use	West Loch Estates – Residential Increment I and Golf Course and Shoreline Park
McIntosh & Cleghorn 2003	Archaeological Survey	No sites found	ʻEwa Gentry Makai
Collins & Jourdane 2005	Site letter report	Burial removal	Old Ft. Weaver Rd., Honouliuli
O'Hare et al. 2006	Inventory survey	5 sites: taro lands, Kapalani Church, Pipeline Village, Drivers/Stable Village	Hoʻopili Project, 546 acres between Honouliuli Town and Kapolei
O'Hare et al. 2007	Archaeological Assessment	No sites found	ʻEwa Industrial Park, 48.18 acres
Mooney & Cleghorn 2007a, 2007b	Archaeological Assessment & CIA	No sites found	Campbell Industrial; near Barbers Point Deep Draft Harbor; ca.3.5 miles W of Ka Makana Aliʻi
Mooney & Cleghorn 2008c, 2008d	Archaeological Assessment, Backhoe Testing, & CIA	No sites found; area previously disturbed; project area in Honouliuli Village/Taro lands vicinity	23 acres N-NW of Old Ft. Weaver & Ft. Weaver Road, ca. 2.2 miles N-NE of Ka Makana Aliʻi
Mooney & Cleghorn 2008a, 2008b	Archaeological Assessment & CIA	No sites found; area developed for the Makakilo Golf Course, now defunct	34 acre Makakilo Quarry Expansion & associated 360 acres, ca. 2 miles NW of Ka Makana Aliʻi
Mooney & Cleghorn 2008f/Pacific Legacy, Inc.	Archaeological Monitoring Report	Three potential sinkholes, historic military structural remains, historic rubbish	Ke Kama Pono Facility At York Town Road, Kalaeloa (Former NAS Barber's Point), ca. 1.5 miles southwest of Ka Makana Aliʻi
Fung Associates, Inc. 2009	Inventory and Condition Assessment of Historic Structures	Inventoried Homes in Tenney and Renton Village; no Varona Village homes were inventoried	ʻEwa Plantation Villages
Mooney & Cleghorn 2011b (report submitted to SHPD)	Archaeological Inventory Survey	Five Historic Sites: 4 associated with plantation homes, one Historic streetlamp	Varona Village

5.1 Early Archaeological Investigations of Honouliuli Ahupuaʻa

During his extensive survey of Oʻahu in the early 1930's, McAllister (1933) recorded 14 sites in Honouliuli and Puʻuloa Ahupuaʻa including the remnants of Puʻu Kapolei's *heiau*. While Sites 133-137 are in the upland region of the *ahupuaʻa*, sites 138 and 146 are located in the ʻEwa Plains and sites 139-145 are positioned on the shore of West Loch – all under 5 miles from Ka Makana Aliʻi. Table 3 lists descriptions of sites 133-146 and Figure 14 maps their locations.

Table 3. McAllister's (1933:107-108) sites located within Honouliuli & Puʻuloa Ahupuaʻa.

Site No.	Description	Location
133	Small enclosure 25'X30', faced walls 2'-5' tall filled w/smaller stones, purported *heiau*	Foot of Puʻu Kanehoa
134	Puʻu Kuina Heiau, destroyed, only a terrace remains	Foot of Mauna Kapu
135	Number of enclosures w/low faced walls, largest enclosure is 85'X100', all on level terrain, possible kuleana sites	Kukuilua's land
136	Small platform, destroyed, 4'-6'sq. made of coral & basalt	Near Mauna Kapu
137	Puʻu Kuua Heiau, destroyed	Waianae Mtns. 1,800' AMSL
138	Puʻu Kapolei Heiau, destroyed	Kapolei, ca. 100' from sea
139	Kalanamaihiki Fishing Shrine (*koʻa*), 2 lrg. rough stones 2.5' in size, 6 or 7 stones avg. 1' in size piled next to lrg. stones	Kapapahui, (point of land where Honouliuli Gulch meets West Loch)
140	Fishpond adjoining Laulau-nui Island to Kapapahui, 4-5 acres, 900' L X 7' W X 3.5' H outer wall, no outlet gates	Between Laulau-nui Island and Kapapahui
141	Kaihuopalaai, entire West Loch, starting point of the mullet run to Lāʻie	Pearl Harbor, west
142	Kapamuku or Pamoku fishpond, 3 acres, 660'L X 6' W X 3.5'H, no outlet gates, loosely piled stones	Puʻuloa/Waipiʻo Peninsula
143	Okiokilepe fishpond, 6 acres, 1000'L X 6.5'W X 4'H outer wall (made of coral), no outlet gates	Puʻuloa, across from Waipiʻo Peninsula
144	Fish traps & fishing shrine, destroyed	Pearl Harbor Inlet
145	Puʻuloa, place of first breadfruit planting	Southeast end of the ʻEwa Plains
146	Ewa Coral Plains, area of many sites (e.g. Puʻuloa Salt Works, extent of old stone walls, and modified pits)	Entire ʻEwa Plains

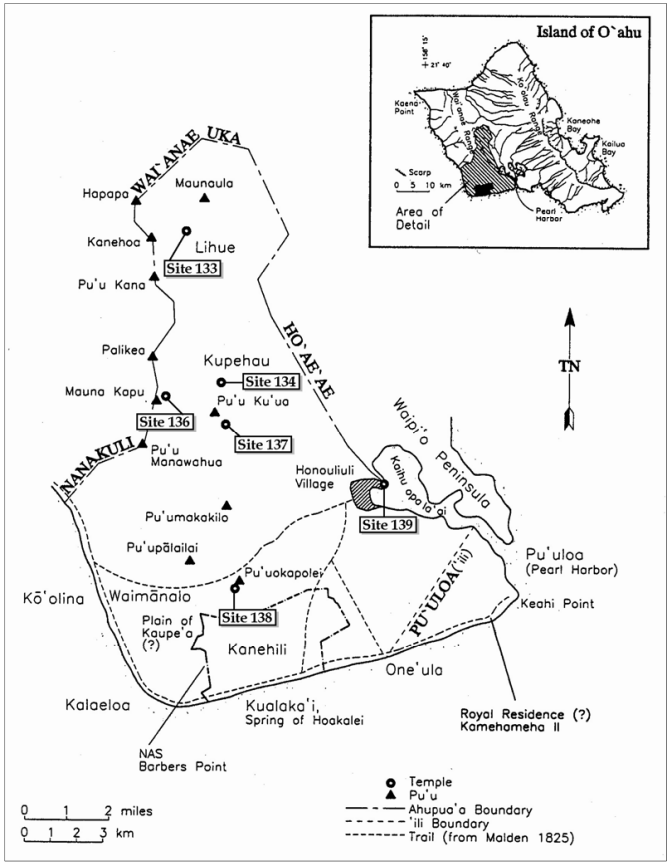

Figure 14. Points of Interest in Honouliuli Ahupuaʻa, see Table 3 for site descriptions (map adapted from Tuggle & Tomonori-Tuggle 1997: Figure 4).

5.2 Recent Archaeological Investigations by Honouliuli Ahupuaʻa Locality

ʻEWA VILLAGES, ʻEWA GENTRY & ʻEWA GENTRY MAKAI

Davis (1988) conducted archaeological testing for Bishop Museum in Ewa Gentry, located ca. 0.95 miles east of Ka Makana Aliʻi, in an area previously utilized for sugar cane cultivation. No archaeological sites were identified during testing. Previously, Kennedy (1988) conducted a surface survey in the same area that failed to detect archaeological sites.

A series of evaluations have been conducted in the ʻEwa Plantation Mill Complex and Village area from the mid-1980's to the present day (Pagliaro 1987; National Park Service 1990; Hammatt et al. 1990; Moy 1995; Fung Associates, Inc. 2009) to determine the Historic significance, restoration potential, and monitor the condition of the Historic District. Pagliaro (1987) states that ʻEwa Plantation manager, George F. Renton, Jr., decided to invest five million dollars in 1920 on infrastructure and housing upgrades, nearby Varona Village being one of the last housing improvements to the plantation under this fund. According to the NHRP Registration form (National Park Service 1990), Varona Village was initially built in 1939 under the name of "B" Village. Another moniker given to Varona Village was "Filipino Camp" (Moy 1995). Locals also called the village "Brooklyn," because this village was separated from the other villages by a bridge crossing Kaloʻi Gulch, which they nick-named the "Brooklyn Bridge" (National Park Service 1990). The homes were described as mostly "Varona Village Types A and B," which were "small, simple rectangular homes 20 feet wide by 38 feet deep, with corrugated metal roof, small eaves, board-n-batten single wall construction, pine floors and canec ceilings" (Moy 1995: 9). However, there were a few houses brought in from Puʻuloa in 1943, which are similar to those of Renton Village (Moy 1995). Additionally, Varona Village sported a large, board-and-batten community hall that was constructed in 1934 for the Filipino Community Association, which is now demolished (Moy 1995). Cultural Surveys Hawaii completed an archaeological reconnaissance of 616 acres of ʻEwa Villages, which included: various sites associated with ʻEwa Plantation infrastructure (e.g. depot, reservoir, etc.), Plantation Cemetery, Buddhist Temple, Japanese School, Renton, Tenney, and Varona Villages as well as former "C", Mill, and Middle Villages (Hammatt et al. 1990). In this study, a sum of 9 sites were recorded, including a historic cemetery, reservoir, a communal bathhouse, OR&L tracks, village store with saimin stand, and a roundhouse. However, no prehistoric sites were detected.

In 1997, Hammatt and Chiogioji performed an archaeological survey of approximately 2.8 mile (4.5 km) long corridor for the proposed North-South Road in Honouliuli Ahupuaʻa. A segment of this corridor borders the subject property's northern edge. In this study, Hammatt and Chiogioji found that, "virtually the entire corridor has been extensively graded repeatedly over the past century by the ʻEwa Plantation Company…in association with sugar cultivation and the construction of plantation infrastructure" (Hammatt & Chiogioji 1997: i). The ʻEwa Plantation Villages Historic District and Oʻahu Railway and Land Co. Right-of-Way, which had previously been placed on the National Register of Historic Places, were encountered in this survey. Yet, no prehistoric sites were detected.

McIntosh and Cleghorn (2003) conducted an archaeological survey for the ʻEwa Gentry Makai residential housing, commercial and industrial mixed uses, community facilities and open spaces development at a 283-acre parcel in ʻEwa (TMK 9-1-10:7 and 9-1-69:5). The project area was, at the time, agricultural land formerly used for sugar cane production and limited grazing activities. No sites were found.

PUʻU KAPOLEI

The first investigation was in the early 1900's, where T. G. Thrum documented a *heiau* at Puʻu Kapolei (Thrum 1906:46), which is located in south-central Honouliuli. Thrum revisited the site in his second monograph on *heiau*, misnaming it Paloleʻi (Thrum 1917). Later, Emory (1933) took pictures and mapped a well-preserved house site and possible *heiau* near Puʻu Kapolei before the remnants were dismantled. McAllister arrived at Puʻu Kapolei shortly after and noted that the site, which he numbered 138, was ruined as its stones were removed and crushed to provide material for new construction (McAllister 1933: 108). He registered that on the side of Puʻu Kapolei was a large rock shelter, rumored to be the dwelling of legendary Kamapuaʻa and his grandmother, as well as a *heiau* that was later destroyed.

HONOULIULI VILLAGE AREA

The earliest recording of a site in this area was done by McAllister (1933), which was a *koʻa* named Kalanamaihiki (site 139). This fishing shrine is still perched on a hill within West Loch's Shoreline Park on a spit of land called Hōʼaeʼae Point across from Laulau-nui Island. This site is located 2.65 miles east of the project area (Figure 14; Table 2).

In 1987, Paul Rosendahl, Ph.D., Inc. (PHRI) performed an archaeological survey of the 232 acre West Loch Estates Residential Increment I, Golf Course, and Shoreline Park development. This project, which divides the area into upper valley, lower valley, coastal margin, and Hōʼaeʼae Point, covered a small section of the current project area's east side and spanned east to the shores of West Loch. The survey revealed four new sites (No. 3314-3317) despite the fact that most of the project area was modified by historic period agriculture. Sites 3315 through 3317 were of historic age, with 3316 being a small cemetery complex located less than 200 meters from the southern tip of the project area and the other two sites being surface artifact scatters. Site 3314 was a disputed midden layer (Wolforth & Wulzen 1998: I-28). Later in the year, PHRI (Jensen et al. 1988) conducted a field survey and subsurface testing in the same area, which yielded seven additional sites (No. 3318-3324). These sites consisted of pre- and post-Contact era habitation and burial sites. This study also suggested that traditional agricultural use of Honouliuli Gulch may have been ongoing for nearly one thousand years. Wolforth and Wulzen (1998) performed data recovery, which peered deeper into the intensity of habitation and agriculture as well as the chronology of these activities in the Honouliuli Stream Floodplain. Further, Wolforth and Wulzen (1998) surmised that the lower valley eventually filled with sediment from upland erosion, which caused the lowland marsh and pond-field system to dry out. As a result, the region became a collage of wet and dry fields with some houses, pastures, and gardens.

Perhaps the most thorough of recent archival investigations performed in the area was O'Hare et al. (2006), which was conducted on several parcels encompassing nearly 1,630 acres, one of which is located less than 1.7 miles east-northeast of Ka Makana Aliʻi. Backhoe testing was

performed in areas that were identified by Hammatt and Shideler (1991) as historic habitation and/or agriculture. The findings were four additional features related to sugar cane cultivation, which were attributed to previously recorded Site 50-80-12-4344 that is located approximately 2.5 kilometers south of the current project area. While O'Hare et al. (2006) were not successful in finding physical remains of Honouliuli Taro Lands, "Kapalani" Catholic Church, Drivers and Stable Village, nor Pipeline Village, their report functions as a well-researched and comprehensive synthesis of these areas within Honouliuli.

More recently, Mooney and Cleghorn (2008c & 2008d) performed a CIA as well as archaeological survey and backhoe test excavations in two parcels at the corner of Old Fort Weaver and new Fort Weaver Roads. The archaeological testing yielded no new archaeological sites. However, results indicated a 3 to 5 feet (0.9 to 1.5 m) deep layer of construction fill with a significant amount of illegal dumping that lies over nearly all of the original ground surface.

PUʼU MAKAKILO AREA

Puʻu Makakilo is located approximately 2.1 miles (3.4 km) north of the proposed Ka Makana Aliʻi. In 1988, a letter report was written by Aki Sinoto for the Makakilo Golf Course survey. On the southeastern flank of Puʼu Makakilo, Sinoto sates:

> As anticipated, large portions of the project area have been and still undergo severe erosion. Barren areas of exposed substrate is interspersed with areas dominated by dry grasses and small kiawe. Steep erosional gullies with vertical walled heads, bare areas of sheet wash, and pedestaled rocks attest to the severe and continuing erosion (Sinoto 1988:1).

While no significant archaeological sites were located in the survey, Sinoto did discover a deteriorated wall segment inside of Puʼu Makakilo that may have served as erosion control in historic times. However, due to its deteriorated state the site did not warrant further archaeological investigation nor preservation (1988:1).

In more recent times, four archaeological investigations have been performed within a mile radius of Puʻu Makakilo with modest finds (Hammatt et al. 1991, Nakamura et al. 1993, and Rasmussen 2006). However, several other investigations have been conducted in nearby Waimanalo, Kaloʻi, and Makaiwa Gulches, recording abundant archaeological sites (Bath 1989, Bordner 1977, Hammatt et al. 1991).

Mooney and Cleghorn completed archaeological and cultural impact assessments for the 34 acre expansion of the Makakilo Quarry and associated 360 acre visual impact modifications (Mooney and Cleghorn 2008a & 2008b). Review of previous archaeological investigations indicated that most the project area was part of a larger area surveyed previously. Further, most of the project area was found to be heavily bulldozed and reshaped for the now defunct Makakilo Golf Course during the January 2008 surface survey. No new sites were found.

ONEʻULA

Elaine Jourdane (1979) performed a reconnaissance survey at Oneʻula, located about 2.15 miles (3.5 km) south of the project area, where she recorded eight pre-contact sites outside of the cane

fields (as cited in Wolforth & Wulzen 1998). Davis (1979) returned to the area later that year and found 107 pre-contact features. Shortly after, the area was revisited by Hommon and Ahlo (1983) who performed subsurface testing without any findings. Hammatt (1984) returned to the same area to evaluate the previous surface findings and relocated 33 of the features found by Davis (1979), which he attributed to 8 new sites. Hammatt (1984) suggested further investigations be performed on the features that would be impacted.

KALAELOA/BARBER'S POINT & CAMPBELL INDUSTRIAL

Little archaeological investigation was performed in Honouliuli Ahupuaʻa during the 1940's-50's, however, investigations picked up just prior to 1960. In 1959, William Kikuchi was the first to investigate the area when he was called to remove 12-16 inadvertently discovered burials at the Standard Oil Refinery at Barber's Point (Kikuchi 1959). Soon after, Lloyd Soehren (1962) recorded and removed a burial before excavating and recording a fishing shrine in NAS Barbers Point (Soehren 1966). This shrine was reported to be destroyed by Barrera (1975:1) and re-examined by Davis in 1982, where he performed supplementary excavations (Davis 1995).

By 1970, archaeological methods had evolved to standards with a more scientific and thorough approach. Lewis' 1970 investigation of Barber's Point and Campbell Industrial area was the first to address the ʻEwa Plain in this manner. In this study, Lewis (1970) recorded an array of house structures and habitation complexes, cairns and mounds (*ahu),* as well as modified sinkholes. Equally important, Lewis (1970) compiled a wealth of Historic documents and traditional chronicles on the ʻEwa Plains as a background for his report. With more innovative methods, Lewis (1970) was able to make some viable postulations about lifeways and the decline of early ʻEwa Plain populations.

In 1975, Barrera revisited the Campbell Industrial Park/Barber's Point area, studied by Lewis in 1970, and located twenty-four sites related to temporary habitation or fishing as well as midden, artifacts, and possible horticultural features (Barrera 1975). Just a year later, Aki Sinoto (1976) performed mapping and test excavations in the same area that would further enlighten archaeologists about the dynamics of early ʻEwa Plain populations and their environment. During his investigations, Sinoto (1976, 1978a) discovered many well-preserved habitation sites, including: C-shapes, enclosures, and modified sinkholes. Additionally, Sinoto (1976, 1978a) found a wealth of *in situ* cultural deposits and extinct avifaunal remains within the sinkholes.

An extensive archaeological and paleontological study was carried out on 89 acres for the Barber's Point Deep Draft Harbor in the early 1980's by the Bishop Museum (Davis 1990). In this investigation, 79 sites were identified, including modified sinkholes and habitation sites.

Haun (1991) performed an archaeological survey of NAS Barber's Point, where he identified 385 features within 42 sites that he claimed were "some of the best preserved and most extensive prehistoric remains known for the ʻEwa Plain" (Haun 1991:1).

Tuggle and Tomonori-Tuggle (1997) authored a synthesis of archaeological and historical investigations performed on the ʻEwa Plain. This comprehensive manuscript examines the prehistory, history, previous archaeology, and the natural resources found on ʻEwa Plain. In 2008, Mooney and Cleghorn (2008f) performed archaeological monitoring for the

construction of the Ke Kama Pono Project located on York Town Road within the former Naval Air Station (NAS) Barber's Point. Three potential sinkholes were encountered; one after the site was cleared of vegetation and two during excavations. While foundation remnants from a late historic military structure (demolished in the late 1980's) were encountered and one historic bottle was found, no significant cultural remains were identified during excavations.

WEST LOCH, PEARL HARBOR

On the eastern edge of Honouliuli Ahupuaʻa, John F. Stokes (1909) composed a detailed study on the fish traps, ponds, and shrines that were located in and around Pearl Harbor. Later, McAllister (1933:28-32) mapped and recorded several fish ponds and traps of Pearl Harbor (sites 140, 142-3), revisiting one (site 144) previously recorded by Stokes in 1909. Additionally, McAllister (1933) gave West Loch itself the site number 141.

Situated under 4.5 miles (7.15 km) to the east is National Register site 9992, which is the Pearl Harbor Naval Base. This site is comprised of all three lochs of Pearl Harbor and associated U.S. Naval facilities as well as several islands and islets within.

PUʻULOA

Puʻuloa, which lies approximately 3-4 miles (4.8 – 6.4 km) southeast of Ka Makana Aliʻi, has been the focus of several investigations. The first report was written by Patrick McCoy (1972), who documented several stone structures when surveying *ʻili* in the proposed Puʻuloa Elementary site. Kennedy et al. (1991) conducted an archaeological inventory survey for the then proposed Puʻuloa Golf Course, now named the New Ewa Beach Golf Club. This survey yielded 72 prehistoric, historic and modern sites. Sinkholes containing cultural material, C-shapes, enclosures and mounds dominated the site types. Later, Kennedy and Denham (1992) performed data recovery at sites scheduled for impact during golf course construction, which concluded that the earliest occupation of the area occurred between A.D. 1020-1480.

5.3 ʻEWA PLAIN SETTLEMENT PATTERNS

In the first and foremost synthesis of archaeological investigations conducted in the ʻEwa Plain, Tuggle and Tomonori-Tuggle (1997) proposed a pre-Contact Hawaiian settlement model. In this model, eight major zones of settlement were suggested for the period representing the height of Hawaiian occupation in the area. According to the ʻEwa Settlement Model map (Tuggle & Tomonari-Tuggle 1997:Figure 22), the project area is located on the southern edge of zone 2 (Figure 13). All settlement zone descriptions are provided in Appendix E. Zone 2 is described by Tuggle & Tomonari-Tuggle (1997:117) as follows:

> 2. Permanent agriculture settlements developed along the upper ʻEwa Plain, associated with the alluvial fans and soil of the upper Plain. Most of the cultivation was dryland, but included some runoff cultivation and some irrigation in a few of the spring-fed gully mouths.
>
> This is based on the environmental conditions of the area and archival data regarding water potential. It is probably not testable, except for the possiblilty of site discovery in small undeveloped gulches.

2a. This area was the first area of agricultural expansion outside the Honouliuli floodplain region, and probably consisted of small settlements at the mouths of gullies.

This proposition is based on the agricultural potential, but may not be testable because of site destruction.

Hence, according to this settlement model, the Ka Makana Ali‘i project area and Keoneula Road corridor could have been an area utilized for permanent habitation and agriculture in pre-Contact times. It is possible that cultural deposits lie encapsulated under plantation era soils.

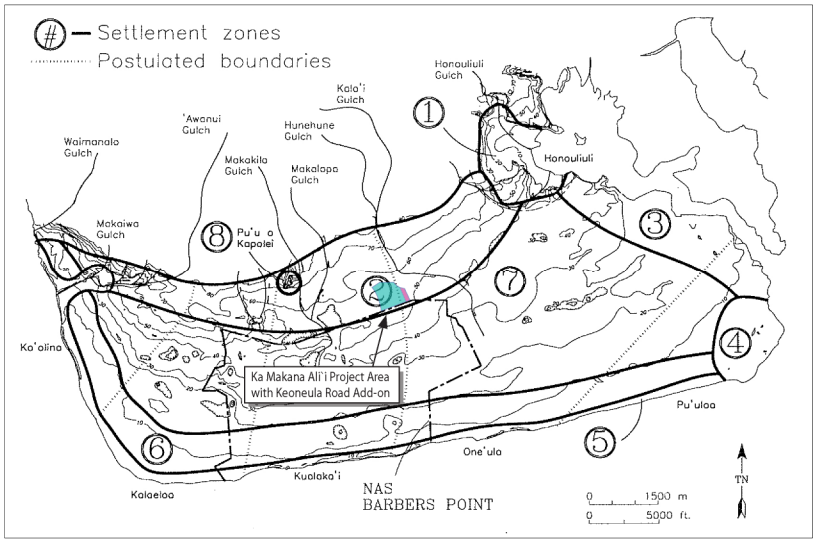

Figure 15. ‘Ewa Settlement Model with Ka Makana Ali‘i project area and Keoneula Road Corridor distinguished (adapted from Tuggle & Tomonari-Tuggle 1997:Figure 22).

Another major feature of ‘Ewa Plain is the Kualaka‘i Trail. While the exact location is unknown and physical evidence of the trail has not been identified, there is a high probability that archaeological deposits relating to the trail may still exist under plantation era soils. Archaeological deposits that may be encountered subsurface could include features of the trail itself, such as curbing and/or features related to temporary camp sites as well as isolated artifacts left behind by travelers.

6.0 COMMUNITY CONSULTATIONS

Between 28 June and 11August 2011, a total of thirty-six potential cultural informants were contacted to participate in the proposed Ka Makana Ali‘i project CIA, out of which eight informants consented to share information. Table 4 provides a list of interviewed and consulted cultural informants, whose testimonies are included in this report. Appendix B provides a list of individuals and organizations requested to participate in this CIA. The cultural informants included a highly revered Hawaiian *kupuna* hailing from ‘Ewa Beach/Pu‘uloa, two local Hawaiian cultural practitioners, and a local Hawaiian cultural historian as well as three Filipino elders/cultural practitioners from nearby Varona Village, the Hawaiian Railway Society President, and the Historian for the Hawaiian Railway Society.

Table 4. List of participating cultural informants

Name	Title	Form of Consultation
Ms. Arline Eaton	Kupuna; Cultural Practitioner; Hawaiian Studies Teacher, Iroquois Point Elementary (Ret.)	Interview, no audio
Mr. Kalani Apana	Cultural Practitioner; Hawaiian Studies Teacher, Iroquois Point Elementary	Interview, no audio
Mr. Shad Kane	Cultural Historian; OEQC Cultural Assessment Provider for ‘Ewa/Honouliuli	Email update
Mr. Kauila Clark	Cultural Practitioner; OEQC Cultural Assessment Provider	Phone interview
Mr. Rosalino Respicio	Varona Village Elder; Cultural Practitioner; former ‘Ewa Plantation worker	Interview; audio recorded
Mrs. Avelina Corpuz	Varona Village Elder; Cultural Practitioner	Interview; audio recorded
Mr. Robert Yatchmenoff	President of Hawaiian Railway Society	Interview; audio recorded
Mr. Jeff Livingston	Historian of Hawaiian Railway Society	Interview; audio recorded

6.1 MRS. ARLINE EATON & MR. KALANI APANA

Kupuna Arline Eaton has participated in several ethnographic interviews conducted by Kimberly Mooney, B.A., of Pacific Legacy, Inc. between the years 2007 and 2008 for various projects within the *ahupua‘a* of Honouliuli. For the current CIA Kupuna Arline Eaton and Makua Kalani Apana were taken to the future site of Ka Makana Ali‘i by Kimberly Mooney of Pacific Legacy, Inc., at 11 a.m. on Wednesday, July 6, 2011, to refamiliarize themselves with the project area. Our tour of the grounds was limited to the northwest portion of the property for ease of access and its easygoing terrain. During our tour, Kupuna Eaton explained the terrain, flora, and fauna as she remembered it, prior to the cultivation of sugarcane. The joint interview was later continued over lunch at “Zippy’s” restaurant in ‘Ewa Beach off of Ft. Weaver Road.

Kupuna Arline Wainaha Puʻulei Brede Eaton knows the ʻEwa Plain of Honouliuli Ahupuaʻa intimately. Ms. Eaton was born in 1927 to one of the oldest families of Puʻuloa, formerly referred to as Iroquois Point. She was raised by her grandparents, Malia and Kaniela Kealoha. Her father, Papa Brede, informed her that during the reign of Kamehameha II or III the Dowsett family purchased the lands of Puʻuloa from the king. Soon afterwards, her family established a home in Kupaka: the area within present day Iroquois Point to Campbell High School and from ʻEwa Beach almost to Oneula Beach. Kupuna Eaton recalls her original Puʻuloa home being a "little grass shack" that predated nearly all others in the area. When she was of school age, Ms. Eaton spent her weekends in Puʻuloa and Barber's Point area. Her weekdays were spent in Kapalama, where she attended Kamehameha School, which she reached by being paddled from Puʻuloa by canoe up through Mamala Bay. Kupuna Eaton states that many areas of southeast Honouliuli were marshy and people traveled to and fro in small boats.

Kupuna Eaton has recently retired from her position as the Hawaiian studies teacher for Iroquois Point Elementary after 25 years of service. Preceding her employment as a Hawaiian Studies teacher, Kupuna Eaton worked for Hawaiian Tel Com for 40 years. Currently, Ms. Eaton serves as President on the board of directors for the Hoakalei Cultural Foundation, which was established in 2006 to promote good stewardship of the *ʻāina* (land) and *hoʻoilina* (heritage) of the ʻEwa Plain for its future generations. Ms. Eaton continues to play a dynamic role in the community and is a member of numerous civic, cultural, professional, and business organizations.

Makua Kalani Apana, nephew to Kupuna Eaton, was born to the Kauhane family of Papakōlea, Honolulu in 1958. Although he has recently taken over for Kupuna Eaton as the Hawaiian Studies teacher at Iroquois Point Elementary, he has been mentored by Kupuna Eaton for much of his life and been a cultural practitioner in the ʻEwa Beach area for nearly five years. He teaches Hawaiian crafts, language, *moʻo lelo*, *mele*, and *hula* to the *keiki* of Iroquois Point Elementary. Mr. Apana also plays a key role in promoting the Hoakalei Cultural Foundation and maintaining the foundation's website.

During our site visit of the Ka Makana Aliʻi project area, Ms. Eaton expressed that before the project area was planted in sugarcane, the terrain was much different as was its usage. Sinkholes in the *karst* were utilized by Hawaiians for growing dry-land *kalo* (taro, *kai* variety), storage, and refuge depending on the size and depth of the sinkhole. To her best recollection, the *wai puka* (sinkholes utilized as planting containers) were likely filled with soil brought in from other areas and irrigated by the ground water within the sinkholes and/or from nearby sinkholes that contained springs or were natural wells. These natural planters were organized into short rows of *kalo,* at times using rows of coral cobbles to divide them. Some of the sinkhole planters were outlined with small coral boulders. Some sinkholes were utilized as storage. She recalls the temperature being cool in storage sinkholes and the sides of these sinkholes would typically be recessed to help shade the items from direct sun. These makeshift storage features would be used for short and long periods of time. Items kept in these sinkholes included, but were not limited to: salt; daily rations of food; water; gardening implements; fishing implements; harvested *kalo;* collected materials used for medicine, tool-making, crafts, or ceremony; collected varieties of shellfish , *limu*, and fish; as well as clothing and personal items. Many of these items were stored in an *ipu* or calabash (typically gourd) or in *kōkō pūʻalu* (netted

bags). Kupuna Eaton recalls taking refuge in the larger sinkholes to escape the heat of the sun, sometimes to eat lunch or rest. Some of the sinkholes were particularly coveted for their windward facing position. To her knowledge, Ms. Eaton does not recall any human burials located in any of these sinkholes.

Kupuna Eaton recalls as a young child a relative abundance of culturally significant plant resources that once grew in the project area. Edible resources available prior to sugarcane cultivation in the area were *ʻulu* (breadfruit), *lilikoʻi* (passion fruit), *niu* (coconut), and *maiʻa* (banana). She holds that both feral food plants and crops maintained by nearby Hawaiian families were located in this area. Kupuna Eaton remembers the feral *lilikoʻi* to be a very tasty variety and that it grew in abundance. In addition, she maintains that there were at least two varieties of *maiʻa* (banana) in the area – one for cooking and one for eating raw. Some medicinal plants that thrived there in the past have returned after sugarcane cultivation had been abandoned. Of these plants, she noted *ʻuha loa* (*Waltheria indica*), which her *Tutu mama* (grandmother) used to treat her chronic childhood asthma by pounding the stem, leaves, and flowers into a pulp and wrapping the pulp in a *ti* leaf, then squeezing the juice into her mouth. This plant was also used to treat congestion, cough, and colds. Another medicinal plant currently thriving in the area is a yellow flowered *ʻilima* (*Sida fallax*), which had many uses and methods of administration. The roots of *ʻilima* were either pounded raw, using juice used to heal bruises, or the roots were boiled to make a tea for headaches. Flowers of the *ʻilima* were also made into a tea as a cure for cramps. While Kupuna Eaton pointed out the ostensible health of the plants and their abundance, she suggested that these plants were potentially too toxic for medicinal use, as they are located close to roadways that get sprayed and other sources for contamination. Another culturally significant plant that has repopulated the area is the *maunaloaʻula ʻula* (*Canavalia cathartica*), specifically a variety with small, dark maroon flowers used to make leis. Makua Kalani added that the flower makes a particularly attractive lei, which is particularly time consuming to make.

Furthermore, Ms. Eaton remembers from early childhood her *Tutu mama* trapping birds in or near to the project area. Her *Tutu mama* trapped the birds for their feathers, carefully plucking only two feathers from each bird before releasing them, using cages made by her *Tutu papa* (grandfather) with sticks of the *kou* tree tied together with cordage made of *olona* (*Touchardia latifolia*) fiber. Bait would be put inside of the cage and a small door would close after the bird was inside. The feathers were used for making a variety of feather leis, including *hulu*, *poepoe*, and *wili wili* styles. Kupuna Eaton stated that it would take many years to complete one feather lei. Feathers were collected from the *aeʻo* or Hawaiian Stilt (*Himantopus mexicanus knudseni*) and three varieties of Hawaiian honey creeper: the *iʻiwi* (*Vestiaria coccinea*) a variety with scarlet body, black wings, black tail, and long curving beak; the *ʻapapane* (*Himatione sanguine*) that has a crimson body, black wings and tail, and short beak; and the *mamo* (*Drepanis pacifica*), which is primarily black with some yellow patches on its tail, wings, and abdomen, and a long curving beak. These birds are now extremely rare to find in this entire region due to the increasing urban sprawl.

Kupuna Eaton also calls to mind the existence of two nearby *ahu* (shrines), one dedicated to agriculture and one dedicated to fishing. The *ahu* dedicated to fishing and other marine activities was much closer to the coast; however, the farming *ahu* was located somewhere near

or inside of the project area. These *ahu* were explained as being constructed similarly, but of different materials. The *ahu kai* was made of stacked coral cobbles and boulders up to five feet tall and wide and was circular in plan view. The *ahu ʻaina* was similar in size and shape, but constructed out of stacked waterworn basalt boulders, likely collected from a nearby stream bed. On these *ahu*, local land users, including Ms. Eaton, would leave offerings to show appreciation for these natural resources and respect for the divine. Both *ahu* were destroyed long ago. The *ahu ʻaina* was destroyed in the initial preparation of the land for sugarcane cultivation and the *ahu kai* was destroyed sometime during the construction of the military base.

On the proposed project, Kupuna Eaton and Makua Kalani agree that there is a need to try new things, such as Ka Makana Aliʻi, so that the community can progress and allow for the progression of future generations. Thus, they are not against development so long as it benefits the community and is done in a responsible manner.

6.2 Mr. Shad Kane

Mr. Kane was interviewed by Kimberly Mooney of Pacific Legacy, Inc., on several occasions between the years 2007 and 2008 for various projects within the *ahupuaʻa* of Honouliuli. Uncle Shad was interviewed for the CIA of a development near the Barber's Point Deep Draft Harbor in January 2007 (Mooney & Cleghorn 2007b). He then participated in an interview on January of 2008 for the Makakilo Quarry expansion CIA (Mooney & Cleghorn 2008b). Additionally, Mr. Kane was interviewed in a joint interview with Robert Alakaʻi on May 2008 for the assessment of a development near Honouliuli Village (Mooney & Cleghorn 2008d). Mr. Kane was also consulted for the Salvation Army Ray & Joan Kroc Corps Community Center CIA, which is less than a mile north of the project area (Mooney & Cleghorn 2008e). For the subject CIA, Uncle Shad was unable to interview. However, he sent an email with supplementary information regarding the project area and made the suggestion that content from previous interviews would be applicable to this project and granted me permission to use statements pertaining to the region's general cultural history.

Born to Hattie and Tazoni Kane in Honolulu on February 23, 1945, Uncle Shad grew up in Wahiawa and later moved to Kalihi where he resided for most of his teenage years. After attending Kamehameha schools, he graduated from the University of Hawaiʻi to join the Honolulu Police Department, and is now a retired Lieutenant. Mr. Kane has served as president of Ahahui Siwila Hawaii O Kapolei Hawaiian Civic Club and Chair of the Makakilo-Kapolei Neighborhood Board as well as a member of the State Environmental Council, the Hawaii Energy Policy Forum, the Kapolei Outdoor Circle, the Friends of Honouliuli, Ka Papa O Kakuhihewa and the Makakilo-Kapolei Lions Club.

Uncle Shad is a longtime resident of Makakilo, which is located approximately 2.75 miles (4.43 km) northwest of the proposed Ka Makana Aliʻi property. He is acclaimed as the resident historian for the *ahupuaʻa* of Honouliuli and has done a great deal of archival research on the subject in addition to being a recipient of oral histories from local *kupuna* on the cultural history of the ʻEwa District. As with other localities of Honouliuli Ahupuaʻa, Mr. Kane has an impressive knowledge of traditional chronicles and myths associated with the project area. He

identifies the general area within Kaloʻi Gulch at the intersection of Farrington Highway and the proposed North-south road as Keoneae, which was the backdrop of several ancient legends.

In the most recent email communication from Uncle Shad, he suggests that the project area may be located on or near to the pre-Contact Kualakaʻi Trail. Regarding this trail, Mr. Kane wrote:

> …The property of your proposed project is if not right on it could be very close to the Kualakaʻi Trail. The ancient trail known historically as the Kualakaʻi Trail originated along the shoreline in area between where we today refer to as White Plains Beach and Nimitz Beach. It passed directly through a 77 acre parcel identified by the Barbers Point Redevelopment Commission as the Kalaeloa Heritage Park. An example of what that trail looked like can be seen today in the Kalaeloa Heritage Park. It continued mauka then made a turn just mauka of the present day fenceline that separated the Barbers Point NAS from the Oahu Sugar lands and connected with a trail from Keoneula (Hau Bush) taking travelers to the flood plains of Honouliuli adjacent Kaiuopalaʻʻai (West Loch). It provided the fishermen of the ancient communities of Kanehili and Kualakaʻi with the Loʻi Kalo of Kaihuopalaʻai. Today your project does not adversely impact the cultural practice of gathering kalo but it does provide a historical context to your project…(Kane email 2011).

While the ancient trail no longer exists, Mr. Kane has implied in previous interviews that it is highly possible that there are subsurface archaeological features, in this case trail related, that need to be avoided.

With insight from his knowledge of Honouliuli terrain, oral history, written history, as well as traditional mythology, he recites stories in a way that one can visualize how these events unfolded in the actual landscape. During the May 2008 interview, Mr. Kane retold the invasion of Honouliuli, Oʻahu by the chief Hilo from the Big Island of Hawaiʻi:

> …One of the names to come out of that invasion was Poʻo-hilo. Hilo was one of the chiefs that came in that invasion. From my understanding, there were two to three thousand canoes that came by the way of…West Loch. And they would have landed where Laulau-nui is; that little harbor…where the fish pond sort of was. They could not go any further *mauka*, because there's a big step…I don't know if you've ever been there, but there's a sheer kind of cliff right there that actually separates West Loch from Waipahu Industrial Park. A lot of people don't realize that there's a big wall right there that they cannot scale – that wall. So they just landed there prior to that, which would be the area where Laulau-nui is today. What they wanted was the resources of the island of Oʻahu. Of course, most of the resources [were] right there. The *loʻi kalo*, the fishponds, and that whole region by Puʻuloa. They went on by way of the trail by Kukaniloko which would be today…probably parallel to where Kunia Road is today. Apparently, according to tradition, they found Maʻili-kukahi's army on the first skirmish up at Waikakalau *puka*. You're probably familiar with that. That was their first battle. And so it was a battle of run, chase each other, fight, run, chase – it was that kind of stuff. It was a series of battles and I think it ended…I think…somewhere in Waimano. I think that was the last name that was mentioned, at least in the stories that I'm familiar with. So I think the last skirmish took place in the area of Waimano – Pearl City. And it was at that point, one of the chiefs…Hilo, was killed. They decapitated him. They took his head and they placed

> it, according to the story, on a stand in an area right about where we're talking about – West Loch Golf Course. And they named that area Po'o-hilo – "the head of Hilo". The whole reason for that is historically, I think, other island chiefs assaulted the island of Oʻahu by way of Ka-ihu-o-Palaʻai. So, in an effort to discourage any more invasions by way of Ka-ihu-o-Palaʻai they did this. Poʻo-hilo. And that name appears in one of the other maps that I had – and its *kuleana* land. Right in there is the name Po'o-hilo. What they actually did, was they placed it…they way it was explained was they…the motivation of placing the head of Hilo, they actually placed it at the intersection of two trails. So, one trail was…our best guess was actually Farrington Hwy. – probably would have been that foot trail. The other trail would have been to go up to Kukaniloko – our best guess today, probably would have paralleled Kunia Road. So, the area would have been the intersection of Farrington Hwy. and Kunia Rd. that the approximate location would have been for Po'o-hilo. So, even in the map that I took a look at where they had Po'o-hilo. It may not have been totally accurate. It may not be consistent with the story. It would have been closer to where the intersection would have taken place – not that the intersection today is in the exact location. It may have been different. They ended up making a straight line out of them and now it's more *mauka*. But, the name Po'o-hilo is associated with the intersection of the two trails (Mooney & Cleghorn 2008d).

Mr. Kane's interpretation puts this legend into a context that is more tangible and easier to visualize the settings in which these events occurred. He also stressed that the nearby Honouliuli Village area, according to legend and archaeological record was the bread basket of Oʻahu; a place chiefs would vie to control. According to Malden's 1825 map of Oʻahu (Figure 6), the proposed Ka Makana Aliʻi is located approximately two miles southwest of Poʻo-hilo. Regarding Honouliuli's population decline, Mr. Kane adds that just prior to the introduction of European diseases, two major invasions of Oʻahu occurred: Kahekili's invasion and Hilo's invasion, both of which noted as being great massacres.

6.3 Mr. Kauila Clark

On 26 November 2008, Kauila Clark was interviewed by Kimberly M. Mooney of Pacific Legacy for the Salvation Army Ray & Joan Kroc Corps Community Center CIA. For the subject CIA, an over-the-phone interview was conducted on 26 July 2011 to supplement the 2008 interview.

Respected as a certified cultural practitioner or *kahuna* in *lāʻau lapaʻau* (herbal healing), *lāʻau kahea* (spiritual healing), *pule* (prayer and chanting), and *hoʻoponopono* (making things correct) in Hawaiʻi and abroad, Kauila Clark has gained a worldwide reputation as one of Hawaiʻi's foremost living ambassadors of aloha. Although he has a Master's Degree in Fine Arts and has achieved the title of "Shihan" (Living Example) from the Academy of Zen and the Arts in Kalihi Valley – among many other honors and certifications, Kauila is accredited by the Hawaiʻi State Legislature as the first traditional Native Hawaiian healer in 200 years to be certified by an Elders Council. Kauila primarily focuses his wisdom and energy on the youth and underprivileged of his native soil, the island of Oʻahu. Yet, Kauila travels the world to spread the message of aloha and brings back to Hawaiʻi teachings and views from these distant places. Mr. Clark has also been an outspoken advocate for affordable healthcare in West Oʻahu for over 20 years. Further, Kauila has worked with Congressman Daniel Akaka on Native Hawaiian Issues and has decades of professorial and lecturing experience in this subject as well as the arts,

spiritual healing, and community health. He currently holds the position of 2nd Vice President on the Waianae Coast Comprehensive Health Center Board of Directors.

Although his ancestors, descendants of the Pili and Paao dynasty, hail from Waiau in ʻEwa District, Mr. Clark was born to Mr. and Mrs. Dewey Clark in Waialua on August 24, 1945 and raised in Wahiawa, Oʻahu. After graduating from Leilehua High School in 1963, he attended university in Iowa, obtaining a B.A. in the Arts and later acquiring a Master's Degree in Fine Art at the University of Puget Sound in Tacoma, Washington in 1972. Mr. Clark returned to Hawaiʻi, as he promised his elders, to help younger generations and share his natural gift of spiritual healing using in a mix of traditional Hawaiian and holistic methods from around the world, which he has successfully fulfilled for nearly 30 years.

As a long-time resident of Kapolei, Mr. Clark has grown familiar with its flora, especially those used in traditional Hawaiian healing practices. While Kauila mentioned during the November 2008 interview that he collects medicinal plants from the general area between Kapolei and ʻEwa Beach away from insecticidal and herbicidal spray zones, he was able to positively identify the Ka Makana Aliʻi property as one of the locations that he gathers from. To his knowledge, he and his two *lāʻau lapaʻau* students are the only practitioners of *lāʻau lapaʻau* who are currently collecting plants for healing in the future Ka Makana Aliʻi project area. From the project area specifically, Kauila states that it is a viable source for the roots, flowers, and leaves of *ʻuha loa* (*Waltheria indica*), which make a tea for respiratory problems. This property is held by Mr. Clark to be one of the last strongholds of *ʻuha loa*, as the plant relies on aridity and good drainage to thrive, which are conditions that the ʻEwa Plain is renowned for. Additionally, the area once contained *kaunaʻoa* (*Cuscuta sandwichiana*) or dodder, which is an orange, lacy parasitic plant that grows on trees near to the ocean, is collected for its medicinal properties and made into a tea.

Some non-plant cultural resources can be found in the project area as well. Kauila says that *ʻalae*, which is the red clay used for coloring salt, for medicine, for dye, and spiritual purification, would have been mined in areas near Old Fort Weaver Road. He states that *ʻalae* can be collected from areas that past excavations have exposed veins or layers of the clay.

While not necessarily collected on the property, water is another resource that Mr. Clark is concerned about with the development of the project. As the area increases in population density and commercial land use, the existing aquifer becomes compromised by decreasing levels of fresh water being replaced by salt water in the water table. This influx of salt water makes the ground water brackish and will eventually affect the soil and flora among other things.

Another concern of Mr. Clark are human burials and cultural resources such as archaeological deposits that may exist underground in the broad Kapolei/ʻEwa Beach area. Mr. Clark advises that developers be wary of sinkholes in the natural karst that may contain these types of deposits.

Additionally, the ʻEwa Plain has many regions within it that have spiritual and mythological associations, attests Kauila. To the ancient Hawaiians, the land between Puʻuloa and Nanakuli

was the land of the "Wandering Spirits." Few travelers would linger in this area for fear of unsettled spirits such as these in olden days. He mentioned that Pu'u Kapolei, located about a mile west-northwest of Ka Makana Ali'i, was also important as a spiritual landmark. He stated that if you project an azimuth from Pu'u Kapolei to Mount Ka'ala, that line is the path of the "Night Marchers," said to be spirits of ancient warriors who march through the night as if to battle – to this day. He listed Kapolei High, Middle, and Elementary schools as well as Makakilo and Mauka Lani elementary schools to have requested his assistance with "clearing" lingering spirits, yet, he designated Holomua Elementary in 'Ewa Gentry as being one of the most haunted areas of 'Ewa Plain. Public buildings are not alone in these hauntings, Mr. Clark has been called to "clear" unwanted spirits from private residences and businesses in this area as well. Hence, many new developments in this broad vicinity could have the potential to interfere or be interfered with by the unsettled spirits.

Ultimately, Mr. Clark expressed that this proposed building site for Ka Makana Ali'i is a location that several traditional cultural resources are gathered currently by cultural practitioners – *'uha loa* and *'alae*. Efforts should be made to foster the *'uha loa* near to its current location. If the project is granted permission to proceed, he suggests that the landscaping be comprised primarily of native plant species that are drought tolerant. Efforts such as this, he asserts, are crucial to conserve scarce native plant species as well as water for local consumption, agriculture, and aquaculture as well as reducing the need for water to be brought in from other areas.

6.4 Mr. Rosalino Respicio & Mrs. Avelina Corpuz

Aunty Avelina and Uncle Rosalino were interviewed by Kimberly Mooney of Pacific Legacy, Inc., on Friday afternoon, 29 July 2011, at the Corpuz Residence.

Avelina Dumlao Corpuz has lived in Varona Village for 44 years and actively tends a vegetable garden located approximately 1200 feet east of the project area. Ms. Corpuz was born in Ilocos Norte, Philippines, to the Dumlao family in 1934 and married the late Segundino Corpuz Sr. in 1952, who was born and raised on the 'Ewa Plantation and raised in Varona Village. In 1967, Aunty Avelina moved to Varona Village to ensure better opportunities for their children. She worked for 21 years as a landscaper at Barber's Point Naval Air Station and continues to work the land as a retiree, tending a large garden with mostly local and Filipino fruits and vegetables, just under 1,200 feet (ca. 360 meters) east of the project area.

Rosalino Respicio, also of Filipino heritage and Aunty Avelina's brother-in-law, was born in the 'Ewa Plantation Hospital in 1932 and raised in Varona Village. Mr. Respicio worked for many years in numerous positions on the 'Ewa Plantation and later served as a cook for the U.S. military in Hawai'i and overseas. Although he moved to neighboring Fernandez Village in 1987, Uncle Rosalino has kept his bond strong with Varona Village until this day. He is also now retired and attends daily to the same vegetable garden that Aunty Avelina tends, located across the street from the Corpuz Residence.

During our interview, Ms. Corpuz and Mr. Respicio recalled that the project area was largely planted in sugarcane and referred to as Field 46. From his earliest memory, Uncle Rosalino

holds that the project area always had a large borrow pit on its south side, perhaps a bit smaller than what it is today, and that the 'Ewa Plantation used the coral for various construction projects on their land. Mr. Respicio and Ms. Avelina agreed that there was once a plantation era gravel road parallel to the power and telephone lines leading *mauka* from Roosevelt Road to "old" Waimanalo Road, now defunct. This old plantation road, though overgrown with vegetation, can still be driven on to this day. Both Aunty Avelina and Uncle Rosalino recall that along the old plantation road, wild bitter-melon once grew and was gathered regularly by locals.

Adjacent to the project area, Uncle Rosalino recalls that the trains once led onto the NAS Barbers Point near the east gate, where the military would transport materials on and off base. He also recalls fondly from his childhood that train rides into town would only cost a quarter. The train allowed him and his friends to go to drive-in theaters and other attractions that did not exist near 'Ewa Villages.

In regards to the current use of the land, neither Ms. Corpuz nor Mr. Respicio knew of any traditional activities occurring. On the proposed project, Aunty Avelina and Uncle Rosalino agree that there is a need to create jobs for the community and see that Ka Makana Ali'i is one way to do so. Furthermore, both look forward to shopping at the mall and having such amenities within walking distance. However, they fear, as does the rest of Varona Village, that the general development of the area may displace the current residents.

6.5 Mr. Robert Yatchmenoff

Mr. Yatchmenoff was interviewed on 6 August 2011 at the Hawaiian Railway Society Museum by Kimberly Mooney of Pacific Legacy, Inc.

Robert was born in 1952 to Marion and Alexander Yatchmenoff in Berkeley, California. His father relocated the family to take a position at a shipyard in Pearl Harbor in 1963. Robert has remained on O'ahu up to the present and currently resides in Makiki. Mr. Yatchmenoff joined the Hawaiian Railway Society in 1975 and has been the society's President for over 15 years.

From Robert's earliest recollection, the proposed project area was covered with sugarcane and features related to sugarcane cultivation, such as haul and access roads. He recalls that during the last term of Governor Ben Cayetano (late 1990s), the southern portion of the property was extensively excavated for a Major League baseball training facility to attract big league teams. The project did not get past the ground-breaking phase, leaving the vast pit as well as the stockpiled soil untouched by developers for over a decade.

Located immediately south of the project area is a segment of the Historic Oahu Railway and Land Company (OR&L) railroad tracks that once was the main artery for transportation used to carry freight, mainly for the sugar plantations and military, around the entire island. Further, the railway was a major mode of transportation for the general public to commute, purchase goods and services from town, and visit remote areas of the island for recreation. According to Mr. Yatchmenoff, the main railway once led from Honolulu all the way around Ka'ena Point,

the western most point of the island, and then east through Waialua up to Kahuku and then back down through Wahiawa to Waipahu.

Mr. Yatchmenoff states that the proposed mixed-use complex area for Ka Makana Aliʻi project and *mauka* end of the proposed Keoneula Road, which provides an eastern access to the mall, will not significantly affect the Historic railway. However, he asserts that if the *makai* end of Keoneula Road and two other roads planned for linking the south side of the project area to Roosevelt Avenue are constructed according to the current plans, which illustrate these future roadways as cross-cutting the railway, the train rides and regular train maintenance will be severely compromised. Mr. Yatchmenoff states that the future site for the Keoneula Road – Roosevelt Avenue intersection is slated too close to a major railway switching yard and if the train operations are to continue, the traffic will be held up for at least 15 minutes at a time, which would be undesirable for local drivers and the railway society. He further holds that Roosevelt Avenue in its current state will not be able to accommodate the increased level of traffic that will occur when North-South road is linked to Roosevelt Avenue.

6.6 MR. JEFF LIVINGSTON

On 6 August 2011, Mr. Livingston was interviewed by Kimberly M. Mooney of Pacific Legacy, Inc. at the Hawaiian Railway Society Museum.

Hawaiian Railway Society Historian, Jeff Livingston, was born in Norwalk, Ohio, on 14 March 1949. Twenty-one years ago, Mr. Livingston was stationed at U.S. Naval Base Pearl Harbor and made the decision to retire on Oʻahu after 27 years in the Navy. He currently resides in Kaneohe and continues to sort through, organize, review, and report on Historic documents pertaining to Hawaiiʻs trains and railways at the Hawaiian Railway Society and Bishop Museum archives. To this day, Mr. Livingston comes across significant Historic information relating to the railway that had been filed away into obscurity.

Mr. Livingston has a firm understanding of the railroad's history as well as its ties to the sugar plantations and U.S. military operations in the area. The railway played a major role for the entire island and its people, beginning with the segment between Honolulu and Aiea that opened in November 1889. The railway then added the stint leading from Waipahu to ʻEwa Mill in 1890 and the stint leading from ʻEwa Mill to Waianae was added in 1891. The latter route was designed primarily as a corridor to get raw sugar and sugar cultivation materials in and out of Waianae Its secondary purpose was to provide rapid transportation for Oʻahu's residents. Prior to the railway service, it would take a day and a half to get from Waianae to Honolulu. There was also the added opportunity of escaping the hustle and bustle of Town to vacation in Waianae, previously too far for people to travel for recreation. It was not long after the railway would come to these isolated havens, that along would come tourism and hotels. However, of greatest significance from a cultural standpoint, the railway opened up new avenues to people in terms of exposure to the western way of life and modernity as well as being able to further education and increase employment opportunities. Military use of the railway was mixed. There was a railway spur near to the Ka Makana Aliʻi project area that led south into the military base, then ʻEwa Field, to move military goods to and from the base. There was also use of the train system for military operations, one of which was the 41st Coast

Artillery, which was a rail road battalion that used 12" mortars mounted on specialized cars and firing points, or modified spurs with four tracks leading off of the main railway, in numerous locations on the island. This was a short-lived enterprise and the battalions never had the opportunity to fire a single shot during the war. Thus, this remaining stretch of working railway represents a huge swath of Oʻahu's socio-economic history as well as U.S. military history.

As far as the project area is concerned, the railway "did little more than pass by," according to Livingston. To his earliest recollection, the project area was fully planted in sugarcane. He has found the Historic record to indicate that sisal, grown sometime around 1910, was only grown on the *makai* side of the railway. In terms of impacts from the proposed project, Mr. Livingston feels as though the mixed-use complex itself poses little harm, but the future roadways, particularly the North-South connector road, also known as Keoneula Road, will cause tremendous problems if it cross-cuts the train tracks. For that matter, any roadways cross-cutting the railway will be problematic.

7.0 SUMMARY AND DISCUSSION

Guidelines provided by the Office of Environmental Quality Control (OEQC; Appendix A) outline acceptable methods to identify the types of cultural practices and beliefs that are subject to a Cultural Impact Assessment (CIA). To carry out the Ka Makana Aliʻi and *mauka* Keoneula Road CIA, archival research was conducted followed by community consultations to identify cultural practices, cultural resources, and beliefs associated with the area. Cultural practices are typically customs relating to subsistence, commerce, residency, agriculture, recreation, religion, spirituality, and collection of cultural resources, which may be carried out by Hawaiian practitioners or practitioners from other ethnic groups. Further, cultural resources, such as natural features, archaeological sites, and collectable materials associated with these types of customs, as well as traditional cultural properties and historic sites are also subject to this CIA.

Archival research has revealed that, in general, the ʻEwa Plain in which the proposed mixed-use complex and road are to be built on has a long and interesting history. From the archaeological record, traditional stories and myths, and Historic documents attributed to the vast area, it is evident that these lands have been the stage of many significant acts in the long drama of Oʻahu's pre- and post Contact history. However, no archaeological research has been conducted on the project area. Oral traditions and Historical references to the specific area do not exist prior to its use as cane field, when it is shown on a 1939 ʻEwa Plantation Map as Field No. 46 (Figure 9). It is possible, that a major feature of pre-Contact and early Contact Honouliuli, the Kualakaʻi Trail, cut across or passed near to the project area according to the Malden (1825) map featuring the south coast of Oʻahu (Figure 6). This prominent trail once connected Honouliuli Village to the coastal settlements of Oneula and Kualakaʻi, and would have been crucial to life on the ʻEwa Plain and its coast. It is likely that the probability of encountering subsurface archaeological deposits increases with proximity to where ancient trail was located.

Furthermore, the project area borders the historic OR&L Railroad to the north. This historic railway, in operations from 1889 to 1947, was placed in the National Register of Historic Places in 1975. The railway no longer serves as the backbone of Oʻahu's economy, nor instrumental in U.S. military operations on Oʻahu, nor the main mode of transportation for O'ahu's citizens to seek services, work, shop, and play far from home. Nevertheless, today it is a vital and tangible means to experience the period in which Hawaiʻi transitioned from an autonomous island nation to an island brimming with an eclectic group of immigrants and entrepreneurs; to an island under U.S. territorial rule and subsequently a major economic and U.S. military hub for the entire Pacific region. Thus, the OR&L railway is itself a cultural resource for those who identify themselves with or have connections to bygone plantation and military cultures as well as those who seek to experience such an important period in the region's history.

No archaeological features were positively identified within the project area during this assessment or in the Archaeological Inventory Survey and Backhoe Testing prepared in concordance with this CIA. Evidence of cultural activities occurring in the project area prior to sugarcane cultivation (before ca. 1939) are now either obliterated by past agricultural and/or

construction activities or encapsulated under plantation era soils. However, features including human burials, habitation remnants, hearths, storage features, activity areas, and ceremonial features as well as paleontological remains, such as extinct avifauna, may also exist in sinkholes that are concealed by plantation era soils. Archaeological features such as these would also be considered cultural resources.

Ethnographical evidence supports the possibility of cultural practices occurring on the property prior to the large scale cultivation of sugar cane. According to Kupuna Arline Eaton, some portions of the project area were used by Hawaiians for a variety of activities. For example, sinkholes in the larger general area were utilized as natural planters for *kalo* (taro, dry-land variety), temporary shelters, storage features, and sources of water. The lands were also planted in *ʻulu* (breadfruit), *liliko'i* (passion fruit), *niu* (coconut), and two types of *maiʻa* (banana). Additionally, birds were trapped for feathers in or near to the project area, including the *aeʻo* (*Himantopus mexicanus knudseni*), *iʻiwi* (*Vestiaria coccinea*),*ʻapapane* (*Himatione sanguine*), and the *mamo* (*Drepanis pacifica*). Kupuna Eaton also recalls the existence of at least one *ahu* (shrine) in the area, which was dedicated to agriculture. This *ahu ʻaina* was made of stacked waterworn basalt boulders and cobbles, likely collected from a nearby stream bed, that stood up to five feet tall and possibly as wide as it was tall with a circular plan view. On these *ahu*, devotees, including Ms. Eaton, would leave offerings to show appreciation for these natural resources and respect for the divine. The *ahu ʻaina* was destroyed sometime during the initial preparation of the land for sugarcane cultivation.

It has not been demonstrated that any cultural practices have been ongoing from the pre-Contact era or Historic era to the present. As the majority of the project area has been heavily disturbed by agricultural and construction activities prior to this CIA, contemporary cultural practices taking place in the project area were limited to the gathering of *ʻuha loa* (*Waltheria indica*) for traditional Hawaiian medicine and *ʻalae* (red clay) for coloring salt, medicine, dye, and spiritual purification. A total of three cultural practitioners were documented as gatherers of these cultural resources: Mr. Kauila Clark and his two *lāʻau lapaʻau* students. Although these resources exist in localities outside of this project area, the location is desired for its easy access, abundance of the resources, and the lack of pesticide sprays in its interior. The proposed development will undoubtedly impact these activities.

Additionally, three of the four interviewees, Kauila Clark, Kupuna Arline Eaton, and Kalani Apana, state that the general area of central ʻEwa Plains is the land of the "Wandering Spirits" and "Night Marchers." Mr. Clark claims that these restless spirits become a problem for many recent developments in the area and has performed many "clearings" to rid public buildings, businesses, and residences of unwanted spirits.

8.0 RECOMMENDATIONS

In total, two Native Hawaiian cultural resources have been identified as being potentially impacted by the proposed Ka Makana Aliʻi and Keoneula Road *mauka* segment: *ʻuha loa* (*Waltheria indica*) for traditional Hawaiian medicine and *ʻalae* (red clay) for coloring salt, medicine, dye, and spiritual purification. Mr. Kauila Clark and his two *lāʻau lapaʻau* students were the only cultural practitioners to be currently collecting these resources from the area. Obviously, the subject development and cultural resources, such as *ʻuha loa* and *ʻalae*, will not likely be able to occupy the same space at the same time. Fortunately, these resources are not endangered and can be found in other, albeit less convenient, locations.

Another concern is about the growing scarcity of fresh water in the general area. This is a growing concern for the entire *ahupuaʻa* of Honouliuli with the rapidly escalation of new homes and businesses. Mr. Kauila Clark suggests that the new development use native, drought-tolerant plants in its landscaping to ensure that local agriculture and aquaculture projects aimed at increasing our independence from outside commodities will be successful.

Furthermore, there is the concern about unsettled spirits that remain in the area causing unwanted paranormal activities to plague the new development or, conversely, surrounding localities being haunted by the displaced spirits. Some informants fear that archaeological sites and burials, also cultural resources, possibly contained in sinkholes and concealed by plantation era soils may be damaged or lost during ground disturbing activities related to the project's construction. It is a common belief that the disturbance of archaeological sites and burials can also upset spirits or cause bad fortune to befall those who have caused the disturbance. To address this, efforts should be made to bless the groundbreaking at Ka Makana Aliʻi formally as well as the ground opening of the mixed-use complex.

In regards to concerns about potential archaeological sites and burials, an archaeological monitoring plan should be prepared prior to the commencement of construction. Further, if archaeological sites are encountered during the construction of Ka Makana Aliʻi or Keoneula Road, a cultural interpretive display is recommended using artifacts (to the extent possible), archival photos, artistic renderings, and traditional accounts to educate its patrons of ʻEwa Plain's colorful past.

Other informants, specifically those currently living in nearby Varona Village, fear that the new development may be further cause to displace them from their plantation era homes. Those informants associated with the Hawaiian Railway Society have similar fears of proposed roadways conflicting with existing tracks and switching yard - ultimately displacing them from their current location. A formal "town hall" style meeting with these communities would be a good way to dispel misconceptions and begin a healthy discourse regarding the proposed project.

9.0 REFERENCES

Ahlo, Hamilton M Jr. and Robert J. Hommon
1983 An Archaeological Reconnaissance Survey of the Site of the Proposed Solid Waste Processing and Resource Recovery Facility, Honouliuli, Ewa, Oʻahu. Report on File at the Historic Preservation Division Library, Kapolei.

1984 Archaeological Test Excavations at the Site of the Proposed Solid Waste Processing and Resource Recovery Facility, Honouliuli, Ewa, Oʻahu. Report on File at the Historic Preservation Division Library, Kapolei.

Allen, Jane
1990 Geology, Soils, and Sediment at Barbers Point, Oʻahu. In Paul L. Cleghorn and Bertell D. Davis (editors), Archaeological Paleontological Investigation at Kalaeloa (Barber's Point), Honouliuli, ʻEwa, Oʻahu. Public Archaeology Section, Applied Research Group, Bishop Museum, Honolulu.

Armstrong, Warwick (ed.)
1973 *Atlas of Hawai'i*. University of Hawai'i Press, Honolulu.

Barrera, William Jr.
1975 A Report on the Archaeological Reconnaissance Survey of the Proposed Barber's Point Harbor Area. Report on File at the Historic Preservation Division Library, Kapolei.

Bath, Joyce
1989 Burial of Hōʻaeʻae Point in West Loch Project Area, Honouliuli, ʻEwa, Oʻahu. Department of Land and Natural Resources, State Historic Preservation Division, Kapolei, Hawaiʻi.

Beckwith, Martha
1970 *Hawaiian Mythology*. University of Hawaii Press, Honolulu, Hawaii.

Belt Collins
2006 Kalaeloa Master Plan. Prepared for the Hawaiʻi CommunityDevelopment Authority (HCDA)and U.S. Economic Development Administration (EDA).

Bishop, S.E.

1835 "Ewa 1835." *Oʻahu Station Reports – ʻEwa to Waianae, from 1835-1863.* On File at the Hawaiian Historical Society Library.

1841 "Report of the Station of Ewa and Waianae for the year ending April 30th 1841" *Oʻahu Station Reports -ʻEwa to Waianae, from 1835-1863*. On File at the Hawaiian Historical Society Library.

1846 "Report of the Station of Ewa and Waianae for the 2 years Ending May 1, 1846" *O'ahu Station Reports -'Ewa to Waianae, from 1835-1863*. On File at the Hawaiian Historical Society Library.

1901 'Ewa, O'ahu– Old Memories. *The Friend*: May 1901: 87.

Bordner, Richard M.
1977 Archaeological Reconnaissance of the Proposed Makaiwa Gulch Landfill Site, 'Ewa, O'ahu. Archaeological Research Center Hawaii, Inc., Honolulu.

Campbell, Archibald
1819 *Voyage Round the World from 1806-1812*, New York.

Campbell, S. M.
1994 "Ewa Plantation Company History," Hawaiian Sugar Planters Association. University of Hawaii, Manoa Website. Viewed on January 22, 2002. http://www2.hawaii.edu/~speccoll/p_ewa.html

Chamberlain, Levi
Ms. *Journals of Levi Chamberlain, 1822-1849*, in Bishop Museum.

Chervet-Pond, A. and B. D. Davis
1992 West Beach Data Recovery Program, Phase 4, Archaeology and Paleontological Excavations, 2 vols. Report for West Beach Estates. Paul H. Rosendahl, Ph. D., Inc., Hilo.

Cline, M.G.
1955 Soil Survey of the Territory of Hawaii. *Soil Survey Series 1939*, No. 25. United States Department of Agriculture.

Collins, S. and Muffet Jourdane
2005 Recovery of Inadvertent Discovered Skeletal Remains Adjacent to 91-2168 Old Ft. Weaver Road (Site: 50-80-04-06665; SHPD Case #2004-1-0003-001) Honouliuli, 'Ewa, O'ahu TMK: (1) 9-1-017:061; (9-1-019:001 Tanaka Residence). Report on File at the Historic Preservation Division Library, Kapolei.

Cordy, Ross
1996 The Rise and Fall of the O'ahu Kingdom: A Brief Overview of O'ahu's History. In J.M. Davidson, G. Irwin, B.F. Leach, A. Pawley, and D. Brown (editors) Oceanic Culture History: Essays in Honour of Roger Green. New Zealand Journal of Archaeology Special Publication, pp. 591-613.

Cuddihy, L. W. and C.P. Stone
1990 *Alteration of Native Hawaiian Vegetation, Effects of Humans, Their Activities and Introductions*. Honolulu: University of Hawaii Cooperative National Park Resources Studies Unit.

Davis, Bertell D.
1988 Final Report Archaeological Subsurface Survey of the Proposed 'Ewa Gentry Project Area, Honouliuli, 'Ewa, O'ahu. Bernice P. Bishop Museum: Honolulu.

1979 Report on Archaeological Survey of the Proposed Ewa-Marina Community Development, Ewa Beach, O'ahu Island, Hawaii. Report on File at the Historic Preservation Division Library, Kapolei.

1990 Summary and Conclusion of the 1981-1983 Barber's Point Research. In Archaeological and Paleontological Investigations at the Barber's Point Deep Draft Harbor, 'Ewa, O'ahu. B.P. Bishop Museum. (P. Cleghorn and B. Davis, eds.)

1995 Archaeological and Paleontological Investigations at the Barber's Point Deep Draft Harbor, 'Ewa District, Honouliuli Ahupua'a O'ahu Island, Hawai'i, Volume I. Report on File at the Historic Preservation Division Library, Kapolei.

Dicks, Merrill A., Alan E. Haun, and Paul H. Rosendahl
1987 Archaeological Reconnaissance Survey for EIS, West Loch Estates – Golf Course and Parks, Honouliuli, Ewa, O'ahu. Report on File at the Historic Preservation Division Library, Kapolei.

Emerson, N. D.
1978 *Pele and Hiiaka: a Myth from Hawaii*. Originally published 1915. Charles E. Tuttle, Rutland.

Emory, Kenneth
1933 Field Notes from Honouliuli Archaeological Survey. Department of Anthropology, Bishop Museum, Honolulu.

Foote, D. E., E. L. Hill, S. Nakamura, and F. Stephens
1972 *Soil Survey of the Islands of Kauai, O'ahu, Maui, Molokai, and Lanai, State of Hawaii*. U.S. Dept. Agriculture-Soil Conservation Service and University of Hawaii Agriculture. Experiment Station. Government Printing Office, Washington, D.C.

Fornander, Abraham
1880 *An account of the Polynesian Race: Its Origin and Migrations and the Ancient History of the Hawaiian People to the Times of Kamehameha I*. Volume II. Trubner, London.

1919 *Fornander Collection of Hawaiian Antiquities and Folklore…from Original Sources.*

Thomas G. Thrum (ed.), B.P. Bishop Museum Memoirs. Vols. IV, V. Honolulu, Hawai'i.

Fung Associates, Inc.
2009 Inventory & Condition Assessments of Historic Structures in 'Ewa Villages Historic District, Island of O`ahu. Prepared for State of Hawaii Department for Land & Natural Resources State Historic Preservation Division.

Gabbard, Mike
2007 In Memory of WWII Honouliuli Internees. In Senate Majority Caucus Blog Archive online. 9 December 2007. Accessed on 9 July 2008. http://www.hawaiisenatemajority.com/2007/12/09/in-memory-of-wwii-honouliuli-internees/.

Geolabs – Hawaii
1987 Geotechnical Engineering Reconnaissance, West Loch Estates Development, Honouliuli, Oʻahu, Hawaii. C.W. Associates Inc. dba Geolabs – Hawaii, Honolulu. Prepared for R.M. Towill Corporation.

Goodman, W.L. and P. Cleghorn
1991 Historical Documents and Literature Search, and Archaeological Surface Survey of the Proposed Laulani City Housing Project at Puʻuloa, 'Ewa, Oʻahu Island. Prepared for William E. Wanket, Inc. Applied Research Group, Bishop Museum, Honolulu.

Hall, Edwin Oscar
1839 *Notes of a Tour Around Oʻahu*. Hawaiian Spectator, Vol. 2: 94-112. Honolulu.

Hammatt, Hallett H.
1984 Reconnaissance and Evaluation of Archaeological Sites in the Proposed Ewa Marina Community, Ewa, Oʻahu, Hawaii. Report on File at the Historic Preservation Division Library, Kapolei.

Hammatt, Hallett H. and David W. Shideler
1991 Archaeological Inventory Survey for a Proposed Expansion of Saint Francis Medical Center West (TMK 9-7-17: por. 56), Honouliuli, 'Ewa, Oʻahu. Report on File at the Historic Preservation Division Library, Kapolei.

Hammatt, Hallett H. and Rodney Chiogioji
1997 Archaeological Reconnaissance Survey of a 4.5-Kilometer (14,730-ft.) Long Land Corridor Within Honouliuli Ahupuaʻa, 'Ewa District, Oʻahu Island. Cultural Surveys Hawaii, Kailua. Report on File at the Historic Preservation Division Library, Kapolei.

Hammatt, Hallett H. and William H. Folk, II
1981 Archaeological and Paleontological Investigation at Kalaeloa (Barber's Point), Honouliuli, 'Ewa, Oʻahu: Federal Study Areas 1a and 1b and State of Hawaii Optional Area 1. Report on File at the Historic Preservation Division Library, Kapolei.

Hammatt, Hallett H., David W. Shideler, and William Folk
1990 Archaeological Reconnaissance of the 'Ewa Villages Project Site, Honouliuli, 'Ewa, Oʻahu. Cultural Surveys Hawaiʻi, Kailua, Hawaiʻi.

Hammatt, Hallet H., Jennifer Robbins, Mark Stride, and Matthew McDermott
1991 An Archaeological Inventory Survey for the Makaiwa Hills Project Site, Honouliuli, 'Ewa, Oʻahu. Cultural Surveys Hawai'i, Kailua.

Handy, E.S.C.
1940 *The Hawaiian Planter*, Vol. I: B.P. Bishop Museum Bulletin 161.

Haun, Allen E.
1991 An Archaeological Survey of the Naval Air Station Barber's Point, Oʻahu, Hawaiʻi. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Hawaii Aviation
2011 "Ewa Field Auxiliary Base, July 29, 1941" and "Ewa Plantation Locomotive #6, 1926" photographs from the Hawaiian Aviation website. Accessed August 2011. State of Hawaii Department of Transportation, Airports Division. http://hawaii.gov/hawaiiaviation/aviation

Hommon, R.J., and H.M. Ahlo, Jr.
1983 Archaeological Survey and Subsurface Testing in Selected Areas of the Proposed Ewa Marina Community Development. Science Management Inc.

Jensen, Peter M., Alan E. Haun, and Paul Rosendahl.
1988 Phase I – Mitigation Plan for Archaeological Data Recovery Excavations: West Loch Estates Mitigation Program Residential Increment I and Golf Course & Shoreline Park, Land of Honouliuli, Ewa District, Island of Oʻahu. Report on File at the Historic Preservation Division Library, Kapolei.

Jensen, P.M. and J.A. Head
1995 Pre-final Report: Phase I Archaeological Reconnaissance Survey, Naval Magazine Lualualei, NAVMAG – West Loch, Lands of Puʻuloa, Honouliuli, Waikele, and Waipiʻo, 'Ewa District, Island of Oʻahu. PHRI Report 1547-041995. Prepared for Department of the Navy, Commander, Pacific Division, Naval Facilities Engineering Command.

Jourdane, E.
1979 Archaeological Reconnaissance Survey of Proposed Ewa Marina Cove. Campbell Estate Properties, Oneula, Honouliuli, Oʻahu, Hawaii. Report 03-0979. B.P. Bishop Museum.

Juvik, Sonia P. and James O. Juvik (ed.)
1998 *Rainfall Atlas of Hawaiʻi*. Third Edition. University of Hawaiʻi Press, Honolulu.

Kamakau, S.M.
1961 *Ruling Chiefs of Hawaii*. Revised Edition. Originally published 1868-1870. The Kamehameha Schools Press, Honolulu, Hawaii.

1964 *Ka Poʻe Kahiko: the People of Old*. Bishop Museum Special Publication d1. Originally published 1866-1871. Bishop Museum Press, Honolulu, Hawaii.

1991 *Tales and Traditions of the People of Old: Na Moʻolelo Ka Poʻe Kahiko*. Originally published 1865-1869. Bishop Museum Press, Honolulu, Hawaii.

Kelly, Marion
1991 Notes on the History of Honouliuli. Appendix A In An Archaeological Survey of the Naval Airstation, Barber's Point, Oʻahu, Hawaiʻi. By Alan E. Haun. Applied Research Group. Bishop Museum, Honolulu.

Kennedy, Joseph
1988 Archaeological Reconnaissance Report Concerning the Proposed ʻEwa Gentry Project in Honouliuli, Oʻahu. Archaeological Consultants of Hawaiʻi.

Kennedy, J. and T. Denham.
1992 Archaeological Data recovery Report for the Puuloa Golf Course located at ʻEwa, Island of Oʻahu, TMK: 9-1-01:27&6. Revised May 1992. Archaeological Consultants of Hawaii, Inc., Hawaii.

Kennedy, J., J. Berlin and T. Denham.
1991 Archaeological Inventory Survey Report for the Puuloa Golf Course Site, TMK: 9-1-01: 27&6, located at ʻEwa, Island of Oʻahu. Archaeological Consultants of Hawaii, Inc., Hawaii.

Kikuchi, William K.
1959 Standard Oil Refinery Site Letter Report. Bernice P. Bishop Museum, Honolulu.

Kuykendall, Ralph S.
1967 *The Hawaiian Kingdom, Volume III, 1874-1893: The Kalakaua Dynasty*. University of Hawaii Press, Honolulu.

Landrum, J., S. Williams, and A.J. Schilz
1993 Archaeological Reconnaissance and Limited Subsurface Testing at the Proposed Family Housing Construction Area Project No. 34863, Barbers Point Naval Air Station, Honouliuli Ahupuaʻa, ʻEwa District, Oʻahu, Island. Ogden Environmental and Energy Services, Honolulu.

Lewis, Ernest
1970 The Campbell Project: a Preliminary Report. Report on file in the State Historic Preservation Division Library, Kapolei.

MacDonald, G.A. and A.T. Abbott
1970 *Volcanoes in the Sea*. University of Hawaii Press, Honolulu.

Manhoff, M. and M. Uyehara
1976 *Rockhounding in Hawaii: Our Rocks, Minerals, and Semi-precious Stones*. Honolulu: Hawaiian Almanac Publishing Co.

Maly, Kepā
1992 Historical Documentary Research. In Archaeological Reconnaissance Survey, Naval Magazine Lualualei, NAVMAG – West Loch, Lands of Puʻuloa, Honouliuli, Waikele, and Waipio, District of ʻEwa, Island of Oʻahu. By Peter M Jensen and James Head, pg. 7-59. Paul Rosendahl, Ph.D., Inc., Hilo, Hawaiʻi.

1997 Historical Documentary Research. In Archaeological Reconnaissance Survey, Naval Magazine Lualualei, NAVMAG – West Loch, Lands of Puʻuloa, Honouliuli, Waikele, and Waipiʻo, ʻEwa District, Island of Oʻahu. PHRI Report 1547-041995. Prepared for Department of the Navy, Commander, Pacific Division, Naval Facilities Engineering Command.

1999 Phase III – Archaeological Site Preservation Plan Phased Mitigation Program ʻEwa Marina Community Project Land of Honouliuli, ʻEwa District, Island of Oʻahu. Prepared for HASEKO (ʻEwa), Inc., Honolulu, Hawaiʻi. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawaii.

McAllister, J.G.
1933 *Archaeology of Oʻahu*. B.P. Bishop Museum Bulletin 104. Bishop Museum Press: Honolulu.

McCoy, Patrick
1972 Archaeological Survey of the Proposed Puʻuloa Elementary School Site, ʻEwa Beach, Oʻahu. Bernice P. Bishop Museum, Dept. of Anthropology, Honolulu.

McIntosh, James and Paul L. Cleghorn
2003 Archaeological Survey for the Proposed ʻEwa Gentry Makai Development ʻEwa District, Ahupuaʻa of Honouliuli, Island of Oʻahu (TMK 9-1-10:7 and 9-1-69-5). Pacific Legacy, Inc., Kailua, Hawaiʻi.

Miller, Lynn
1993 Archaeological Data Recovery of State Sites 50-80-12-2710 and 50-80-12-2711 at Barber's Point, Honouliuli Ahupuaʻa ʻEwa district, Oʻahu Island. Prepared for R.H.S. Lee, Inc. Report on File at the Historic Preservation Division Library, Kapolei.

Mitchell, Auliʻi and Hallett H. Hammatt
2004 A Cultural Impact Assessment of Approximately 595 Acres at Kapolei, Honouliuli Ahupuaʻa, ʻEwa District of Oʻahu. Prepared for Helber Hastert & Fee Planners, Inc. Report on file at the Historic Preservation Division Library, Kapolei.

Mooney, Kimberly M. and Paul L. Cleghorn
2007a Archaeological Assessment for the Proposed Imperium Renewable Bio-Diesel Plant at Barber's Point, Honouliuli, ʻEwa, Oʻahu [TMK (1) 9-1-14:24]. Pacific Legacy, Inc., Kailua. Report on file at the Historic Preservation Division Library, Kapolei.

2007b Cultural Impact Assessment for the Proposed Imperium Renewable Bio-Diesel Plant at Barber's Point, Honouliuli, ʻEwa, Oʻahu [TMK (1) 9-1-14:24]. Pacific Legacy, Inc., Kailua.

2008a Archaeological Assessment for the Proposed Makakilo Quarry Expansion, Kapolei, Honouliuli Ahupuaʻa, ʻEwa Oʻahu[TMK (1) 9-2-3:18]. Pacific Legacy, Inc., Kailua. Report on file at the Historic Preservation Division Library, Kapolei.

2008b Cultural Impact Assessment for the Proposed Makakilo Quarry Expansion, Kapolei, Honouliuli Ahupuaʻa, ʻEwa Oʻahu[TMK (1) 9-2-3:18]. Pacific Legacy, Inc., Kailua.

2008c Archaeological Assessment for the Proposed Development of two parcels between Fort Weaver Road and Old Fort Weaver Road, Honouliuli Ahupuaʻa, ʻEwa, Oʻahu TMK: (1) 9-1-17: 010 & 041. Pacific Legacy, Inc., Kailua. Report on file at the Historic Preservation Division Library, Kapolei

2008d Cultural Impact Assessment for the Proposed Development of two parcels between Fort Weaver Road and Old Fort Weaver Road, Honouliuli Ahupuaʻa, ʻEwa, Oʻahu TMK: (1) 9-1-17: 010 & 041. Pacific Legacy, Inc., Kailua.

2008e Cultural Impact Assessment for the Proposed Development of Kroc Center in East Kapolei, Honouliuli Ahupuaʻa, ʻEwa District, Island of Oʻahu [TMK: 9-1-17: 71]. Pacific Legacy, Inc., Kailua.

2008f Archaeological Monitoring Report for the Ke Kama Pono Facility at York Town Road,
Kalaeloa, Honouliuli Ahupuaʻa, Oʻahu, Hawaiʻi [Tmk (1) 9-1-13:24]. Pacific Legacy, Inc., Kailua. Report on file at the Historic Preservation Division Library, Kapolei.

2011a Archaeological Assessment of the Proposed Ka Makana Aliʻi Mixed-use Complex, Kapolei, Honouliuli Ahupuaʻa, ʻEwa District, Oahu Island. Report submitted for review to the Historic Preservation Division Kapolei.

2011b Revised Archaeological Inventory Survey of Varona Village, Honouliuli Ahupuaʻa, ʻEwa District, Island Of Oʻahu [Tmk: (1) 9-1-17:069]. Pacific Legacy, Inc.,Kailua. Report submitted for review to the Historic Preservation Division Kapolei.

Moore, James R. and Joseph Kennedy
2002 An Archaeological Archival Research Report for the ʻEwa Nonpotable Water System, Honouliuli Ahupuaʻa, ʻEwa District, Island of Oʻahu. Archaeological Consultants of the Pacific, Inc., Haleiwa, Hawaiʻi.

Moy, Tonia
1995 ʻEwa Sugar Plantation Villages Registration Forms (OMB No. 1024-001). United States Department of the Interior, National Park Service, National Register of Historic Places. On file at the Historic Preservation Department

Nakamura, Barry S., Jeffrey Pantaleo, and Aki Sinoto
1993 Archaeological Inventory Survey of Proposed Development Parcels D and D-1 Makakilo, Honouliuli ahupuaʻa ʻEwa District, Oʻahu Island (TMK 9-2-3:18 POR.; 75 POR.; 81 POR.). Prepared for LandPlan Associates, Kailua, Hawaiʻi . Aki Sinoto Consulting, Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

National Park Service
1990 ʻEwa Plantation Historic District Registration Forms (OMB No. 10024-0018; October 1990). United States Department of the Interior, National Park Service, National Register of Historic Places. On file at the Historic Preservation Department.

Office of Environmental Quality Control (OEQC)
2011 Guidelines for Assessing Cultural Impacts, as adopted by the State of Hawai'i Environmental Council, in 1997 and amended in 2000. Electronic document in OEQC website, accessed in April 2011. http://oeqc.doh.hawaii.gov/ Shared%20Documents/ Environmental_Assessment_PrepKit/ Cultural_Impact_Assessments/Guidelines-Assessing-Cultural-Impacts.pdf

O'Hare, Constance R., David W. Shideler, and Hallett H. Hammett
2006 An Archaeological Inventory Survey for the Hoʻopili Project, Honouliuli Ahupuaʻa, ʻEwa District, Island of Oʻahu. TMK: (1) 9-1-010:002, 9-1-017:004, 059, 072; 9-1-018:001, 004; 9-2-002:004, 005. Cultural Surveys Hawaii. Prepared for D. R. Horton – Schuler Division. Report on File at the Historic Preservation Division Library, Kapolei.

2007 Archaeological Assessment of the ʻEwa Industrial Park Project, Honouliuli Ahupuaʻa, ʻEwa District, Oʻahu Island. TMK: (1) 9-1-069:003. Cultural Surveys Hawaiʻi. Prepared for Mr. Valentine Peroff, Jr. Report on File at the Historic Preservation Division Library, Kapolei.

Pagliaro, Penny
1987 Ewa Plantaion: An Historical Survey, 1890 to 1940. Report on File at the Historic Preservation Division Library, Kapolei.

Pukui, Mary Kawena
1943 *Ke Awa Lau o Puʻuloa: The Many-Harbored Sea of Puʻuloa.* Hawaiian Historical Society Report 52: 56-62.

1983 *ʻOlelo Noʻeau: Hawaiian Proverbs and Poetical Sayings*. Bernice P. Bishop Museum Special Publication No. 71, Bishop Museum Press, Honolulu.

Pukui, Mary K., Samuel H. Elbert, and Esther Mookini
1974 *Place Names of Hawaiʻi*. University of Hawaiʻi Press, Honolulu.

Rasmussen, Coral
2006 Archaeological Assessment for Makakilo, Honouliuli Ahupua'a, Island of Oʻahu, TMK (portions) 9-2-003:081, (1) 9-2-019:003, 072, 081, 084, 085. Prepared for D.R. Horton-Schuler Division. International Archaeological Research Institute, Inc. Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

Rosendahl, P.H.
1987 Archaeological Reconnaissance Survey for Environmental Impact Statement, West Loch Estates – Residential Increments I and II. PHRI Report 322-040787. Prepared for the City and County of Honolulu. (September).

Schoofs, Robert
1978 *Pioneers of the Faith: History of the Catholic Mission in Hawaii (1827-1940)*. Revised by Fay Wren Midkiff. Second Printing. Sturgis Printing Co. Inc., Hawaii.

Silva, Carol
1987 Historical Documentary Research – West Loch Estates Project Area. In Archaeological Reconnaissance Survey for Environmental Impact Statement, West Loch Estates Golf Course and Parks, Honouliuli, ʻEwa, Oʻahu. By Merrill A. Dicks, Alan E. Haun, and Paul H. Rosendahl, Appendix A. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawaiʻi.

Sinoto, Aki
1976 A Report on Cultural Resources Survey at Barber's Point, Island of Oʻahu. Manuscript 122476. Department of Anthropology, B.P. Bishop Museum, Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

1978a Archaeological and Paleontological Salvage at Barber's Point, Oʻahu. Manuscript 030278. Department of Anthropology, B.P. Bishop Museum, Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

1978b Archaeological Reconnaissance Survey and Salvage of Burial at NAVMAG Lualualei, West Loch Branch, Oʻahu Island. Cultural Surveys Hawaiʻi, Inc. Kailua, Hawaiʻi.

1979 Cultural Resources Survey of New Dredged Material Disposal Sites at Barbers Point, Oʻahu, Hawaiʻi. Manuscript 050179. Department of Anthropology, B.P. Bishop Museum, Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

1988 Surface Survey of the Proposed Makakilo Golf Course, ʻEwa, Oʻahu. TMK 9-2-03:18. Bernice P. Bishop Museum, Department of Anthropology, Honolulu.

Smith, L.
1835 "Ewa 1835." *Oʻahu Station Reports – ʻEwa to Waianae, from 1835-1863*. On File at the Hawaiian Historical Society Library.

Soehren, Lloyd
1962 Burial Recording, Secondary Internment in Sinkhole. In Oʻahu Sites folder , Department of Anthropology and Education, B.P. Bishop Museum, Honolulu.

1966 Recording and Excavation at Possible Fishing Shrine. (Site 50-Oa-B6-13) In Oʻahu Sites folder , Department of Anthropology and Education, B.P. Bishop Museum, Honolulu.

Stearns, H.T.
1946 *Geology of the Hawaiian Islands*. Division of Hydrography Bulletin 8. Territory of Hawaii.

1978 *Quaternary Shorelines in the Hawaiian Islands.* Bernice P. Bishop Museum Bulletin 237. Bishop Museum Press, Honolulu.

Stearns, H.T. and K.N. Vaksvik
1935 *Geology and Groundwater Resources of the Island of O'ahu, Hawaii*. Bulletin 1, Division of Hydrology, Territory of Hawaii, Honolulu.

Sterling, E.P. and C.C. Summers
1978 *Sites of O'ahu*. Bishop Museum Press, Honolulu, Hawaii.

Stokes, John F.
1909 *Walled Fish Traps of Pearl Harbor*. Occasional Papers of the Bishop Museum. 4(3): 199-212.

Thrum, T.
1906 Heiaus and Heiau Sites Throughout the Hawaiian Islands. *Hawaiian Almanac and Annual for 1907*. T.G. Thrum, Honolulu.

1907 Heiaus and Heiau Sites Throughout the Hawaiian Islands. *The Hawaiian Almanac and Annual for 1908*. Honolulu.

1917 List of Heiaus and Sites. *Hawaiian Almanac and Annual or 1918*. Pacific Commercial Advertiser, Honolulu.

1923 *More Hawaiian Folk Tales*. , Chicago.

Tuggle, David H. and M.J. Tomonari-Tuggle
1997 Synthesis of Cultural Resource Studies of the 'Ewa Plain. Task 1a: Archaeological Research Services for the Proposed Cleanup, Disposal and Reuse of Naval Air Station

Barbers Point, O'ahu, Hawai'i. International Archaeological Research Institute, Inc. Prepared for Belt Collins Hawaii.

U. S. Department of Agriculture (USDA)/Natural Resources Conservation Service (NRCS)
2011 Custom Soil Resource Report for Island of Oahu, Hawaii: Ka Makana Alii Project Area.
A Publication of Web Soil Survey. Produced 6/30/2011online at http://websoilsurvey.nrcs.usda.gov/. Copy available upon request.

Vancouver, G.
1798 A Voyage of Discovery to the North Pacific Ocean, and Round the World. 3 Volumes. Robinson and Edwards, London, England.

Welch, David J.
1987 Archaeological Reconnaissance of Former Ewa Marine Corps Air Station, Barbers Point Naval Air Station, O'ahu, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Westervelt, William D.
1963 *Legends of Old Honolulu*. Collected and Translated from the Hawaiian by W.D. Westervelt. Press of George H. Ellis Co., Boston.

Wilson, Christie
2008 "Clues Sought to Honouliuli's Dark Past." *The Honolulu Advertiser*. 17 February 2008: A1.

Wolforth, Thomas R. and Warren Wulzen
1998 Archaeological Data Recovery at West Loch Estates Residential Increment I, and Golf Course and Shoreline Park, Land of Honouliuli, 'Ewa District, Island of O'ahu. Paul Rosendahl, Ph.D., Inc. Prepared for City and County of Honolulu. Report on File at the Historic Preservation Division Library, Kapolei.

Zeigler, Alan C.
2002 *Hawaiian Natural History, Ecology, and Evolution*. University of Hawai'i Press. Honolulu.

9.1 Historic Maps

Alexander, W. D.
1873 "Map of Honouliuli, Oʻahu" Reg. No. 618, Hawaiʻi State Survey Office.

Malden, Leroy C.R.
1825 "Sandwich Islands, South Coast of Woahoo" Reg. No. 640, Hawaiʻi State Survey Office.

Monsarrat, M.D.
1878 "Map of Honouliuli Taro Land, Ewa, Oʻahu" Reg. No. 630, Hawaiʻi State Survey Office

APPENDIX A

Office of Environmental Quality Control (OEQC) Cultural Impact Assessment Guidelines

Guidelines for Assessing Cultural Impacts
Adopted by the Environmental Council, State of Hawaii November 19, 1997

1. INTRODUCTION

It is the policy of the State of Hawaii under Chapter 343, HRS, to alert decision makers, through the environmental assessment process, about significant environmental effects which may result from the implementation of certain actions. An environmental assessment of cultural impacts gathers information about cultural practices and cultural features that may be affected by actions subject to Chapter 343, and promotes responsible decision making.

Articles IX and XII of the State Constitution, other state laws, and the courts of the state require government agencies to promote and preserve cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups. Chapter 343 also requires environmental assessment of cultural resources, in determining the significance of a proposed project.

The Environmental Council encourages preparers of environmental assessments and environmental impact statements to analyze the impact of a proposed action on cultural practices and features associated with the project area. The Council provides the following methodology and content protocol as guidance for any assessment of a project that may significantly affect cultural resources.

Background
Prior to the arrival of westerners and the ideas of private land ownership, Hawaiians freely accessed and gathered resources of the land and seas to fulfill their community responsibilities. During the Mahele of 1848, large tracts of land were divided and control was given to private individuals. When King Kamehameha the III was forced to set up this new system of land ownership, he reserved the right of access to privately owned lands for Native Hawaiian ahupua'a tenants. However, with the later emergence of the western concept of land ownership, many Hawaiians were denied access to previously available traditional resources.

In 1978, the Hawaii constitution was amended to protect and preserve traditional and customary rights of Native Hawaiians. Then in 1995 the Hawaii Supreme Court confirmed that Native Hawaiians have rights to access undeveloped and under-developed private lands. Recently, state lawmakers clarified that government agencies and private developers must assess the impacts of their development on the traditional practices of Native Hawaiians as well as the cultural resources of all people of Hawaii. These Hawaii laws, and the National Historic Preservation Act, clearly mandate federal agencies in Hawaii, including the military, to evaluate the impacts of their actions on traditional practices and cultural resources.

If you own or control undeveloped or under-developed lands in Hawaii, here are some hints as to whether traditional practices are occurring or may have occurred on your lands. If there is a trail on your property, that may be an indication of traditional practices or customary usage. Other clues include streams, caves and native plants. Another important point to remember is that, although traditional practices may have been interrupted for many years, these customary practices cannot be denied in the future.

These traditional practices of Native Hawaiians were primarily for subsistence, medicinal, religious, and cultural purposes. Examples of traditional subsistence practices include fishing, picking opihi and collecting limu or seaweed. The collection of herbs to cure the sick is an example of a traditional medicinal practice. The underlying purpose for conducting these traditional practices is to fulfill one's community responsibilities, such as feeding people or healing the sick.

As it is the responsibility of Native Hawaiians to conduct these traditional practices, government agencies and private developers also have a responsibility to follow the law and assess the impacts of their actions on traditional and cultural resources.

The State Environmental Council has prepared guidelines for assessing cultural resources and has compiled a directory of cultural consultants who can conduct such studies. The State Historic Preservation Division has drafted guidelines on how to conduct ethnographic inventory surveys. And the Office of Planning has recently completed a case study on traditional gathering rights on Kaua'i.

The most important element of preparing Cultural Impact Assessments is consulting with community groups, especially with expert and responsible cultural practioners within the ahupua'a of the project site. Conducting the appropriate documentary research should then follow the interviews with the experts. Documentary research should include analysis of mahele and land records and review of transcripts of previous ethnographic interviews. Once all the information has been collected, and verified by the community experts, the assessment can then be used to protect and preserve these valuable traditional practices.

Native Hawaiians performed these traditional and customary practices out of a sense of responsibility: to feed their families, cure the sick, nurture the land, and honor their ancestors. As stewards of this sacred land, we too have a responsibility to preserve, protect and restore these cultural resources for future generations.

TEXT OF ACT 50, SLH 2000
A BILL FOR AN ACT RELATING TO ENVIRONMENTAL IMPACT STATEMENTS

UNOFFICIAL VERSION

HOUSE OF REPRESENTATIVES H.B. NO, 2895 H.D.1
TWENTIETH LEGISLATURE, 2000
STATE OF HAWAII

A BILL FOR AN ACT

RELATING TO ENVIRONMENTAL IMPACT STATEMENTS.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

SECTION 1. The legislature finds that there is a need to clarify that the preparation of environmental assessments or environmental impact statements should identify and address effects on Hawai'i's culture, and traditional and customary rights.

The legislature also finds that native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the "aloha spirit' in Hawaii. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on government agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.

Moreover, the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many important cultural resources and has interfered with the exercise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.

The purpose of this Act is to: (1) Require that environmental impact statements include the disclosure of the effects of a proposed action on the cultural practices of the community and State; and (2) Amend the definition of "significant effect" to include adverse effects on cultural practices.

SECTION 2. Section 343-2, Hawai`i Revised Statutes, is amended by amending the definitions of "environmental impact statement' or "statement" and "significant effect", to read as follows:

"'Environmental impact statement" or "statement" means an informational document prepared in compliance with the rules adopted under section 343-6 and which discloses the environmental effects of a proposed action, effects of a proposed action on the economic [and] welfare, social welfare, and cultural practices of the community and State, effects of the economic activities arising out of the proposed action, measures proposed to minimize adverse effects, and alternatives to the action and their environmental effects.

The initial statement filed for public review shall be referred to as the draft statement and shall be distinguished from the final statement which is the document that has incorporated the public's comments and the responses to those comments. The final statement is the document that shall be evaluated for acceptability by the respective accepting authority.

"Significant effect" means the sum of effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the State's environmental policies or long-term environmental goals as established by law, or adversely affect the economic [or] welfare, social welfare[.], or cultural practices of the community and State."

SECTION 3. Statutory material to be repealed is bracketed. New statutory material is underscored.

SECTION 4. This Act shall take effect upon its approval.

Approved by the Governor as Act 50 on April 26, 2000

2. CULTURAL IMPACT ASSESSMENT METHODOLOGY

Cultural impacts differ from other types of impacts assessed in environmental assessments or environmental impact statements. A cultural impact assessment includes information relating to the practices and beliefs of a particular cultural or ethnic group or groups.

Such information may be obtained through scoping, community meetings, ethnographic interviews and oral histories. Information provided by knowledgeable informants, including traditional cultural practitioners, can be applied to the analysis of cultural impacts in conjunction with information concerning cultural practices and features obtained through consultation and from documentary research.

In scoping the cultural portion of an environmental assessment, the geographical extent of the inquiry should, in most instances, be greater than the area over which the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment. Thus, for example, a proposed action that may not physically alter gathering practices, but may affect access to gathering areas would be included in the assessment. An ahupua'a is usually the appropriate geographical unit to begin an assessment of cultural impacts of a proposed action, particularly if it includes all of the types of cultural practices associated with the project area. In some cases, cultural practices are likely to extend beyond the ahupua'a and the geographical extent of the study area should take into account those cultural practices.

The historical period studied in a cultural impact assessment should commence with the initial presence in the area of the particular group whose cultural practices and features are being assessed. The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs.

The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both man made and natural, including submerged cultural resources, which support such cultural practices and beliefs.

The Environmental Council recommends that preparers of assessments analyzing cultural impacts adopt the following protocol:

1. identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or ahupua`a;

2. identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;

3. receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;

4. conduct ethnographic, historical, anthropological, sociological, and other culturally related documentary research;

5. identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

6. assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

Interviews and oral histories with knowledgeable individuals may be recorded, if consent is given, and field visits by preparers accompanied by informants are encouraged. Persons interviewed should be afforded an opportunity to review the record of the interview, and consent to publish the record should be obtained whenever possible. For example, the precise location of human burials are likely to be withheld from a cultural impact assessment, but it is important that the document identify the impact a project would have on the burials. At times an informant may provide information only on the condition that it remain in confidence. The wishes of the informant should be respected.

Primary source materials reviewed and analyzed may include, as appropriate: Mahele, land court, census and tax records, including testimonies; vital statistics records; family histories and genealogies; previously published or recorded ethnographic interviews and oral histories; community studies, old maps and photographs; and other archival documents, including correspondence, newspaper or almanac articles, and visitor journals. Secondary source materials such as historical, sociological, and anthropological texts, manuscripts, and similar materials, published and unpublished, should also be consulted. Other materials which should be examined include prior land use proposals, decisions, and rulings which pertain to the study area.

3. CULTURAL IMPACT ASSESSMENT CONTENTS

In addition to the content requirements for environmental assessments and environmental impact statements, which are set out in HAR §§ 11-200-10 and 16 through 18, the portion of the assessment concerning cultural impacts should address, but not necessarily be limited to, the following matters:

1. A discussion of the methods applied and results of consultation with individuals and organizations identified by the preparer as being familiar with cultural practices and features associated with the project area, including any constraints or limitations which might have affected the quality of the information obtained.

2. A description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken.

3. Ethnographic and oral history interview procedures, including the circumstances under which the interviews were conducted, and any constraints or limitations which might have affected the quality of the information obtained.

4. Biographical information concerning the individuals and organizations consulted, their particular expertise, and their historical and genealogical relationship to the project area, as well as information concerning the persons submitting information or interviewed, their particular knowledge and cultural expertise, if any, and their historical and genealogical relationship to the project area.

5. A discussion concerning historical and cultural source materials consulted, the institutions and repositories searched, and the level of effort undertaken. This discussion should include, if appropriate, the particular perspective of the authors, any opposing views, and any other relevant constraints, limitations or biases.

6. A discussion concerning the cultural resources, practices and beliefs identified, and, for resources and practices, their location within the broad geographical area in which the proposed action is located, as well as their direct or indirect significance or connection to the project site.

7. A discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area, affected directly or indirectly by the proposed project.

8. An explanation of confidential information that has been withheld from public disclosure in the assessment.

9. A discussion concerning any conflicting information in regard to identified cultural resources, practices and beliefs.

10. An analysis of the potential effect of any proposed physical alteration on cultural resources, practices or beliefs; the potential of the proposed action to isolate cultural resources, practices or beliefs from their setting; and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place.

11. A bibliography of references, and attached records of interviews which were allowed to be disclosed.

The inclusion of this information will help make environmental assessments and environmental impact statements complete and meet the requirements of Chapter 343, HRS. If you have any questions, please call 586-4185.

APPENDIX B

List of Organizations and Individuals Contacted and Communication Log

Ka Makana Ali‘i Cultural Impact Assessment - Cultural Informants				
Name	**Affiliation/Association**	**Contact Log**	**Interview**	**Comments**
Abang, Myrna-Lyn Diaz	Ewa Community Church	Called and left a message on machine 7/6/11; Aunty Myrna called me back on 7/7/11 and gave me information on the project area vicinty		Declined interview – referred Barbietos
Alaka‘i, Robert	OEQC Cultural Assessment Provider	Sent a request letter 6/23/11; called Uncle Robert 7/6/11 and spoke with him. Says his knowledge of the area is the same as that of Uncle Shad		Declined interview – says he and Uncle Shad Kane share same information regarding the area
Andrade, Maureen	Waipahu Neighborhood Board No. 22	Sent email requesting info 6/24/11		No response
Apana, Kalani	Cultural Practioner in Ewa Beach area, nephew of Aunty Arline, new Kupuna of Iroquois Point Elem.	Spoke with Uncle Kalani on the phone and he agreed to meet for an interview; performed joint interview with Makua Kalani and Kupuna Eaton 7/7/11; sent letter with summary for review 8/3/11	**YES**	Informed me about lei making and Hawaiian language
Barbieto Family	Lifelong resident of Varona Village	Sent request letter 7/8/11; called 7/26/11 twice and was hung up on by a younger female of the household.		Declined interview
Bond, John	Special Assistant to City Councilmember Tom Berg (Council District One – Ewa Beach, Kapolei, Waianae Coast)	Sent email requesting participation 6/30/11; sent email to Mr. Bond 7/6/11; was put on mailing list for “SAVE DEC. 7, 1941 EWA FIELD” mailing list; tried to contact Mr. Bond for specifics, but no response		Requested information regarding his sources - noresponse
Chun, Cory	Waipahu Neighborhood Board No. 22	Sent email requesting info 6/24/11		No response
Clark, Melvin Kauila	OEQC Cultural Assessment Provider for `Ewa/Honouliuli	Sent an email requesting participation Thu 6/23/2011 12:26 PM; called Uncle Kauila 6/28/11 and phone was disconnected, then called second number and left message on machine; Uncle Kauila called back and said he changed his email address, so he did not get the emails; he said he’s interested, but wants a better idea of project and project area, so I told him that I’d resend the email to new address.	**YES**	Phone interview (too busy for interview)
Corpuz, Abelina Dumlao	Long-time resident of Varona Village (NW corner, since 1967); gardens in lot mauka of Varona Village	Interviewed 7/29/11	**YES**	Interview informative about plantation era
Cullen, Sy	Waipahu Neighborhood Board No. 22	Sent email requesting info 6/24/11		No response

Ka Makana Ali'i Cultural Impact Assessment - Cultural Informants				
Name	**Affiliation/Association**	**Contact Log**	**Interview**	**Comments**
De Gracia, Daniel II	Waipahu Neighborhood Board No. 22	Sent email requesting info 6/24/11		No response
Eaton, Aunty Arline	OEQC Cultural Assessment Provider for `Ewa; Kupuna Iroqois Point Elementary - Kupuna, born & raised in Pu'uloa, Mo`olelo, Hale O Na'auao Society,	Sent a request letter 6/23/11; talked to Aunty Arline on the phone (Iroquois Point Elem) 6/29/11, and she agreed to an interview (joint with Kalani Apana) on June 7th – wants to view the project area; after taking Aunty Arline to the project area, I interviewed her and her nephew Kalani at Zippy's restaurant in 'Ewa Beach and finished interview at Iroquois Point Elementary; sent letter with summary for review 8/3/11	**YES**	Not recorded, due to the background noise in restaurant
Fevella, Kurt	Ewa Neighborhood Board No. 23	Sent email requesting info 6/24/11		No response
Gollner, John Kane	Ewa Neighborhood Board No. 23 *(Treasurer)*	Sent email requesting info 6/24/11		No Response
Hawaiian Railway Society	Adjacent lands to south are OR&L; HRS Museum is adjacent to KMA project area	Called 7/6/11 and left message on machine requesting participation		Was contacted by Tom McCarthy
Kane, Shad	OEQC Cultural Assessment Provider for `Ewa/Honuliuli - Oral Traditions, Cultural Practitioner, Nakoa, Wahipana O Ewa, Burials, Kalaikahili	Sent a request letter 6/23/11; Uncle Shad replied to my letter via email	**Email Update**	Declined interview, gave permission to use previous info
Kanekoa, Miki'ala M.	Kumu Hula, Halau 'O Kaululaua'e	Sent request email 7/6/11		No response
Knauer, Steve Alan	Ewa Neighborhood Board No. 23	Sent email requesting info 6/24/11		No response
Lacuesta, Celeste	Ewa Neighborhood Board No. 23	Sent email requesting info 6/24/11		No Response
Livingston, Jeff	Hawaiian Railway Society, Historian		**YES**	Information based mainly on Railroad and Military
Matanane, Eric	OEQC Cultural Assessment Provider for `Ewa/Honuliuli	Sent a request email Wed. 6/29/11		No Response

Ka Makana Ali'i Cultural Impact Assessment - Cultural Informants				
Name	**Affiliation/Association**	**Contact Log**	**Interview**	**Comments**
Matthews, Darwynne "Moki"	Kupuna - Cultural Practitioner in Ewa Beach area; Manager of West Loch Golf Course Maint.; Family hails from West Loch area	Called Golf Course Maint. several times 6/23/11, no answer		No Response
McCarthy, Tom	administrator at Hawaiian Railway Society	called Hawaiian Railway Society & left a message requesting info for individuals who might know the background of the project area 6/29/11; called 7/18/11 same #, but no answer or message service; 7/26/11 called and spoke with Tom on the phone, said he was not the best person to talk to about cultural significance, but is interested if it pertains to the railway; I said I'd send him a letter outlining what info the CIA requires; called Tom 8/5/11 following up on letter; said he got it and that he was trying to get a hold of Uncle Shad Kane for me (I told him that I'd already consulted with Uncle Shad) and he suggested that I contact Jeff Livingston via Email, as he's the most knowledgeable on the History of the Plantation – save for Bob Yatchmenoff, who is extremely hard to get a hold of; suggests coming in on Saturday to interview		Declined interview – referred me to Jeff Livingston and Bob Yatchmenoff
Orr, Maria Kaimipono	OEQC Cultural Assessment Provider for all Islands – has performed Arch & Cultural Assessments in Barber's Pt. area			No response
Parayno, Ilalo	Ewa Neighborhood Board No. 23	Email correspondences : shared 10 emails between 6/26 and 6/30		Declined interview – suggests John Bond
Philpotts, McDee	Cultural Practitioner in `Ewa, descendant of J. Campbell	Called Mr. Phillpots 6/24/11 at 12pm and spoke with him about project. Says he is not familiar with area		Declined interview – suggests finding people from adjacent Ewa Villages
Rathbun, Kevin	Ewa Neighborhood Board No. 23	Sent email requesting info 6/24/11		No response
Respicio, Rosalino	Lifelong resident of Varona Village; garden's Filipino vegetable garden; was Plantation worker	Interviewed on 7/29/11	**YES**	Informative interview mostly about plantation
Simmons, Aloha Keko'olani	Kumu Hula in Kapolei	Called 7/4/11 & left message		No response

Ka Makana Ali'i Cultural Impact Assessment - Cultural Informants				
Name	**Affiliation/Association**	**Contact Log**	**Interview**	**Comments**
Souza, Evelyn	Member: Makakilo/Kapolei Neighborhood Board No. 34;	Sent mass email Friday, June 24, 2011, 10:27 AM; Ms. Souza replied to my email and referred Uncle Shad		Declined interview – refers Uncle Shad Kane
Tiffany, Nettie	Kahu, lifetime resident of Kapolei	Sent letter 6/23/11; called 7/6/11 left message; called & spoke Aunty Nettie 7/11/11 and she was interested in an interview, but call back in a week; called 7/18/11 no answer left message; called 7/22/11 left message		Several Attempts made, no interview
Timson, Maeda C.	Chair: Makakilo/ Kapolei Neighborhood Board No. 34	Sent email requesting info 6/24/11		No response
Tseu, `Iwalani E. R. Wahinekapu Walsh	Kumu Hula of `Iwalani's School of Dance	Sent email requesting info 7/4/11; Aunty 'Iwalani called me back 7/6/11 and said that she grew up in Honouliuli Village and is very familiar with the cultural background of 'Ewa, but not aware of any cultural practices that are occurring in the project area; She remembers it being sugar cane when she was growing up; she says she will ask around and let me know if anything comes up		Declined interview, says she's not too familiar with the project area
Yamamoto, George S.	Member: Makakilo/ Kapolei Neighborhood Board No. 34	Sent email requesting info 6/24/11		No response
Yatchmenoff, Robert	President of Hawaiian Railway Society		**Yes**	Informative about project area during the 1990's, Railroad, & military
Zahn, Charles	Makakilo/Kapolei/Honokai Hale Neighborhood Board No. 34	Sent email requesting info 6/24/11		No response

APPENDIX C

Ethnographic Interview Questionnaire

Pacific Legacy, Inc.
Cultural Impact Assessment (CIA)
Ethnographic Interview Form

Job Name/#:_____ Interviewer Name:_____

Location:_____ Date/Time:_____

Permission to Record Audio (Y/N):_____

Interviewee Full Name:	Birth Name:
Birth Date:	Occupation/Title:
Current Residence:	Birth Place & Place of formative years:
Years spent in or near subject area:	Affiliation with subject area:
Parents:	Informants/Mentors:

1) How familiar are you with the subject area?

2) How would you describe the physical characteristics of the area from your earliest memory?

3) Are there any significant or special features (i.e. landmarks or unique topography) in this area as it relates to land use and/or its history?

4) How was the area used by people in the past?

Land Use Details:

Activity	Types & Uses	Where/ Frequency
5) Hunting/ Fishing		
6) Gathering		
7) Agriculture/ Aquaculture		
8) Ceremonial		
9) Burial		
10) Other		

11) What stories or mythologies have you heard of this area?

12) What are your thoughts about the project proposal?

13) Additional Comments by the Interviewee:

14) Additional Comments:

Would you like to view the synopsis of the interview prior to CIA report submittal(Y/N)?_____

Time Interview Concludes :_____

Interviewee Signature: _____ Date: _____

APPENDIX D

Oral History Study – Personal Release of Interview Records

ORAL HISTORY STUDY
PERSONAL RELEASE OF INTERVIEW RECORDS

Project: Ka Makana Alii

Date of Interview: 6 July 2011

I, ARLINE EATON, have been interviewed by Kimberly Mooney of Pacific Legacy, Inc. for the above referenced project. I agree that the interview information may be used in a report that may be made public.

Arline Eaton
Interviewee Signature

August 8, 2011
Date

ORAL HISTORY STUDY
PERSONAL RELEASE OF INTERVIEW RECORDS

Project: Ka Makana Alii

Date of Interview: 6 July 2011

I, Kalani Apuna, have been interviewed by Kimberly Mooney of Pacific Legacy, Inc. for the above referenced project. I agree that the interview information may be used in a report that may be made public.

Interviewee Signature

Aug 8, 2011
Date

ORAL HISTORY STUDY
PERSONAL RELEASE OF INTERVIEW RECORDS

Project: KA MAKANA ALI'I - CIA

Date of Interview: 7-26-2011 (phone interview)

I, Kanila Clark, have been interviewed by Kim Mooney of Pacific Legacy, Inc. for the above referenced project. I agree that the interview information may be used in a report that may be made public.

Kanila Clark
Interviewee Signature

08/6/11
Date

ORAL HISTORY STUDY
PERSONAL RELEASE OF INTERVIEW RECORDS

Project: Ka Makana Alii

Date of Interview: 29 - July 2011

I, Roselino Rapozo have been interviewed by Kim Mooney of Pacific Legacy, Inc. for the above referenced project. I agree that the interview information may be used in a report that may be made public.

Interviewee Signature

8-8-11
Date

ORAL HISTORY STUDY
PERSONAL RELEASE OF INTERVIEW RECORDS

Project: Ka Makana Alii

Date of Interview: 29 July 2011

I, Avelina D. Corpuz have been interviewed by Kim Mooney of Pacific Legacy, Inc. for the above referenced project. I agree that the interview information may be used in a report that may be made public.

Avelina D Corpuz
Interviewee Signature

8-8-11
Date

ORAL HISTORY STUDY
PERSONAL RELEASE OF INTERVIEW RECORDS

Project: Ka Makana Alii

Date of Interview: 8-6-11

I, Robert W. Yatchmenoff have been interviewed by Kim Mooney of Pacific Legacy, Inc. for the above referenced project. I agree that the interview information may be used in a report that may be made public.

Interviewee Signature

8-6-2011
Date

Pacific Legacy
Historic Preservation

ORAL HISTORY STUDY
PERSONAL RELEASE OF INTERVIEW RECORDS

Project: Ka Makana Ali'i

Date of Interview: 8·6·11

I, J. A. Lindsey-Ho, have been interviewed by Kim Mooney of Pacific Legacy, Inc. for the above referenced project. I agree that the interview information may be used in a report that may be made public.

Interviewee Signature

6 Aug 11
Date

APPENDIX E

'Ewa Plain: A Hawaiian Settlement Model
In *Synthesis of Cultural Resource Studies of the 'Ewa Plain.*
By David Tuggle and M.J. Tomonari-Tuggle
(1997: Section VIII, pp.115-119)

VIII. ʻEWA PLAIN: A HAWAIIAN SETTLEMENT MODEL

At its maximum development during Hawaiian occupation, the main portion of the ʻEwa Plain was a dryland agricultural landscape, comparable in broad terms to leeward Kohala on the island of Hawaiʻi, the Kaunakakai region of Molokaʻi, or upper Mākaha Valley on Oʻahu (although certainly with a much lower overall yield than these other regions). The distinctive characteristic of the ʻEwa Plain is that the agricultural system was developed on a karst landform. Adapted to this, the ʻEwa cultivation system emphasized mounds and sinkholes (and possibly the use of wetlands such as swamps), rather than dry terraces. Variation in ʻEwa Plain cultivation occurred on the Honouliuli floodplain and at the base of the Waianae slopes.

ʻEwa Plain Settlement Model

With this perspective, the following is proposed as a general model for pre-contact ʻEwa Plain settlement (the primary numbers in the following list refer to corresponding numbers in Figure 22):

1. The population center of the region was the irrigation complex of lower Honouliuli (or Makaliʻi) Stream, lying at the northeastern edge of the Plain. Although lower Honouliuli is not part of the physiographic region of the Plain, its proximity and cultural history define it as crucial to the settlement of the Plain itself.

   This is based on the archival data for the area, with the assumption that similar conditions existed in pre-contact times, partly corroborated by traditions that refer to the many place names recorded for this area (e.g., Poʻohilo).

   Some evaluation of this proposition may be testable through archaeological research, depending on the nature and extent of buried deposits.

1a. Honouliuli floodplain is an area that included chiefly residential complexes.

   This is based on general models of Hawaiian settlement. It may not be testable because of site destruction.

1b. Honouliuli floodplain was one of the areas of earliest settlement of ʻEwa and one of the earliest settlements in Hawaiʻi.

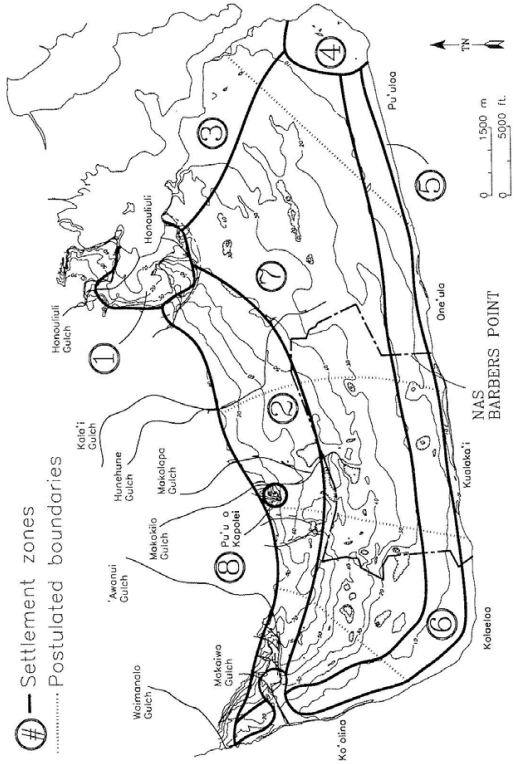

Figure 22. ʻEwa settlement model.

This is based on the richness of the resource catchment area, and is testable depending on the preservation of buried deposits.

2. Permanent agricultural settlements developed along the upper ʻEwa Plain, associated with the alluvial fans and soil of the upper Plain. Most of the cultivation was dryland, but included some runoff cultivation and some irrigation in a few of the spring-fed gully mouths.

This is based on the environmental conditions of the area and archival data regarding water potential. It is probably not testable, except for the possibility of site discovery in small undeveloped gulches.

2a. This area was the first area of agricultural expansion outside the Honouliuli floodplain region, and probably consisted of small settlements at the mouths of the gullies.

This proposition is based on the agricultural potential, but may not be testable because of site destruction.

3. The West Loch coast of the ʻEwa Plain had fishponds and fishtraps, with an adjacent strip of dense population including elite residence. The density of population would have been greater than that along the seaward coasts.

The fishponds and traps are recorded from archival and archaeological data. The settlement argument is based on general Hawaiian models. It is probably not testable because of site destruction.

4. The area of Puʻuloa was a place of royal residence.

This proposition rests in part on the documentary evidence of the existence of a residence of Kamehameha II, and in part on a general Hawaiian settlement model of royal residence associated with rich resources areas, surfing, and canoe landing (cf. Kahaluʻu, Waikīkī, and Kaunakakai). In the absence of traditional records noting this for royal habitation, the residence was probably a secondary one and not a royal center. The area in question has been destroyed by development, and thus the nature of this settlement can be evaluated only by means of archival research.

5. The coastline of the ʻEwa Plain was intensively occupied, primarily with temporary camps associated with resource collection. The temporary camps were tied to permanent settlements in zones 1, 3 and 6.

This rests on the archaeological data sample.

5a. Early settlement in this area emphasized marine exploitation and bird collection, based on temporary habitation associated with permanent habitation along the West Loch coast and the Honouliuli floodplain.

5b. Later settlement emphasized marine exploitation, with continued temporary habitation, but in association with permanent inland settlements (see Fig. 22, zones 6 and 7).

These propositions are based in part on archaeological data and in part on general Hawaiian settlement models. They are partially testable with additional archaeological research. Some of the cultural resources of NAS Barbers Point are appropriate for this testing.

6. The zone inland of the coast line was a region of permanent habitation based on cultivation and marine exploitation. The settlements were focused on sinkhole clusters, which were a source of water and could be developed for cultivation.

Because of disturbance, there are few archaeological areas left in this region but several sites suggest a permanent and long-term occupation (e.g., complexes at 2700 and 2702). This model component is testable with the extensive remains at NAS Barbers Point in this topographic zone.

6a. The permanent occupation of the area was initiated in the A.D. 1200 to 1400 range and developed within the A.D. 1400 to 1850 range, and is associated with the construction of rectangular stone-walled houses.

This is based on radiocarbon dating and evidence of occupation into the post-contact period. Additional testing of this proposition is possible, and resources at NAS Barbers Point are ideal for this.

6b. Early occupation occurred in the form of temporary camps related primarily to resource collection (primarily bird hunting) and was not related to development of cultivation.

This is based on archaeological information combined with settlement modeling. It is argued, for example, that there is no evidence for permanent "home settlement" from which to establish temporary agricultural camps. Additional testing is possible, but dependent on site preservation.

7. The central area of the ʻEwa Plain was occupied with permanent settlements dependent on cultivation. However, unlike the settlement in zone 6, this occurred late in the pre-contact period and with the permanence based on adaptation to long-term rainfall variation.

This proposition is based on archaeological data, and is additionally testable, particularly at NAS Barbers Point.

8. Pu'uokapolei is the sacred center of the 'Ewa Plain.

   This is based on traditional information. There are probably no physical remains of Hawaiian sites left on Pu'uokapolei to determine the nature of the religious activities that may have taken place there. The proposition can be evaluated through additional archival research.

9. Land division boundaries. One possible generalized land division model for the 'Ewa Plain is shown on Figure 22. If any such divisions existed, they would have been further subdivided, probably in *lele* fashion, so that parcels would have been held along the coast as well as in agricultural areas inland, possibly including lots for stream irrigation in the Honouliuli lowlands.

   This is based on the known local names of the 'Ewa Plain and a general Hawaiian settlement model. Testing may be possible with additional archival research, although the searches of land records have not provided any information outside the Honouliuli floodplain. Some limited testing may be possible with archaeological remains, including in areas of NAS Barbers Point.

10. (not on Figure 22). Scattered Hawaiian occupation existed on the Plain into the mid-19th century. This was a time of low population. Families occupied a number of scattered residences and use areas, including coastal fishing camps and inland houselots and walled cultivation areas.

    This is based in part on archival data and in part on preliminary archaeological data. It is testable by detailed analyses of existing archaeological information and through additional archaeological research. NAS Barbers Point has resources suitable for testing this proposition.

'Ewa Plain Settlement and the Cordy O'ahu Model

In order to place the 'Ewa settlement in context, the Cordy model (1996) of the development of O'ahu (with some modifications) is summarized in graphic and schematic form (Figs. 23-26). This is also shown with a model of population growth for Hawai'i as a whole (Dye and Komori 1992a), and the comparative development of 'Ewa Plain settlement based on radiocarbon dates.

APPENDIX F

Historical Features of the 'Ewa Plain from 1825 to World War II (Figure 5, Map and Key)
In *Synthesis of Cultural Resource Studies of the 'Ewa Plain.*
By David Tuggle and M.J. Tomonari-Tuggle
(1997: Section II, pp.32-33)

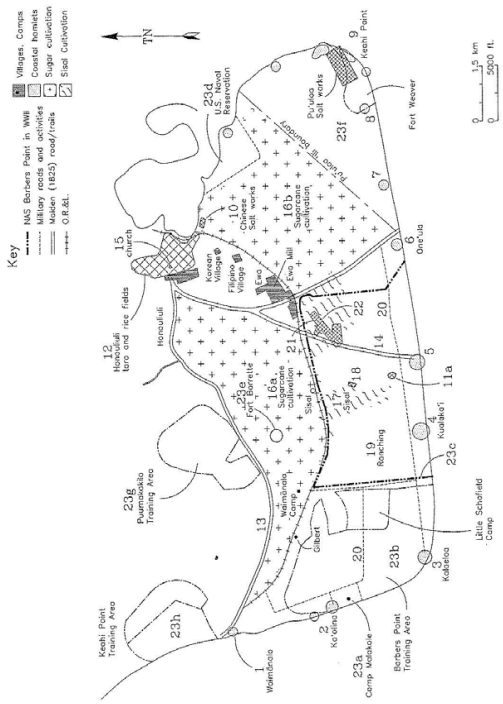

Figure 5. Historical features of the 'Ewa Plain from 1825 to World War II.

Key to Figure 5. Historical features of the 'Ewa Plain from 1825 to World War II.

1-8. Coastal hamlets in the 1800s (Malden 1825; Alexander 1873; tax records).
9. Puʻuloa salt works, hamlet, and residence of Kamehameha II, 1800s (Malden 1825; Alexander 1873; Wilkes 1840; Sand, Cutts, and Wilson 1873; Silva 1987).
10. Chinese salt works, 1800s (Silva 1987:A-4).
11. Kualakaʻi salt flats and salt works of 1800s (Kelly 1991:160).
12. Taro fields of the mid-1800s, converted to rice by 1882 (Malden 1825, Land Commission award data [see Appendix G]; Monsarrat 1878; Silva 1987:11).
13. Road from Honouliuli to the Waiʻanae coast (traditional Hawaiian trail into the 1800s, Government Road, later Waimanalo Road, then Farrington Highway)(Rockwood map from Ii 1959:96; Malden 1825; Alexander 1873; USGS 1928).
14. Two trails to coast, early 1800s (Malden 1825).
15. Church at Honouliuli, 1870s (Alexander 1873).
16. Rail line of Oahu Railway & Land Company, ʻEwa Plain section built in early 1890s, with associated villages, camps, and sugar fields (Feher 1969:304; Conde and Best 1973:279; Wall 1902; USGS 1914, 1928).
16a. Sugar cane fields of Ewa Plantation Company, developed north of the OR&L line prior to the early 1900s (Wall 1902).
16b. Sugar cane fields of Ewa Plantation Company, developed south of the OR&L line generally after the early 1900s (Ewa Plantation map 1939).
17. Sisal plantation area, early 1900s (Wall 1902; USGS 1928; Ewa Plantation map 1939).
18. U.S. Coast and Geodetic Survey Magnetic Survey Station, established in 1902 (Kelly 1991:170; Wall 1902).
19. Ranching activities, 1800s into 1900s, numerous walls, roads, water catchment areas, and windmills over ʻEwa Plain (Wall 1902; USGS 1928).
20. U.S. Army road network, as of 1939 (Ewa Plantation map 1939).
21. Mooring Mast, Mooring Mast Field, Ewa Marine Corps Air Station.
22. Location of attack of Dec. 7, 1941 at Ewa Marine Corps Air Station.
23. Military activity areas of World War II (Albert 1981:Figures 101 and 103; Ewa Plantation map 1939; U.S. Army maps 1943).
23a. Camp Malakole.
23b. Barbers Point Training Area and Little Schofield.
23c. NAS Barbers Point (note that WWII area is greater than area of Station today).
23d. U.S. Naval Reservation.
23e. Ft. Barrette (at Puʻuokapolei).
23f. Ft. Weaver.
23g. Puu Makakilo Training Area.
23h. Keahi Point Training Area.

Appendix I

Socio-Economic Analysis

Socio-Economic Impact Assessment:

Ka Makana Ali‘i Regional Commercial Center,

O‘ahu, Hawai‘i

August 2011

Prepared by

Belt Collins Hawaii Ltd.

Prepared for

Lee Sichter LLC
Hawaii DeBartolo LLC

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ABBREVIATIONS AND ACRONYMS

DBEDT	Department of Business, Economic Development and Tourism, State of Hawaii
DHHL	Department of Hawaiian Homelands, State of Hawaii
DOE	Department of Education
DP	Development Plan
DPP	Department of Planning and Permitting, City and County of Honolulu
EIS	Environmental Impact Statement
HCDA	Hawaii Community Development Authority
HHFDC	Hawaii Housing Finance & Development Corporation
HFD	Honolulu Fire Department
HPD	Honolulu Police Department
OEQC	Office of Environmental Quality Control, Hawaii State Department of Health
sq. ft.	square feet
TMK	Tax Map Key (real property parcel identifier)
UHWO	University of Hawai‘i West O‘ahu
ZCTA	Zip Code Tabulation Area (U.S. Census)

1 Introduction

1.1 Objectives and Approach

This report describes the Ka Makana Ali‘i project in relation to its social context and identifies potential socio-economic impacts. [1] Any project of its size will have identifiable impacts, which may be beneficial, neutral or adverse in relationship to the surrounding community.

The aim of a socio-economic impact assessment is to provide information to decision makers and the public at large to help them assess a proposed project.

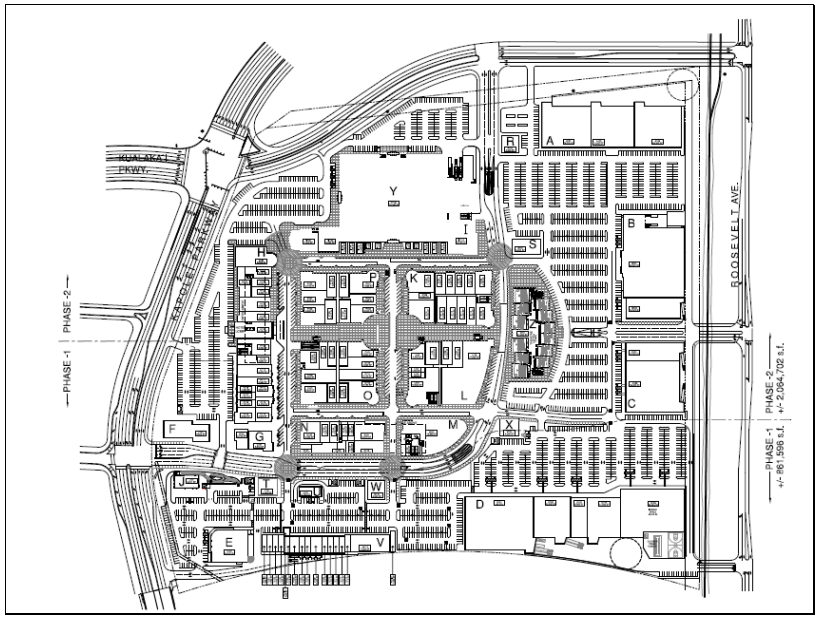
The report relies on a mix of publically available information and information compiled or gathered for the report. The Bureau of the Census’s 2010 decennial census is a major data source. In addition, minutes of Neighborhood Board meetings and newspaper accounts of events in the area shed light on local concerns, and interviews with selected stakeholders dealt with community issues and specific concerns about the proposed project.

1.2 The Proposed Project

The Ka Makana Ali‘i project is a mixed use regional center including retail and entertainment space, offices, and two hotels along with a large urban court or promenade and a total of approximately 4,500 parking spaces. Phase 1 consists of a neighborhood commercial center that can be reached from Kapolei Parkway or from Franklin D. Roosevelt Avenue. Phase 2 includes the larger retail area, both above grade and underground parking, the hotels, and new entries, one from an extension of Kualaka‘i Parkway, and the other from Roosevelt Avenue. Figure 1-1 shows the project when built out, while Table 1-1 provides more details concerning the components of the project.

[1] In this report, Hawaiian language diacritical marks are used for words of Hawaiian origin, except for political units, organizations or agencies with official names that lack such marks. Many place names – ‘Ewa Beach is an obvious example – became common during a period in which diacriticals were not used. Diacriticals are used for them here, if only for the sake of consistency.

Figure 1-1: The Project (Bird’s Eye View)



SOURCE: Hawaii DeBartolo LLC June 2011.

Table 1-1: Components of the Project

	Phase 1	Phase 2	Combined
Gross Area (square feet)			
Retail	202,000	685,000	887,000
Entertainment		41,000	41,000
Hotel		220,000	220,000
Office		217,000	217,000
	202,000	1,163,000	1,365,000
Parking spaces			
Above ground	1,088	1,564	2,652
Underground		1,835	1,835

NOTE: Estimates include rounded totals based on planning documents; phasing and quantities are subject to change.

The project is located on approximately 67 acres owned by the Department of Hawaiian Home Lands (DHHL) of the State of Hawaii. It is near residential areas serving DHHL beneficiaries (Villages of Kapolei Village 8 [Kaupeʻa] and Kānehili). The project has been backed by DHHL as a source of continuing revenues for DHHL's work on behalf of Native Hawaiians.

1.3 Summary of Findings

The Ka Makana Aliʻi project will locate a regional commercial area at the center of ʻEwa. Major socio-economic impacts of the project consist of:

- Construction jobs and associated economic benefits throughout the island economy.
- Short-term construction impacts (traffic, dirt, fugitive dust); these can be controlled to minimize impacts on nearby homes and schools.
- Development of a neighborhood commercial center, which will serve nearby subdivisions along Kapolei Parkway and beyond, providing a convenient alternative to larger centers at some distance.
- Location of a wide range of commercial jobs in ʻEwa, increasing residents' opportunities to live and work in the same region.
- Introduction of a new visitor amenity, hotels catering to local residents and their guests.
- Synergy with new community facilities along Kualakaʻi Parkway – the University of Hawaiʻi West Oʻahu campus, the Kroc Center, and the terminus of the new rail transit line – which will help to increase demand for each of these facilities.
- A cumulative impact on the region: development of facilities for residents along the central corridor will help to bring together residents from the separate communities of eastern and western ʻEwa.
- Significant contributions to revenues for the State of Hawaii and the City and County of Honolulu.
- Lease rent paid to the Department of Hawaiian Homelands which will help that agency serve beneficiaries and add to the stock of housing for Native Hawaiians.

2 Socio-Economic Context

2.1 Region Potentially Affected

The project is located at the center of the ʻEwa plain, the southwest part of the island of Oʻahu. Its nearest neighbors are the Kalaeloa Community Development District – the former Naval Air Station Barbers Point – to the south, Kapolei Middle School and the Villages of Kapolei to the west, Department of Hawaiian Home Lands (DHHL) development areas to the north, and the ʻEwa Villages area to the east. The site is State land, owned by DHHL and leased to Hawaii DeBartolo LLC for development.

The ʻEwa region has been slated for urban development for decades. The City and County of Honolulu identifies ʻEwa as a Development Plan area, like the Primary Urban Center, but unlike the five regional "Sustainable Communities Plan" areas that make up the rest of the island.[2] Figure 2-1 shows the outlines of the region, along with its major roadways and selected communities. Figure 2-2 shows where existing and proposed commercial areas serving the region are located. While several commercial areas are located in the region, the largest ones serving ʻEwa – Pearlridge and Ala Moana – are to the east.

[2] The ʻEwa Development Plan (DP) area (City and County of Honolulu) includes two Neighborhood Board Areas: ʻEwa (Number 24) and Makakilo/Kapolei/Honokai Hale (No. 34). The ʻEwa Development Plan area and the ʻEwa judicial district (State of Hawaii) are distinct. The latter includes much of Central Oʻahu. It will not be discussed in this report. All references to ʻEwa as a region in the remainder of this report are to the DP area.

Figure 2-1: Regional Location Map

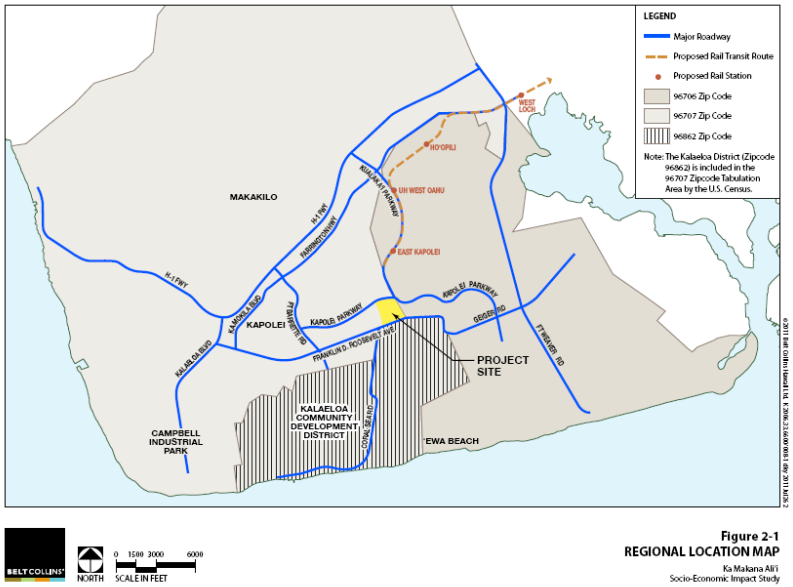


Figure 2-1
REGIONAL LOCATION MAP
Ka Makana Ali'i
Socio-Economic Impact Study

Figure 2-2: Shopping Centers Serving Leeward O'ahu Residents

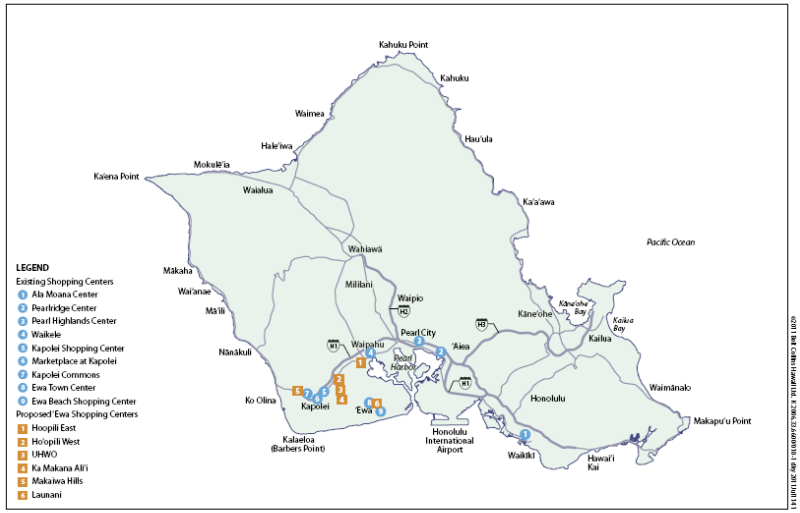


Figure 2-2
SHOPPING CENTERS SERVING LEEWARD O'AHU RESIDENTS
Ka Makana Ali'i
Socio-Economic Impact Study

The major facilities being developed along Kualakaʻi Parkway – the new University of Hawaii West Oahu campus, the Salvation Army Ray and Joan Kroc Corps Center, and Ka Makana Aliʻi – may well serve all of Leeward Oʻahu, not just ʻEwa. However, the Waiʻanae Coast and Central Oʻahu are not discussed in detail here, since the project is not likely to have specific impacts on communities in those areas.

The region of impact can be defined by the City and County boundaries, as the ʻEwa Development Plan (DP) area, or in terms of sub-regions. The U.S. Census provides data for the ʻEwa Beach and Kapolei Zip Code Tabulation Areas (ZCTAs) – 96706 and 96707, respectively. These cover nearly all the DP area.[3] Some information is also available for sub-areas named for particular communities, as defined by the Census or by the City and County.[4]

2.2 The ʻEwa Region and Major Communities

Geographically, ʻEwa consists of a plain with soil over coral rock, and of hills forming the southern end of the Waiʻanae mountain range. For most of the twentieth century, the ʻEwa plain was used for sugar cultivation, and many residents were plantation workers, living in scattered villages. Also, the United States military occupied large areas from the 1940s through the end of the century. Nowadays, the military presence is reduced to a Coast Guard air station at Kalaeloa, a firing range, and a blast zone on the western shore of Pearl Harbor, an area where development is excluded because of proximity to the Navy's ammunition wharf on the Waipiʻo Peninsula.

Urbanization of the area has long been planned. Development along the western side of the region began with the funding of the H-1 Interstate Highway in the 1960s. Next, Makakilo and the James Campbell Industrial Park were established. The State of Hawaii created Barbers Point Kalaeloa Harbor as a commercial harbor supplementing Honolulu harbor. As "the secondary urban growth area" on Oʻahu, Kapolei was designated as a city in the 1977 General Plan, and was to include the full range of urban land uses. The Villages of Kapolei were master planned by the State housing development agency, and then built by private developers. The Estate of James Campbell and its successor companies began development of the Kapolei city center in the early 1990s, and have leased or sold large parts of the area to the west for commercial projects. Ko ʻOlina is being developed as a resort area.

In the 1990s, most new development in ʻEwa was residential. Suburban growth spread down the major north-south roadways: Fort Weaver Road in the east, Fort Barrette Road in the west. New commercial development began with the Kapolei Shopping Center, which opened in 1992. Additional commercial areas have been built nearby. Commercial development along Fort Weaver Road has been slow, although residential development has continued steadily for nearly

[3] While the Kalaeloa District has its own zip code (96862), it is included in the 96707 Zip Code Tabulation Area by the U.S. Census.

[4] Several Census sub-areas were recognized in 1990 and 2000 and again in 2010, but mapping procedures have changed, so that later data cannot be compared with earlier data without careful analysis of the maps for each sub-area. Similarly, Census tract boundaries and numbering have changed.

twenty years. Even during the current recession, new housing development has continued. Most of Oʻahu's new housing development is located in ʻEwa.[5]

Many of the large residential projects in ʻEwa still have large increments to be built. At the northeast and northwest corners of the region, the proposed Hoʻopili and Makaīwa Hills developments have not begun construction. Similarly, residential and commercial uses on UHWO land have been proposed in concept, but have not yet been designed or permitted. Redevelopment of the Kalaeloa District, immediately south of the project site, could eventually involve some 6,500 additional residential units. Table 2-1 lists the major projects in terms of their development status in mid-2009. It shows some 21,750 housing units built, out of a potential total of nearly 60,000 units.

Table 2-1: Existing and Proposed Residential Communities in the ʻEwa DP Area

	Potential units	Share built by 2009
East (Fort Weaver Road) Side		
West Loch	1,630	100%
Hoʻopili	11,750	0%
ʻEwa by Gentry	8,490	79%
ʻEwa Villages	1,390	57%
Ocean Pointe	4,850	57%
Iroquois Point (1)	1,440	100%
Central (Kualakaʻi Parkway)		
University of Hawaiʻi West Oʻahu (2)	4,040	0%
East Kapolei I (DHHL)	400	3%
East Kapolei II (DHHL)	2,020	0%
West (Fort Barrette Road) Side		
Makakilo	3,460	87%
West Kapolei	2,500	0%
Makaīwa Hills	4,280	0%
Ko ʻOlina Resort	4,450	26%
City of Kapolei	3,200	1%
Villages of Kapolei	4,230	84%
Kapolei Knolls	430	100%
Kalaeloa Redevelopment (3)	1,180	15%

NOTES: This table is based on the City's *Development Plan Annual Report 2009* (for units built by 2009), developer input, Census 2010 data, and published plans. All unit totals have been rounded to the nearest ten. No attempt has been made to estimate when various developments would be built out.
(1) Iroquois Point is Navy property on long-term lease. No plans for redevelopment have been announced.

[5] Data for 2009 and 2010 compiled for City and County of Honolulu *Development Plan Annual Report.* Personal communication, Michael Watkins, planner, DPP (July 2011).

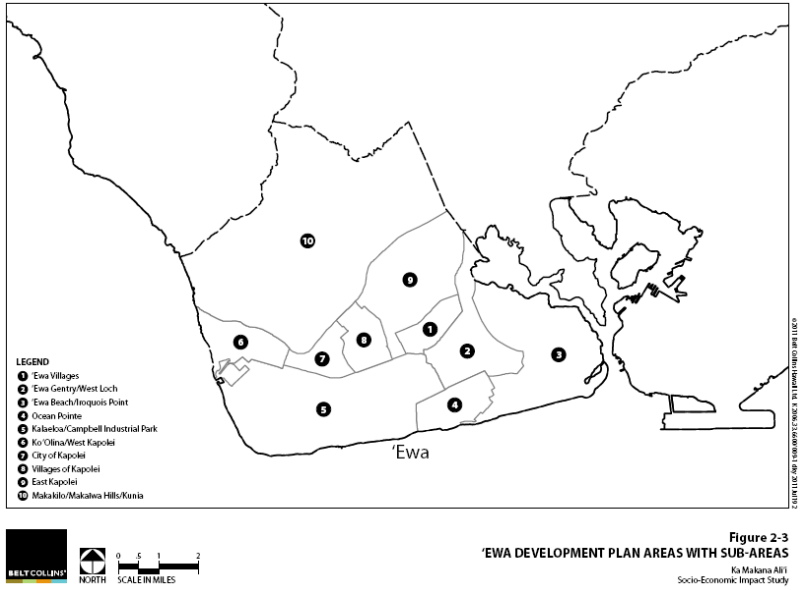
(2) The *UHWO Environmental Impact Statement* (2006) projected eventual development of 760 units of student housing and 3,280 additional residential units.

(3) The 2005 *Kalaeloa Community Development Plan* called for a mix of residential, industrial and commercial projects to support infrastructure investment.

Figure 2-3 shows the DP area as divided into sub-areas by the City Department of Planning and Permitting (DPP). The DPP provides population estimates and forecasts for the sub-areas (discussed in section 2-4 below).

The 'Ewa DP area has been planned to be self-sufficient, with a mix of homes and commercial, industrial and civic facilities. It includes visitor units at Ko 'Olina and, in time, Ocean Pointe. Unique land uses, serving the whole island, include a general aviation airport and a water park. In recent years, many 'Ewa residents commuted to work in Honolulu and at Pearl Harbor. With regional growth (and continuing congestion of the H-1 Interstate Highway making long-distance commuting difficult), the number and variety of jobs in the region are expected to increase.

Figure 2-3: 'Ewa Development Plan Area and Sub-Areas



2.3 Socio-Economic Trends

2.3.1 Demographics and Housing

The region's population increased by 135% between 1990 and 2010. This growth is clear in Table 2-2, when historic DP area counts and recent ZCTA totals are compared.[6] The population is young when compared to the islandwide population and few people live in group quarters or non-family households (as shown in Table 2-3).

Households in 'Ewa are larger, in general, than the statewide average. Homeownership is more prevalent than elsewhere in Hawai'i. Rental units are found throughout the region as well. Notably, when the Navy withdrew from the area in the mid-1990s, rental housing in both Kalaeloa and Iroquois Point – now the "Waterfront at Pu'uloa" area – became available for rent by civilians.

Table 2-2: Recent Population Growth in 'Ewa

	'Ewa DP Area	Both ZCTAs	'Ewa Beach ZCTA 96706	Kapolei ZCTA 96707
Population				
1990	42,931			
2000	68,718	68,928	43,874	25,054
2010		101,547	62,730	38,817
Housing Units				
1990	11,722			
2000	20,804	20,838	12,961	7,877
2010		30,780	18,319	12,461

NOTES: The Development Plan (DP) Area geography is used by the City and County of Honolulu, but not the State of Hawaii. It is close to the combined Zip Code Tabulation Areas (ZCTAs) shown above. ZCTAs are Census areas, based on the Postal Service's zip code geography, but the Census is not obligated to correspond fully to that geography, or to reflect changes in zip code areas. While Barbers Point has a separate zip code, it is included in the 96707 ZCTA.

Even though 'Ewa is seen as a new development area, where subdivisions are replacing cane fields, the density of settlement is already much higher than the statewide average.

[6] DP area demographics and projections are developed by the Department of Planning and Permitting, City and County of Honolulu. The 2010 counts are not yet posted. Because the DP areas do not overlap neatly with census tracts in the Waipahu area, the ZCTA figures seem the most useful current Census counts for the region.

Table 2-3: Demographic and Household Characteristics, 2010

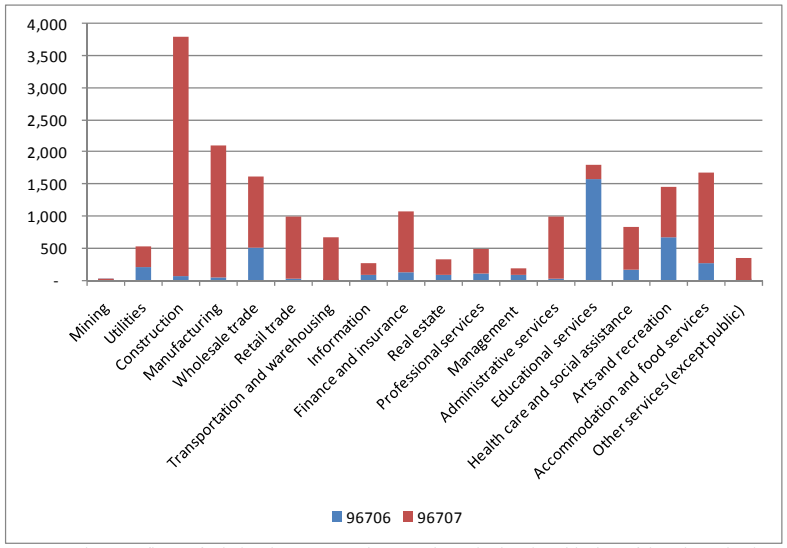
	State of Hawaii	Combined ZCTAs	'Ewa Beach ZCTA 96706	Kapolei ZCTA 96707
Population				
Total Population	1,360,301	101,547	62,730	38,817
Share under 18	22.3%	28.8%	28.8%	28.9%
Share 18 to 64	63.4%	63.0%	62.5%	63.7%
Share 65 and over	14.3%	8.2%	8.7%	7.4%
Median Age	38.6	NA	32.9	32.8
Share in				
Family Households	82.8%	91.8%	92.7%	90.3%
Non-family Households	14.1%	7.2%	6.9%	7.7%
Group Quarters	3.2%	1.0%	0.3%	2.0%
Housing				
Housing Units	519,508	30,780	18,319	12,461
Vacant Share	12.4%	7.1%	5.4%	9.7%
Occupied Units	455,338	28,584	17,331	11,253
Owner-Occupied Share	57.7%	67.8%	67.9%	67.7%
Share of Households				
Family Households	68.9%	82.3%	82.3%	82.2%
Non-family Households	31.1%	17.7%	17.7%	17.8%
Average Household Size	2.89	3.52	3.61	3.38
Owner-Occupied	3.02	3.64	3.75	3.48
Rental Units	2.72	3.25	3.3	3.18
Density of Settlement				
Persons per square mile	212	NA	3,661	895

SOURCE: U.S. Census data available on American FactFinder (www.census .gov) or through DBEDT (http://hawaii.gov/dbedt/info/census/Census_2010/SF1/DEC_10_SF1_GCT_ZIPCODE.xls).

2.3.2 Economics

With O'ahu's largest industrial area, second harbor, second resort area, and new business parks, the west side of 'Ewa has a diverse economic base. The east side has more limited employment opportunities. The largest industrial sector in the east side is education; in the west side, construction, manufacturing, and accommodation and food services each support thousands of jobs. (See Figure 2-4.)

Figure 2-4: Distribution of Jobs by Industry, ‘Ewa Zip Code Tabulation Areas, 2008



Note: Employment figures for industries are approximate, estimated using the midpoints of data shown by the U.S. Census in ranges.
Source: Zip Code Business Patterns for ZCTAs 96706 and 96707 for 2008, posted at www.census.gov.

2.3.3 Community Life and Facilities

Community organizations in ‘Ewa have emerged over decades. Churches and associated schools in ‘Ewa Beach and ‘Ewa Villages date back to the plantation years. On the west side, churches were established recently; some lack permanent facilities. In newer subdivisions, homeowners’ associations are responsible for community maintenance; they may also operate recreational facilities.

Hawaiian homestead areas in Kapolei have residents’ associations. The Kapolei Community Development Corporation was formed in 2008 to serve both existing and planned homestead communities. Responding to residents’ input, the Department of Hawaiian Homelands (DHHL) has leased parcels for a community center and commercial development to the corporation. The commercial parcel will be developed to support building and operating the Community Center, jobs, job training, and the quality of life of the homestead community. A request for proposals has been issued for the commercial component (personal communication, Shirley Swinney, President, Kapolei Community Development Corporation, July 2011).

The City and County of Honolulu established Neighborhood Boards to assure community participation in decision-making pursuant to its 1973 revised Charter. Currently, the DP area includes two elected Neighborhood Boards (‘Ewa Neighborhood Board Number 23 and Makakilo/Kapolei/Honokai Hale Neighborhood Board Number 34), covering the east and west sides of the area, respectively. The Neighborhood Boards have an advisory role, and provide an arena for expression of community concerns and views.

Active local organizations include the Hawaiian Railway Society, a group of volunteers who maintain historic railroad equipment and run a passenger train from its ‘Ewa Villages station to Ko ‘Olina. Youth sports leagues use local park areas; some have worked to maintain fields in the Kalaeloa district. As parts of the district have passed from Navy ownership to other hands, access, maintenance and security have been problematic. While the Hawaii Community Development Authority [HCDA] has oversight for the district, it depends on tenants to fund security patrols. The Navy continues to operate a golf course in the district, and cooperates with the City and County to patrol beach areas. A riding stable is near the golf course on Navy land, but its lease is expected to be terminated in 2012.

2.4 Anticipated Trends, 2011 to 2035

In the next few years, new institutions along Kualaka‘i Parkway will provide a center for the DP area, serving both east and west:

- The Honolulu High Capacity Rail line will run from a station beside the Kroc Center to Honolulu. It is planned to be fully operational by 2019. Trains may run from its western terminus to locations such as Pearl Harbor and the Honolulu Airport before the tracks extend to Ala Moana in Honolulu. (Eventually, the line could be extended to Kalaeloa and the City of Kapolei, and to Waikiki and the University of Hawai‘i at Mānoa.)

- The University of Hawai‘i West O‘ahu is slated to move all operations to its Kapolei campus as of the fall 2012 semester. The new campus will serve up to 7,600 students in time.

- The Kroc Center will provide recreational, meeting and worship facilities. At 200,000 square feet, it will be the largest recreational center in Hawai‘i. It is to open in 2011. It is located next to the terminus of the rail line.

- A community center for Department of Hawaiian Homelands (DHHL) residents and a separate commercial facility are planned by the Kapolei Community Development Corporation. The commercial facility will be located across Kapolei Parkway from the Ka Makana Ali‘i project.

With rapid population growth in ‘Ewa, traffic congestion has been a serious problem. The construction of Kualaka‘i Parkway, improvements to the H-1 highway interchange at Makakilo and opening of a new interchange at Kualaka‘i Parkway, along with widening of Fort Weaver Road have addressed the problem. Planned improvements to Fort Barrette Road and the Kapolei

Interchange Complex will be needed to reduce congestion in the western side of the area. Rush hour traffic to and from Honolulu via H-1 remains slow and is expected to become slower.[7]

When Naval Air Station Barbers Point closed in 1996, a direct route between ‘Ewa Beach and Kapolei (along Geiger Road, Franklin D. Roosevelt Avenue, and Fort Barrette Road) was opened. More recently, segments of Kapolei Parkway have been completed, making that drive possible along roads built to current standards.

In Kalaeloa, near-term initiatives include a headquarters for the Federal Bureau of Investigation, now under construction, and three different solar projects, capable of producing some 15 Megawatts of energy. Other recreational, commercial and residential areas have been planned, but are not now being developed, largely due to the high cost of infrastructure that would meet current standards. Further development within the district will depend on improvements in its roadways and utilities.

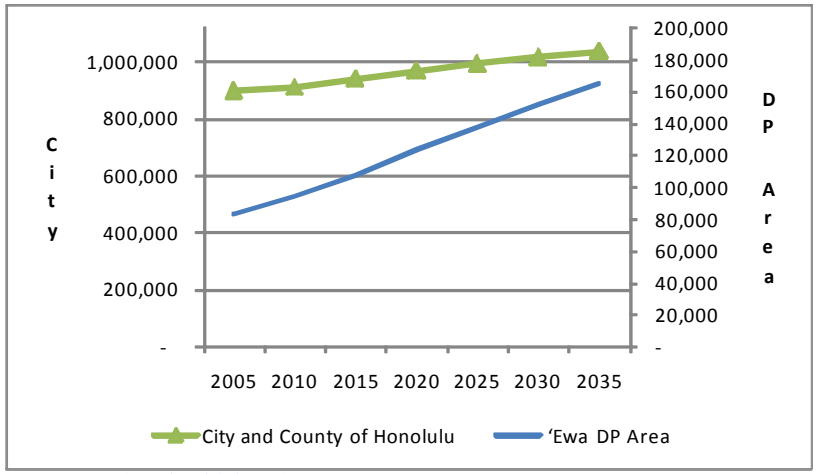
Much new housing for residents of O‘ahu will be built in ‘Ewa, so the DP Area population is expected to grow much faster than that of the City and County as a whole (as shown in Figure 2-5). Job growth is also projected for the region. (See Table 2-4.)

While little population growth is projected for ‘Ewa Beach/Iroquois Point and the Villages of Kapolei, all other sub-areas will see significant growth in both residents and jobs. A small visitor population has been projected for Ocean Pointe, and a larger one for Ko ‘Olina.

Commercial development is part of the largest projects slated for ‘Ewa. Ho‘opili includes a planned commercial area next to Waipahu that may include medical offices, and a second commercial area on Kualaka‘i Parkway (as shown in Figure 2-2). The University of Hawai‘i at West O‘ahu site includes lands for commercial and residential development. These will be expected to support further expansion of the University. A new shopping center has long been planned for Fort Weaver Road. A new Safeway store is to be built soon. Near Kapolei Shopping Center, a WalMart store is now under construction. At the western end of the DP area, Kapolei Commons is still being developed and additional commercial areas are planned for Makaīwa Hills.

[7] Oahu Metropolitan Planning Organization. *Oahu Regional Transportation Plan 2035.* Honolulu, HI, 2011. As noted in the plan, both the new rail system and job growth in ‘Ewa will tend to limit, but not reverse, increased traffic congestion along the highway.

Figure 2-5: Projected Population Increase, ‘Ewa Development Plan Area and City and County of Honolulu



SOURCE: DPP (www.honoluludpp.org).

Table 2-4: Population and Employment Projections, 2010 to 2035

	2010	2015	2020	2025	2030	2035
POPULATION						
Development Plan Subareas:						
Ewa Villages	5,650	6,227	6,403	6,550	6,677	6,834
Ewa Gentry/West Loch	26,458	27,315	27,411	27,440	27,447	27,490
Ewa Beach/Iroquois Pt	17,972	17,860	17,670	17,464	17,260	17,072
Ocean Pointe	6,652	7,981	8,783	9,235	9,657	10,117
Kalaeloa/Campbell Ind Park	1,381	1,690	3,147	5,057	7,484	10,534
Ko Olina/West Kapolei	3,942	4,766	6,750	7,697	8,344	9,040
City of Kapolei	756	3,339	4,804	6,418	7,469	8,577
Villages of Kapolei	14,012	14,422	14,462	14,466	14,465	14,471
East Kapolei	809	4,382	11,803	18,605	26,421	32,886
Makakilo/Makaiwa Hills/Kunia	16,872	19,252	21,868	24,789	26,108	27,535
‘Ewa Development Plan Area	94,504	107,234	123,101	137,721	151,332	164,556
O‘ahu Total	**911,841**	**941,847**	**969,467**	**994,632**	**1,017,576**	**1,038,317**
Ewa share of Island Total	10%	11%	13%	14%	15%	16%
JOBS						
Development Plan Subareas:						
Ewa Villages	1,485	1,480	1,459	1,485	1,557	1,639
Ewa Gentry/West Loch	3,591	4,007	4,020	4,235	4,501	4,758
Ewa Beach/Iroquois Pt	3,302	3,429	3,432	3,484	3,620	3,759
Ocean Pointe	1,233	2,517	2,600	2,799	3,006	3,139
Kalaeloa/Campbell Ind Park	7,951	10,714	13,430	17,124	20,303	23,296
Ko Olina/West Kapolei	2,623	4,000	4,618	4,810	5,081	5,287
City of Kapolei	13,591	16,730	18,899	20,774	22,116	23,112
Villages of Kapolei	3,138	2,843	2,731	2,794	3,024	3,301
East Kapolei	6,855	13,857	17,801	21,764	25,658	29,558
Makakilo/Makaiwa Hills/Kunia	2,407	3,087	3,984	4,825	5,225	5,585
‘Ewa Development Plan Area	46,176	62,664	72,974	84,094	94,091	103,434
O‘ahu Total	**561,684**	**597,183**	**621,115**	**643,963**	**666,194**	**688,380**
Ewa share of Island Total	8%	10%	12%	13%	14%	15%

SOURCE: Allocation by City and County of Honolulu Department of Planning and Permitting of County population and employment projected by DBEDT. Projections were made in mid-2009, and take into account the recession felt as of 2008. Sub-areas are shown in Figure 2-3.

2.5 Community Issues and Concerns

2.5.1 Sources

Written sources for this report include the minutes of the two regional Neighborhood Boards (‘Ewa Neighborhood Board No. 23 and Makakilo/Kapolei/Honokai Hale Neighborhood Board No. 34) from January 2009 through May 2011 and newspaper accounts of local controversies. A few stakeholders were interviewed to learn of local concerns. These are listed in Table 2-5. Belt Collins Hawaii has conducted interviews with regard to various plans and projects in the ‘Ewa DP area in the past, and relies on that experience as well.

Table 2-5: Stakeholders Interviewed for this Report

Interviewee	Affiliation
Major Raymond Ancheta	Commander, Kapolei Station, Honolulu Police Department
Pearline Fukuba	HCDA Kalaeloa District
Terry Hildebrand	‘Ewa Villages resident, Planner
Larry Howard	Member, Board of Directors, Hawaiian Railway Society
Dana Kobashigawa	Interim Principal, Kapolei Middle School
Matthew LoPresti	Member, ‘Ewa Neighborhood Board, recent candidate for City Council, District 1
Tesha Malama	HCDA Kalaeloa District; Past Chair, ‘Ewa Neighborhood Board
Beth Malvestiti	HHFDC; Member of Board of Directors, Villages of Kapolei Association
Shirley Swinney	Executive Director, Kapolei Community Development Corporation
Virgil Rewick	Member, Board of Directors, Hawaiian Railway Society

2.5.2 Issues and Concerns Independent of the Project

In interviews, local stakeholders discuss traffic congestion immediately as a regional problem. The slow process of designing and building Kualakaʻi Parkway (long known as the North-South Road) over two decades has fueled a widely-held sense that the area's needs are not a priority for State and County agencies. Next, the poor condition of older roadways has led to fatalities (of pedestrians as well as automobile passengers).

Many ʻEwa residents have expressed strong support for the new rail transit system. However, some residents of eastern ʻEwa have argued that the new system should be re-aligned to serve their communities as well as the west.

Local community stakeholders have long pressed for development of new schools and have greeted innovative schools warmly. However, by the time new schools are built, they typically serve a large population and soon include portable structures as well as permanent facilities. Kapolei schools are on a multitrack calendar, to allow them to serve a large student population.

Continued operation of the Waimānalo Gulch Sanitary Landfill for the City and County of Honolulu has long been contested by stakeholders from Kapolei and from the Waiʻanae Coast. The landfill and trucks carrying refuse to it are identified as sourced of trash and dust affecting residential areas and the ocean. Both Mayor Hannemann and Mayor Carlisle have supported planning for an alternative site and measures to decrease waste going to the landfill, while expanding the existing landfill.

Crime and vandalism have been problems in Kalaeloa and at the western edge of ʻEwa Beach. These areas were not well patrolled for many years. Homeless campers occupied areas in Kalaeloa near the ocean. These have been evicted, but much of the district is undeveloped land covered by brush. Transitional housing for homeless veterans and families has been developed in old Navy facilities in the urbanized part of the district. These are supported by service agencies and a shuttle service.

After the closure of Naval Air Station Barbers Point, area residents have sought to keep several facilities open for community use. These include a child care center and bowling alley in the Downtown area, along with sports fields near the northern edge of the Kalaeloa District. Pride Field, across Franklin D. Roosevelt Avenue from the project site, is heavily used for baseball and softball.

2.5.3 Concerns with Regard to the Project

Both interviewees and community groups listening to presentations about Ka Makana Aliʻi expressed concern that it would create or add to traffic congestion. Questions were raised concerning construction traffic during rush hour periods and about eventual growth in traffic as Ka Makana Aliʻi becomes a retail and entertainment destination. Pedestrian safety was of concern, given the size and location of the project.

Some interviewees saw the project as leading to further development of the Kalaeloa District. While they welcomed investment, they had questions about a future extension of Kualakaʻi Parkway. This future road would cross tracks used by the Hawaiian Railway Society and could affect traffic on Franklin D. Roosevelt Avenue and other roads within Kalaeloa.

When the project was introduced to the two regional Neighborhood Boards, questions were raised concerning the following:

- The project's location on DHHL property: some view the use of DHHL land for commercial uses when Hawaiians in the beneficiary pool do not have leases as inappropriate. (However, DHHL leases lands for commercial and industrial use to fund the homestead program.)[8]
- Whether the project would fund or support a road link between Kapolei Parkway and Roosevelt Avenue. (The State Legislature has allocated funds to build an extension of Kualakaʻi Parkway to Roosevelt Avenue. The Ka Makana Aliʻi project does not make that link necessary.)
- Whether water and sewer lines were in place to support the project. (They were.)
- Whether the project would increase water use. (Past plans for the site already allowed for the use of water equivalent to that needed to support approximately 34 households.)
- Whether the project would involve "green" buildings. (Plans include sustainable design for some of the buildings.)
- How the project would affect the Hawaiian Railway Society. (The State Department of Transportation and the developer were working with the society to resolve problems.)
- Whether the project would respond to the spectrum of residents' needs. (The response indicated that medical care and child care could be part of the project, as well as retail stores, if justified by demand.)

Interviewees largely viewed the project as benefitting the region. They saw a commercial center as offering new shopping opportunities. They expected that the project operators would be able to co-operate with nearby institutions.

[8] The responses provided here mostly paraphrases of ones recorded in Neighborhood Board minutes. No response was recorded to the comment about the use of DHHL lands; the comment shown here is based on the Department's stated policies.)

3 Socio-Economic Impacts

Economic impacts are discussed first, since they can be quantified. Other social impacts are less clear-cut, and their scale depends on economic impacts. Fiscal impacts are discussed last, since these follow both from the economic estimates and from demand for public services.

3.1 Economic

Construction of the project will generate jobs, both on-site and throughout the economy. Job and wage impacts are estimated using the State's Input-Output model. It distinguishes direct impacts – for construction, work in the firms building a project – from indirect and induced ones. Indirect impacts occur as firms directly involved in an activity purchase materials and supplies from other firms. Induced impacts occur as workers in direct and indirect jobs spend their pay in the regional economy.

Jobs due to project operations can also be estimated, and their indirect and induced impacts can similarly be projected. The direct jobs at the project are important for the local community. They will help local residents find work near home. For the island economy and the state as a whole, the location of those jobs at Ka Makana Ali‘i does not count as an impact, since nearly all the spending that supports those jobs would occur somewhere on the island of O‘ahu even if the project were not built.

3.1.1 Construction Employment and Wages

Table 3-1 shows calculations of construction jobs and wages derived from estimated construction cost. Construction work on a project is not permanent, so these job impacts are counted in person-years, i.e., full-time jobs for a year.

Construction of Phase 1 would generate about 190 direct person-years of work; construction of Phase 2 would involve approximately 1,470 person-years. The total employment impact of Phase 1 construction is approximately 550 person-years, while the total impact of Phase 2 construction is nearly 4,280 person-years of work.

Direct construction jobs include on-site work and work in contractors' yards and offices. The actual number of workers at a job site varies from day to day, depending on the type of work to be done. (If a construction project involves 60 person-years of direct work over 18 months, the average number of direct jobs would be 40 per year. However, many workers could be present in some phases, and few at others.) Indirect jobs are located at suppliers' places of business, while induced jobs are found throughout the island, wherever workers spend their wages.

3.1.2 Operations Employment and Wages

Once Ka Makana Ali‘i opens, it will offer permanent jobs in retail, eating and drinking establishments, and hotels. Office space will house a range of businesses. Project management, maintenance and security work will be needed as well. Table 3-2 provides an estimate of the number of these permanent jobs on-site, once each phase of the project is completed, along with the indirect and induced jobs associated with them. More than 3,900 direct jobs will eventually be located at Ka Makana Ali‘i.

Direct operations jobs continue year after year, and so do the indirect and induced jobs associated with them. The calculations show employment with build-out and occupancy of each phase of the project. These levels will be reached over several years' time.

Table 3-1: Construction-Related Employment and Wages

	Phase 1	Phase 2	Combined
Construction Cost (Million $s)	$40.0	$310.0	$350.0
Construction-Related Jobs (Person-Years)			
Direct	189	1,468	1,657
Indirect and Induced	363	2,812	3,175
Total	552	4,280	4,832
Construction-Related Wages (Million $s)			
Direct	$13.0	$100.6	$113.5
Indirect and Induced	$16.3	$126.1	$142.3
Total	$29.2	$226.6	$255.9

NOTES: Construction costs estimates supplied by Hawaii DeBartolo LLC.

Direct construction jobs estimated from ratio of excise tax base for construction to annual job count for 2009. Direct construction jobs include on-site jobs and ones at yards and headquarters needed to support firms' work on construction. Indirect jobs are jobs in firms supplying materials and services to direct construction firms; induced jobs are jobs supported by spending of the workforce in direct and indirect jobs. The ratio of indirect and induced jobs to direct jobs is estimated from the State's Input-Output model, as recently updated to take into account 2007 Economic Census data. All construction employment estimates are in "person-years," i.e., full-time jobs for a year. The actual number of workers on a construction site will vary depending on the phase of work.

Wages are estimated from the average wages in construction (for direct jobs) and all covered employment (for indirect and induced jobs) in the City and County of Honolulu in 2009. Average wages have been increased to mid-2011 dollars in line with increases in the Consumer Price Index for Honolulu.

SOURCES: DBEDT, *State of Hawaii Data Book, 2009; Hawaii State 2007 Input-Output Model; Quarterly Statistical and Economic Report, Second Quarter 2011*; Hawaii State Department of Labor and Industrial Relations, *Employment and Payrolls in Hawaii, 2009.*

Table 3-2: Operations-Related Employment

COMPONENT OF PROJECT	DIRECT JOBS (1) Phase 1	Phase 2	Both Phases	INDIRECT AND INDUCED JOBS (2)	TOTAL
Retail	400	1,340	1,740	886	2,626
Eating and Drinking	200	640	840	361	1,201
Entertainment		50	50	28	78
Offices		870	870	901	1,771
Hotel		380	380	372	752
Project Administration, Maintenance	10	25	35	29	64
Total	610	3,305	3,915	2,578	6,493

NOTES:
(1) Employment estimated on the basis of estimated gross square footage for various uses.

Retail	varies:	from 2 to 3.5 per 1,000 sq. ft
Eating and Drinking	3.15	per 1,000 sq. ft
Entertainment	1.3	per 1,000 sq. ft
Offices	4	per 1,000 sq. ft
Hotel	0.75	per hotel room

(2) Indirect and induced jobs estimated from Hawaii State Input Output tables based on a model developed and refined by DBEDT, incorporating 2007 Economic Census data. For this analysis, office jobs were assigned to the "other professional services" industrial category.
SOURCES: DBEDT, *Hawaii State Data Book, 2009*; *Hawaii State Input-Output Model, 2007.*

Operations-related wages can be estimated from average salaries in different industries. (See Table 3-3.) The amounts shown are for annual wages once each phase of the project is built out. Wages will likely increase in each phase as it is developed and spaces within the commercial center are filled.

Table 3-3: Operations-Related Wages

	Industry	Annual Wages Associated with Project (Million $s) Phase 1	Phase 2	Both Phases
Direct Jobs				
Retail	Retail	$11.5	$38.7	$50.2
Eating and Drinking	Eating/Drinking	$4.8	$15.3	$20.1
Entertainment	Arts and Entertainment		$1.3	$1.3
Offices	Average of Covered Employment		$39.0	$39.0
Hotel	Accommodation	$0.0	$9.1	$9.1
Project Administration, Maintenance	Administrative, Support Services	$0.3	$0.8	$1.1
Direct Jobs Total		$16.6	$104.1	$120.7
Indirect and Induced Jobs	Average of Covered Employment			$115.6

NOTES: Wages estimated from 2009 averages, adjusted to 2011 in line with the Consumer Price Index.
SOURCE: Department of Labor and Industrial Relations, *Employment and Payrolls in Hawaii, 2009*; DBEDT, *Quarterly Statistical and Economic Report, Second Quarter, 2011.*

3.2 Population and Housing

The project will provide jobs that may appeal to local residents. Office space in the project will help island firms to locate or expand activities in 'Ewa. No direct resident population impact is anticipated, since few or no employees will need to move from outside O'ahu to fill positions at Ka Makana Ali'i.

When firms establish offices or stores in a new commercial area, many current employees must commute from other neighborhoods. Over time, the project's workforce will likely be drawn increasingly from 'Ewa, since jobs will be convenient for local residents. Also, the regional center will be an amenity for residents, offering a wide range of goods and services.

Consequently, while the project is likely to have little or no impact on resident population, it may contribute to housing demand in the 'Ewa region, and may make the region more attractive to some residents of other parts of the island.

The hotel component of the project introduces a new facility for non-residents. It will serve travelers on business or visiting family and friends in the region, and will be designed as less upscale than the major hotels in Waikiki and Ko 'Olina. One market served by these hotels will be sports teams attending tournaments or similar events at the Waipi'o Peninsula Soccer Park or Central O'ahu Regional Park. Major tournaments bring teams from other islands in Hawai'i and from the U.S. Mainland. It is reasonable to expect that hotels near the major sports venues will benefit visiting teams and their supporters, especially ones from the Neighbor Islands.

Presumably, many of the hotel guests would come to the area in any event, staying in resort hotels or with family and friends. The hotels at Ka Makana Ali'i will make it easier for some travelers to come to 'Ewa and for others to extend their stays. With some 500 rooms, the hotels can be expected to house, on average, some 700 persons.[9] If approximately 20 percent of these are attracted to stay because of the new facilities, the impact would be an increase of the visitor population by 140 persons.[10] This is small, both in comparison with the number of tourists on O'ahu (80,324 in 2009)[11] and with the resident population of 'Ewa (over 100,000 by 2010), and therefore does not amount to a significant impact.

3.3 Public Facilities

Public facilities considered in this report include recreation, education, medical services, and public safety.

[9] This assumes average occupancy of 70% of available rooms, and two persons per room.
[10] The 20 percent figure is a high estimate of the likely new visitor impact. It is intended to include both new visits and potentially longer visitor stays.
[11] Hawaii Tourism Authority, *2009 Annual Visitor Research Report*. Honolulu, HI. 2010.

3.3.1 Recreation

Existing Conditions and Future without Project:

The ‘Ewa DP area includes beach parks, neighborhood parks, community parks, and space for regional park development. The developed park acreage totaled approximately 211.6 acres as of 2003.[12] Eventually, regional, district, community, neighborhood and beach parks could cover as much as 714.2 acres.[13] However, that estimate includes acreage in Kalaeloa that may require investment by the City and County, along with smaller parks that are more likely to be developed by private parties. Nearby, in Central O‘ahu, the City and County of Honolulu has created a regional park (Central O‘ahu Regional Park) and a soccer facility serving the entire island (Waipi‘o Peninsula Soccer Park).

Area residents note that fields for organized sports are in great demand in the region. The Kroc Center will add a gymnasium, an aquatics complex, and a sports field.

Plans for the UHWO property have included play fields and a gymnasium, but these are not included in near-term development. Similarly, while the City and County has claim to acreage in Kalaeloa for sports-related projects, no plans for their development are currently being advanced.

Future with Project:

The Ka Makana Ali‘i project will include entertainment and recreation facilities, such as a cineplex and health club. It may include play areas for children, but will probably not have facilities for outdoor sports.

3.3.2 Schools

Existing Conditions and Future without Project:

The ‘Ewa Development Plan Area includes eleven public elementary schools, three middle schools, and two high schools, as shown in Table 3-4 The school population has grown quickly. The Department of Education (DOE) has opened new schools in recent years, and has organized schedule and programs so that schools such as Kapolei Middle School can operate with high enrollments.

[12] Department of Land and Natural Resources, *Statewide Comprehensive Outdoor Recreation Plan.* Honolulu, HI, 2003.

[13] Department of Planning and Permitting, City and County of Honolulu. *Public Review Draft, Ewa Development Plan.* Honolulu, HI: 2008, Table 3.1.

Table 3-4: Public School Enrollment, ‘Ewa Development Plan Area

School	2010-2011 Enrollment
Barbers Point Elementary	401
Ewa Beach Elementary	507
Ewa Elementary	1,003
Holomua Elementary	1,382
Iroquois Point Elementary	718
Kaimiloa Elementary	610
Kapolei Elementary	1,043
Keoneula Elementary	847
Makakilo Elementary	502
Mauka Lani Elementary	563
Pohakea Elementary	565
Ewa Makai Middle	587
Ilima Intermediate	777
Kapolei Middle	1,424
Campbell High	2,639
Kapolei High	2,107

SOURCE: Hawai‘i State Department of Education, enrollment data posted at http://doe.k12.hi.us/reports/enrollment.htm

The National Guard operates the Youth ChalleNGe program for at-risk youth, helping them earn high school diplomas in a structured program, at a site in the Kalaeloa redevelopment area. Nearly 200 cadets graduate each year.

Private schools in the area include Island Pacific Academy in Kapolei, Friendship Christian and Lanakila Baptist in Ewa Villages, and Messiah Lutheran and Our Lady of Perpetual Help in ‘Ewa Beach.

Additional schools are proposed for sites in the UH West O‘ahu lands, the Ho‘opili project, the DHHL East Kapolei Phase I project, and the East Kapolei Phase II project, including a new elementary school adjacent to the proposed community center. When residential development occurs in the Kalaeloa Community Development District, additional schools would be needed in that area.

University of Hawai‘i West O‘ahu enrolls some 1,306 students at its Pearl City campus (as of mid-2011). The university will move to its new site in fall 2012. The campus is designed for eventual enrollment of 7,600 students.

Future with Project:

The project will have little or no effect on the size of the resident population of the region, so it will not add to the student population for the local schools. No significant impact is expected.

3.3.3 Medical Facilities

Existing Conditions and Future without Project:

'Ewa is served by a single hospital, Hawaii Medical Center – West, founded as St. Francis Medical Center West. It has 102 beds. It is located on Fort Weaver Road. The Kaiser and Queens health systems have clinics in Kapolei.

The Emergency Medical Services Division, City and County of Honolulu Emergency Services Department, has 19 ambulance units and two rapid response paramedic units located on O'ahu. The project site is in the region serviced by the Makakilo ambulance unit. Honolulu Fire Department units also commonly respond to emergency calls.

With continuing residential development in the region, demand for medical services can be expected to increase.

Proposed senior residential areas (Franciscan Vistas in 'Ewa Villages; Leihano in Kapolei) may make nursing care available to residents and some neighbors.

The proposed Ho'opili development would include a commercial area near the Hawaii Medical Center – West hospital. Medical offices could be located there if demand warrants.

Future with Project:

The project may include medical offices or clinics. While it will increase the visitor population in 'Ewa slightly, it is not expected to have a significant impact on demand for medical services.

3.3.4 Public Safety

Existing Conditions and Future without Project:

The Honolulu Police Department (HPD) has a district headquarters in the City of Kapolei. For O'ahu as a whole, the department has 2.3 officers for every 1,000 residents.[14] District 8 of the City and County of Honolulu Police Department covers most of the '*Ewa Development Plan* area and all of the Wai'anae Coast. (Part of 'Ewa near Waipahu is included in District 3).

The Kalaeloa Redevelopment District is patrolled in part by private security services. The Honolulu Police Department responds to calls from that area. (The Navy withdrew its security patrols after the closure of Barbers Point Naval Air Station in 1996. Vandalism and theft of property from unprotected buildings occurred. By 2004, as many as 100 people were living in cars and tents near Nimitz Beach until HPD and representatives of other City agencies conducted a sweep of the area.)

[14] HPD statistics for 2009, posted at http://www.honolulupd.org/download/HPD2009annualreportstats.pdf.

A West O'ahu Security Coalition has recently formed. It brings together private security firms and local businesses as partners with HPD to increase public safety (personal communication, Major Raymond Ancheta, HPD, July 2011).

The Honolulu Fire Department (HFD) has stations in Makakilo (No. 35) and on the west side of Kapolei (No. 40). A new station is under construction by the Kapolei Parkway/Kualaka'i Parkway intersection. It is planned to house both an engine and ladder company, and to have space for emergency supplies and for training facilities.[15]

With population growth in the region, demand for public safety services is likely to rise over time. However, road improvements have reduced traffic congestion in parts of the region. Kualaka'i Parkway provides a new central corridor, connected to new H-1 interchange and major East-West roadways (Farrington Highway and Kapolei Parkway). Traffic congestion, and hence traffic control duties for HPD, is now more likely on Fort Barrette Road and at the west end of Kapolei.

Future with Project:

Located on two major new roads, the project is not likely to create major traffic control problems for HPD. The traffic study of the project indicates that it will not cause a significant reduction in level of service on the surrounding roadways.

During construction, cement trucks will be able to reach the site from Makakilo Quarry via Kualaka'i Parkway. As a result, project construction is likely to pose little problem for traffic control, even during peak traffic periods.

Currently the project site has no immediately adjacent neighbors, and it can be reached by Roosevelt Avenue in Kalaeloa as well as by Kapolei Parkway and Kualaka'i Parkway. In light of the history of vandalism in Kalaeloa, it may be prudent for the developer to provide security for all construction materials stored at the site.

With a new station near the project, HFD is well situated to respond to incidents at Ka Makana Ali'i. The project will be built to current codes, and hence will be better designed than older facilities to minimize risks of fire.

3.4 Fiscal Impacts: Government Revenues and Costs

3.4.1 Approach

Fiscal impacts consist of the revenues and costs for government agencies due to a project. Revenues can be estimated from information about construction and operations of the project, taken with current tax structures. Costs may arise if a project introduces new populations, new calls for service, or new demands for maintenance. Some of these can be quantified, e.g., the cost

[15] J. Goolsby, "New Fire Station Slated for Kapolei." *Midweek.* July 28, 2010.

of supporting a new resident or visitor population, based on recent government spending. Others are not easily estimated, both because costs are not easily associated with a single project and because it is far more difficult to break out specific operations costs than capital improvement costs.

A commercial project responds to demand from the public. It does not generate spending so much as accommodate increased spending in the economy or provide a new location for spending that would go elsewhere if the project were not built. Hence the operations of stores and firms located at Ka Makana Ali‘i are not counted here as generating new public revenues. Construction of the project clearly involves new spending, and hence new tax revenues. Similarly, some hotel guests at the project arguably would not come to O‘ahu if the project were not built. Both revenues and costs associated with this visitor population growth are treated as project impacts.

3.4.2 Revenues

Public revenue streams associated with the project include transportation impact fees, construction-related taxes, property taxes, and taxes on visitor spending.

The ‘Ewa Transportation Impact Fee program (Revised Ordinances of Honolulu Chapter 33A) was created to help develop roadways serving the region in a period of rapid growth. Developers contribute to the program at the time that building permits are obtained, in amounts determined by the type of new development (residential, retail, office, industrial, hotel or timeshare) and the number of units or area being built. The current fee structure is under review. Since it became law, road construction costs have increased sharply. A new fee structure is being developed by the City and County, based on a model of 2020 regional transportation demand and input from developers. Table 3-5 estimates transportation impact fees according to the current program. A future program to be proposed to the City Council is likely to include higher fees and an escalator clause (so fees rise along with construction costs). Consequently, the fee estimate in Table 3-5 is likely to be much less than the fees that would be charged in the future.

Table 3-5: Estimate of Transportation Impact Fees for the Project

Project Components			
Retail / Entertainment		Gross SF	927,572
Office		Gross SF	217,000
Hotel		Units	500
Transportation Impact Fee			
Retail	per	1,000 Gross SF	$4,053
Office	per	1,000 Gross SF	$3,403
Hotel	per	Unit	$1,003
Fees for Ka Makana Ali'i			
Retail			$3,759,449
Office			$738,451
Hotel			$501,500
Total			$4,999,400

Construction spending will generate revenues from excise and income taxes as estimated below in Table 3-6. The City and County of Honolulu collects a share of the excise taxes levied on O‘ahu to cover the cost of the rail transit system. It is assumed here that the County surcharge would still be in force throughout the time of project construction.

Table 3-6: Construction-Related Revenues

	Phase 1	Phase 2	Combined
Construction cost (1)	$40	$310.0	$350.0
Construction-related Wages (2)	$29	$226.6	$255.9
Excise Taxes To State (3)			
On Construction	$2	$12.6	$14.2
On Spending by Workforce (4)	$1	$5.7	$6.5
Excise Taxes to City and County of Honolulu (3)			
On Construction	$0	$1.4	$1.6
On Spending by Workforce (4)	$0	$0.6	$0.7
Income Taxes			
Corporate (5)	$0	$0.5	$0.6
Personal (6)	$2	$13.8	$15.6
Total Revenues from Construction Spending			
State of Hawaii	$4	$32.6	$36.8
City and County of Honolulu	$0	$2.0	$2.3

NOTES:
(1) Estimated by DeBartolo Hawaii LLC.
(2) From Table 3-1.
(3) The State collects General Excise Tax (4%) and, on O'ahu, an additional tax for transit (.5%). Act 247 of 2005 directs the State to retain 10% of the County surcharge for administration costs. Hence the State share of excise taxes is 4.05%, while the City and County share is 0.45%
(4) Excise tax is calculated on disposable income, estimated as 62.6% of wages (from historical spending rates).
(5) Corporate income tax estimated (from historical rates) as 0.17% of revenues (data from 2000).
(6) Personal income tax estimated as 6.1% of taxable income (from 2005 data).
SOURCES: Hawaii State Department of Business, Economic Development and Tourism, 2005; Hawaii State Department of Taxation, 2001, 2008

Once the site is improved, the City and County of Honolulu will begin to collect property taxes based on the value of the land for commercial use and on the value of the improvements to the land. Table 3-7 includes calculations of the property taxes levied by the City and County on the property, once each Phase is developed and opened. It shows that taxes on Phase 1 of the project would amount to about $700,000 annually, while taxes on the fully developed project would approach seven million dollars annually. (As DHHL land not in productive use, the land is currently not taxed, so all property taxes on the project are a net impact.)

Table 3-7: Annual Real Property Tax Revenues, Ka Makana Ali'i

		Phase 1	Phase 2	Combined
Land Area (acres)		19.78	47.45	67.23
Land Value				
Estimated value/sq. ft.	$22.00			
Value of Property (Million $s)		$19.0	$45.5	$64.4
Cost of Improvements (Million $s) (1)		$36.0	$279.0	$315.0
		$55.0	$324.5	$379.4
Real Property Tax				
Commercial Rate (2)	$12.40			
Annual Tax (Million $s)		$0.7	$4.0	$4.7

NOTES:
(1) Estimated as 90% of construction cost.
(2) Rate per $1,000 value of land or improvements. Currently, rates for hotel, commercial and industrial properties are all the same. Current rate is for the 2011-2012 tax year.
SOURCES: Honolulu Real Property data downloaded and analyzed by Belt Collins Hawaii from Hawaii Information Service, Inc. City and County of Honolulu, Department of Budget and Finance, Real Property Assessment Division.

Lease payments to DHHL will constitute an additional revenue source for the State. These have been set for the first 25 years of the lease. The cumulative ground rent over the first 25 years will amount to $141,846,800 – for an annual average ground rent of $5,673,872. For the following 40 years, the rent will be renegotiated based on an independent appraisal process prior to the commencement of the 26th, 36th, 46th and 56th years.

New visitors will provide the State and County with tax revenues, while also generating costs for the provision of public services to an additional population. Table 3-8 estimates direct tax revenues once the hotels are built and occupied.

Table 3-8: Annual Tax Revenues on Direct Visitor Spending

Persons		
New visitor population (1)		
Rooms		500
Average persons/room		2
Average occupancy (of rooms)		70%
Average number of guests at hotels		700
Share of guests who would not come to O'ahu without the project	up to	20%
High estimate of new visitors		140
Revenues (2)	*2009 $*	*2011 $*
Average daily visitor spending per person, O'ahu, 2009	$174.20	$182.27
Average spending on lodging per person, 2009	$65.50	$68.53
Annual excise tax on visitor spending , new visitors		
State of Hawaii (4.05%)		$377,209
City and County of Honolulu (0.45%)		$41,912
Annual Transient Accommodations Tax, new visitors (2)		$296,511
State of Hawaii (55.2%)		$163,674
City and County of Honolulu (19.8%)		$58,581

NOTES:

(1) Estimates of occupancy, guests per room and share of guests who are new visitors developed by Belt Collins Hawaii.

(2) Average visitor spending for visitors on O'ahu, 2009, from Hawaii Tourism Authority, *Annual Visitor Research Report 2009*. TAT and GET levels, and State and County share of each are calculated on the basis of current practice.

SOURCES: DBEDT, *State of Hawaii Data Book 2009*; Hawaii Tourism Authority, *Annual Visitor Research Report 2009*

3.4.3 Costs

The cost of public services provided to new visitors can be estimated on the basis of average costs, i.e., total costs allocated to all users equally. Tables 3-9 and 3-10 show calculations for average costs per visitor (based on government spending in earlier years, adjusted to 2011 dollars). Table 3-11 applies those calculations to the new visitors associated with the project once it is fully occupied.

Table 3-9: Average Cost of Public Service Provision to Visitors, State of Hawaii

	FY 2008 spending ($1,000s)	Spending for residents or all?	Visitor share
General expenditure, by function:			
General government	537,541	All	$387
Education	$3,040,223	Residents	--
Public welfare	$1,857,473	Residents	--
Health	$863,914	All	$622
Highways	$406,795	All	$293
Public safety	$411,152	All	$296
Natural resources	$103,596	All	$75
Culture and recreation	$110,404	All	$75
Urban redevelopment, housing	255,783	Residents	--
Economic development and assistance	$149,075	Residents	--
Debt service	$478,735	All	$345
Other and unallocable	$5,880	All	$4
Total	$8,220,571	Total	$2,098
		Adjusted to 2011	$2,206

NOTES: Average cost calculated for resident or de facto population, depending on function. Spending is for most recent year for which expenditures reported by function in Data Book.

State of Hawaii Population, mid-2008:

Residents	1,287,481
De Facto	1,387,888

Total resident share adjusted to 2011 in line with increase in Consumer Price Index (5.17%)

SOURCE: DBEDT, *State of Hawaii Data Book 2009*; *Quarterly Statistical and Economic Report, Second Quarter, 2011.*

Table 3-10: Average Cost of Public Service Provision to Visitors, City and County of Honolulu

	FY 2003 Spending ($1,000s)	Spending for residents or all?	Visitor share
General expenditure, by function:			
General government:	$115,067	All	$124
Public safety:	$246,109	All	$266
Highways	$13,831	All	$15
Mass transit	$150,523	Residents	--
Miscellaneous	$101,655	All	$110
Sanitation	$265,331	All	$287
Health and human resources	$52,007	All	$56
Culture and recreation	$62,260	All	$67
Urban redev. and housing	$22,275	Residents	--
Utilities and other enterprises	$22,557	All	$24
Capital outlay	$193,722	All	$209
Debt service	$120,332	All	$130
Total	$1,365,669	Total	$1,289
		Adjusted to 2011	$1,681

NOTES: Average cost calculated for resident or de facto population, depending on function. Spending is for most recent year for which expenditures reported by function in Data Book.

City and County of Honolulu Population, mid-2003:

Residents	888,026
De Facto	925,595

Total resident share adjusted to 2011 in line with increase in Consumer Price Index (30.46%)

SOURCE: DBEDT, *State of Hawaii Data Book 2009; Quarterly Statistical and Economic Report, Second Quarter, 2011.*

Table 3-11: Annual Cost of Public Services for New Visitors Staying at the Project

Costs		
Average annual cost of public services per visitor		
State of Hawaii		$2,206
City and County of Honolulu		$1,681
Average annual cost, new visitors at project		
New visitors at project	140	
State of Hawaii		$308,853
City and County of Honolulu		$235,386

NOTES: Average cost per visitor calculated in Tables 3-9 and 3-10. Annual cost based on new visitor share estimated in Table 3-8.

Additional costs associated with new demand for public services and maintenance of public utilities may well be generated because the project adds to the urban area on the island. These are not further calculated here.

3.4.4 Net Fiscal Impact

The revenues and costs estimated above result in large net benefits for both the State of Hawaii and the City and County of Honolulu, as summarized in Tables 3-12 and 3-13. The major cash flow for the State general fund is the one-time tax revenue flow associated with construction. The City and County will also collect revenues during construction, through the transportation impact fee and excise taxes. For the City and County of Honolulu, new property tax revenues provide continuing annual revenue streams in the millions of dollars. DHHL will collect lease rent annually. For both, the State and the City and County, new costs will arise above all once the project has been largely built, and new visitors come to stay at the hotels. The net impacts shown here for annual cash flows cover the years after the project is fully built out, and visitor-related costs have stabilized.

The calculations shown here demonstrate that both the State of Hawaii and the City and County of Honolulu will gain significant benefits from the Ka Makana Ali'i project. Even though some additional costs may arise that have not been estimated here, it is clear that the net fiscal benefit associated with the project far outweighs likely costs.

Table 3-12: Net Fiscal Impact of the Project for the State of Hawaii

Costs	
Average annual cost of public services for visitors attracted by the project	$308,853
Revenues	
One-time revenues:	
Associated with construction	$36,846,764
Continuing Revenues (Annual)	
DHHL lease payments (1)	$5,673,872
Income from visitor spending	$540,883
Continuing Net Revenues (Revenues > Costs)	
Annual, after build out	$5,905,902

NOTE: Annual average lease payment estimated from cumulative payments over the first 25 years of the lease. Subsequent lease payments will be renegotiated, based on independent appraisals.

Table 3-13: Net Fiscal Impact of the Project for the City and County of Honolulu

Costs	
Average annual cost of public services for visitors attracted by the project	$235,386
Revenues	
One-time revenues:	
Associated with construction	$2,296,054
Transportation Impact Fee	$4,999,400
	$7,295,455
Continuing Revenues (Annual)	
Revenues from Visitor Spending	$100,493
Real Property Tax revenues	$4,704,905
Continuing Net Revenues (Revenues > Costs)	
Annual, after build out	$4,570,013

3.5 Other Potential Impacts on the Community

Construction will involve temporary impacts: dirt, fugitive dust, noise and traffic congestion due to large loads. These have been irritants for ‘Ewa residents in the past. All of these can be limited by using best practices, and are subject to State and County rules that limit impacts on neighbors. Before construction begins, the developer will work out plans to mitigate impacts on the community. For example, open areas will be watered to limit dust on a regular basis, and the general contractor will probably be expected to offer a telephone contact, to hear about and respond to neighbors’ problems quickly.

When the first phase opens, the project will offer stores and services that are convenient for the immediate neighborhood. It will provide residents of East Kapolei and areas along Kapolei Parkway an alternative to trips to more congested shopping centers. It should also benefit residents of housing areas in Kalaeloa.

As Phase Two is developed, the center will provide more stores and services. It will combine offices with retail and entertainment areas, and hence become an important employment center. It will serve the larger region, not just its immediate neighborhood.

The community institutions on Kualaka‘i Parkway will work together to bring residents to the central corridor, increasing the appeal of each of these facilities. The University of Hawai‘i West O‘ahu, the Kroc Center and Ka Makana Ali‘i are likely to increase demand for each other, simply by making it more convenient to visit any one of these. (In other words, these will have a cumulative impact, increasing and reinforcing demand for each facility.) Again, the project could

increase travel along the rail transit line to the terminus next to the Kroc Center, if a shuttle or bus service links the terminus with the regional commercial center.

In interviews, some stakeholders looked forward to partnerships between the project and surrounding institutions. Collaboration on community activities should be mutually beneficial, and seems likely to occur.

UHWO, the Kroc Center and the project will all contribute, over time, to change island and regional residents’ views of ‘Ewa as a whole. First, these all serve the region, not just a subarea. Second, they work to make ‘Ewa, not just the City of Kapolei, the “second city” of O‘ahu. Until recently, non-residential development in the region was concentrated in the west; residents of subdivisions along Fort Weaver Road had little reason to view Kapolei as serving them. Road connections between the two sides of the DP area were few and in poor repair, so access was also difficult. Nowadays, improved connections and new attractions make Kualaka‘i Parkway into a central corridor for the entire region. With its commercial and entertainment venues, Ka Makana Ali‘i can serve as a “gathering place” for people from all parts of ‘Ewa.

The project’s impacts on its neighbors to the south will emerge over time. First, any entry from Roosevelt Avenue to Ka Makana Ali‘i will cross the Hawaiian Railway Society tracks. Crossing gates or the like will be needed when trains run along the route.

Next, extension of Kualaka‘i Parkway to Roosevelt Avenue – a link for which the Hawaii State Legislature has already set aside funds – will cross tracks used for switching rail cars in the Railway Society yard; these are used more often than the tracks leading west. Ka Makana Ali‘i’s developers have not proposed this connection, as it would not be needed to develop the center or to mitigate its impacts on regional traffic. Nonetheless, the project can collaborate with the State and the Railway Society to find ways to mitigate the future roadway’s impacts. It may be possible to re-organize the Railway Society’s yard space to minimize the interaction between the yard and a potential roadway extension.

Location of a regional commercial center next to the Kalaeloa Community Development District will increase the appeal of that area for residents, both of existing and eventual neighborhoods. Again, that impact is cumulative and would depend on new roadway connections, both between Kalaeloa and the rest of the region and within Kalaeloa.

The project will generate a continuing cash flow for DHHL to support its work on behalf of Native Hawaiians. This is an important objective for the Department, which has relied in recent years on payments from the State for past land takings – payments which will cease in a few years. Development of commercial space on DHHL lands in Kapolei and elsewhere offers a long-term financial basis for the Department, and hence for Native Hawaiian communities.

REFERENCES

Belt Collins Hawaii. *Kalaeloa Community Development Plan.* Prepared for Hawaii Community Development Authority, 2005.

City and County of Honolulu, Department of Planning and Permitting, *Public Review Draft, Ewa Development Plan.* Honolulu, HI, 2008

Development Plan Annual Report 2009, Honolulu, HI, 2010.

Projections of Population and Employment by DP Area and Subarea to 2035, posted in 2009 at (www.honoluludpp.org).

Goolsby, J. "New Fire Station Slated for Kapolei." *Midweek.* July 28, 2010.

Hawaii Tourism Authority, *2009 Annual Visitor Research Report*. Honolulu, HI. 2010.

Honlulu Police Department. *Annual Report for 2009, Statistical Appendix*. Honolulu, 2010, posted at http://www.honolulupd.org/download/HPD2009annualreportstats.pdf

Oahu Metropolitan Planning Organization. *Oahu Regional Transportation Plan 2035.* Honolulu, HI, 2011.

State of Hawaii, Department of Business, Economic Development and Tourism (DBEDT) *State of Hawaii Data Book, 2009.* Honolulu, HI, 2010, posted at http://hawaii.gov/dbedt/info/economic/databook/db2009/

Hawaii State 2007 Input-Output Model. Honolulu, HI, 2011. Posted at http://hawaii.gov/dbedt/info/economic/data_reports/2007-io/

Quarterly Statistical and Economic Report, Second Quarter 2011. Honolulu, HI, 2011. Posted at http://hawaii.gov/dbedt/info/economic/data_reports/info/economic/data_reports/qser/

State of Hawaii Department of Labor and Industrial Relations, *Employment and Payrolls in Hawaii, 2009.* Honolulu, HI, 2010.

Department of Land and Natural Resources, *Statewide Comprehensive Outdoor Recreation Plan.* Honolulu, HI, 2003.

Hawaii State Department of Taxation, *Hawaii Income Patterns – Individual 2005.* Honolulu, HI, 2008. Posted at http://www.state.hi.us/tax/a5_5ind_inc.htm

Hawaii Income Patterns – Corporations, Proprietorships and Partnerships.2001 Honolulu, HI, 2002. . Posted at http://www.state.hi.us/tax/a5_6bus_inc.htm

PBR Hawaii. *University of West O'ahu Final Environmental Impact Statement*. Prepared for the University of Hawai'i. Honolulu, HI, 2006.

PBR Hawaii. *East Kapolei Master Plan Final Environmental Impact Statement*. Prepared for Housing and Community Development Corporation of Hawaii. Honolulu, HI, 1998. Posted at http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_ Library/Oahu/1990s/1998-07-OA-FEIS-EAST-KAPOLEI.pdf.

Rider Levett Bucknall, *Quarterly Construction Cost Report, Second Quarter 2011*. Posted at http://rlb.com/index.php/usa-and-canada/research